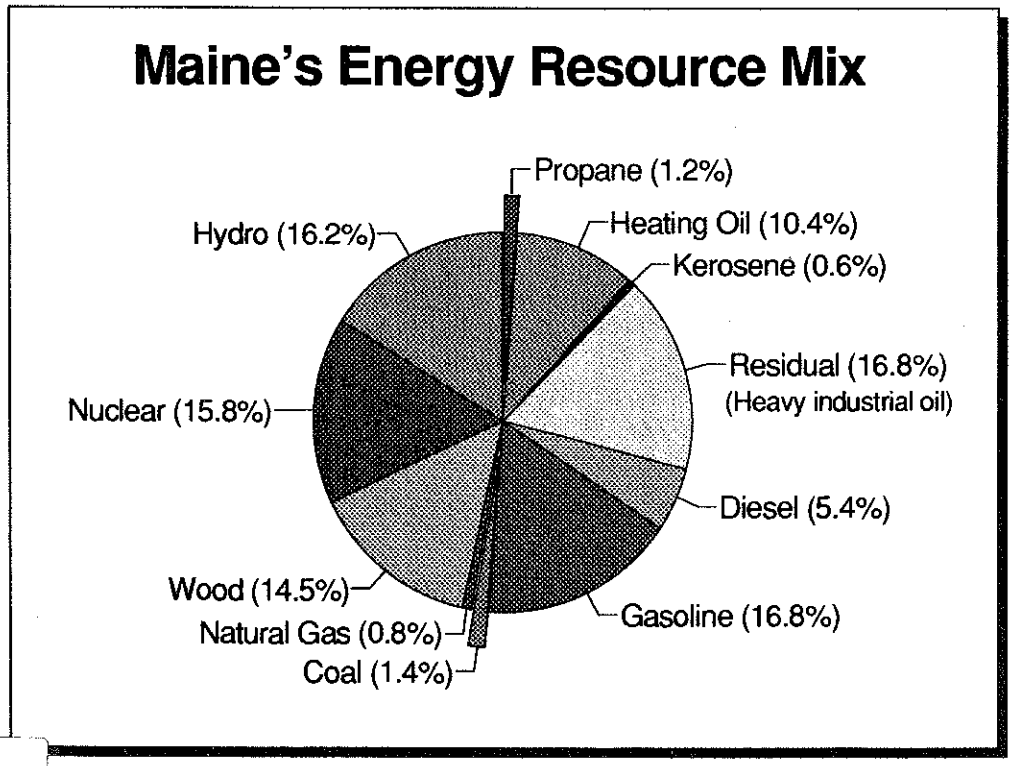
Final Report of the

Commission on Comprehensive Energy Planning



May 1992

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Commission on Comprehensive Energy Planning

Chapter 50, Resolves of 1991

Sen. John J. Cleveland, Chair
Sen. Bonnie L. Titcomb, Vice-Chair
Sen. David. L. Carpenter
Sen. Margaret G. Ludwig
Sen. Harry L. Vose
Rep. James Reed Coles
Rep. Maria Glen Holt
Rep. Carol A. Kontos
Rep. Michael H. Michaud
Rep. Hugh A. Morrison
Dana Connors, Commissioner of Transportation
Kenneth Gordon, Chairman, Public Utilities Commission
Dean Marriot, Commissioner of Environmental Protection
C. Edwin Meadows, Commissioner of Conservation
Stephen G. Ward, Public Advocate
Richard H. Silkman, Director, State Planning Office
(see Appendix A for list of staff designees)

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May 1992

Senator John J. Cleveland
District 22
State House Station 3
Augusta, Maine 04333

THE MAINE SENATE
115th Legislature

183 Davis Avenue
Auburn, Maine 04210

May 1992

To the Governor, the Legislature and the People of Maine:

We are pleased to submit to you the Final Report of the Commission on Comprehensive Energy Planning (Resolves Ch. 50, 1991). This report represents an extensive effort to fashion a well-balanced and comprehensive energy policy for the State of Maine. We are also pleased to note that the report has been approved by a two-thirds majority of the Commission, as required by law, and is offered as a consensus document dealing with a broad range of complex and difficult energy planning issues.

The Commission received extensive public input during the course of its deliberations. The process began with a series of regional public forums and included a public hearing on a draft final report. The Commission has also developed a substantial written public record. The Commission is extremely grateful to all the citizens, businesses and interest groups who invested the time and effort to participate in this important planning process. All of this input has been carefully considered in the development of the final report.

This report recognizes the progress that Maine has already made and examines the energy challenges that lie ahead. Specific recommendations are offered that will help ensure a sustainable and affordable energy future for all of the citizens of Maine.

We urge that the goals, objectives and recommendations contained in this report be adopted as Maine's energy policy.

Respectfully submitted,

Sen. John J. Cleveland, Chair
Sen. Bonnie L. Titcomb, Vice-Chair
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Table of Contents

List of Tables and Figures

Appendices

Preface

The Commission on Comprehensive Energy Planning

The Commission on Comprehensive Energy Planning was established by Chapter 50 of the Resolves of 1991 and included 10 members of the Maine Legislature, chosen by the President of the Senate and the Speaker of the House, and 6 representatives of Executive Branch agencies whose jurisdictions include issues related to energy. These include the Public Utilities Commission, the Public Advocate, the State Planning Office, the Department of Environmental Protection, the Department of Transportation, and the Department of Conservation. The legislation charged the Commission with developing a comprehensive energy plan for the State. A copy of the legislation establishing the Commission is included as Appendix A. A complete list of Commission members, including agency designees, is included as Appendix B.

This report represents the first time Maine energy planning has been undertaken by a formal legislative Commission, and the first time that such a process included significant public input and direct participation of agencies that have not historically been involved directly in energy planning. This document also represents the first time that issues related to environmental and economic impacts have been explicitly included in the development of Maine's energy policy.

The Commission's work included 4 public hearings, including regional hearings in Houlton, Bangor, and Portland, and a public hearing on its draft final report. In addition, the Commission received significant input and written comments from a wide variety of businesses, interest groups and consumers. Copies of the Minutes from the public hearings and an index of the written materials contained in the Commission's public record are included with this report as Appendix C.

Summary and Recommendations

Introduction

The purpose of this report is to identify and discuss Maine's energy-related goals and objectives as a framework for engaging in responsible energy decision-making in the 1990's. A set of recommendations is offered that, if implemented aggressively, will go a long way toward achieving an energy future that will protect the vital interests of future generations in Maine.

Maine must develop a sustainable energy future -- a future that protects human health and the environment and promotes economic prosperity. The Commission believes that the cornerstone of this plan is to increase energy efficiency in every sector of energy use. Energy efficiency is the key to reducing long-term energy costs, enhancing Maine's economic competitiveness in the global economy, reducing pollution, and reducing dependence on imported energy. But conservation may not be enough to meet the State's projected energy needs. The Commission, therefore, also encourages increased reliance on clean resources, renewable resources, and a diverse mix of resources.

Specifically, the Commission recommends the following targets for Maine's energy future:

- Reduce the State's level of dependence on oil from 50 percent to at least match the national average of 43 percent by the year 2000, with further reductions to at least the 30 percent level by 2010;
- Increase the percentage of renewable energy resources in the State's primary energy mix from 30 percent to 40 percent by the year 2000, and by at least 50 percent by 2010;
- Increase statewide energy efficiency relative to 1990 levels (as measured by Btu's per dollar of Gross State Product) by 25 percent by the year 2000 and by at least 50 percent by 2010; and
- Work to stabilize long-term energy prices, in balance with Maine's other energy-related goals, with a specific emphasis on enhancing Maine's competitive position relative to New England and the U.S.

This report also recognizes the need for well-balanced strategies that are coordinated within State, on an inter-agency basis, and the need to pursue energy-related goals in the context of regional and federal policies. In today's dynamic energy markets, energy does not respect the sanctity of State borders, nor does energy-related pollution. While Maine can and should pursue State-based energy initiatives based on the goals and objectives developed by this Commission,

we must look increasingly toward coordination at the federal and regional level to fully achieve a desirable energy future.

Future Energy Demand

It is unlikely that energy use in Maine will continue to increase at the relatively high rate seen during the 1980's, due to slower economic growth, relatively higher energy prices, and continued conservation efforts. This projection assumes moderate, but stable, economic growth in Maine through 2010, and oil prices that remain relatively stable when adjusted for the effects of inflation, but still higher than those seen during most of the 1980's. This also assumes that Maine will continue to become more energy efficient at the same rate seen over the past 10 years. Given these assumptions, growth in energy consumption will occur unless Maine realizes gains in energy efficiency at much higher levels than are currently expected.

Goals and Objectives

The principal goals of past State energy plans -- securing reliable, low-cost energy supplies -- continue to be fundamentally important today. This is especially true in view of the higher energy costs seen in recent years and our renewed recognition of the dangers of being exposed to the potential volatility of international oil markets. In addition, the Commission believes that energy policy must pay careful attention to issues related to the impacts of energy use on the environment, and how our energy decisions affect the Maine economy. With this in mind, the Commission finds that Maine energy policy should address the following four fundamental attributes:

- Cost
- Reliability
- Environmental Impact, and
- Economic Impact

Cost refers both to direct energy prices (i.e., dollars per gallon or cents per kilowatt-hour) as well as to overall energy costs (the total bill for energy used). **Reliability** refers to the assurance of adequate necessary supplies of energy, and includes issues related to energy security. **Environmental impact** refers to the wide variety of air, land, water, and health impacts that result from energy production, transportation, and use. **Economic impact** refers to how energy policy will affect the economy, in terms of jobs, competitiveness and general economic health.

Thus, the goal of Maine energy policy should be to meet the State's energy needs with reliable energy supplies at the lowest possible cost, while at the same time ensuring that our energy production and use is consistent with Maine's goals for a healthy environment and a vibrant economy. Unfortunately, there is no "perfect" energy option that will achieve this goal. Maine must develop an energy *portfolio* which, when taken as a whole, achieves the desired result.

Maine can enjoy an energy future that balances cost, reliability, environmental impacts and economic impacts by focussing on the following set of objectives:

- Promoting energy efficiency and conservation
- Supporting energy education
- Controlling energy costs
- Ensuring adequate levels of competition and promoting market-based approaches to energy problems, and overcoming market barriers and distortions
- Ensuring equity in how energy supplies and costs are allocated among Maine energy consumers
- Promoting greater diversity in Maine's energy resource base
- Promoting the continued development of renewable indigenous resources
- Improving the State's flexibility to respond to unforeseen price volatility and supply disruptions
- Reducing/avoiding environmental degradation
- Promoting consistency among energy policies and programs and coordination between energy policy and other State goals and objectives

Strategies and Recommendations

The Commission believes that increased energy efficiency should be the cornerstone of meeting Maine's future energy demand. This report recommends that energy efficiency should not only be pursued through programs offered by electric utilities, but through programs that target every sector of energy use, including transportation. To the extent that increased efficiency, by

itself, is not enough to offset Maine's growing energy needs, the Commission recommends that the State should continue to develop renewable, indigenous resources, where appropriate, and should continue to diversify its energy mix, specifically through the increased use of natural gas and the development and use of alternative transportation fuels.

The Commission recommends that Maine should:

- Develop funding mechanisms for State-sponsored conservation programs, targeting low-income citizens, schools and municipalities, and small businesses;
- Maintain current law and Public Utility Commission regulations concerning utility-sponsored conservation programs;
- Pursue increased investment in energy efficiency in publicly-owned buildings;
- Strengthen and enforce mandatory energy efficiency building standards;
- Develop an Energy Rating System for all types of buildings;
- Pursue increased efficiency within the transportation sector, including higher mileage vehicles, innovative land-use practices that promote clustering, the development of efficient inter-modal transportation systems, and increased opportunities for carpooling, ridesharing, etc.;
- Support energy education and outreach programs;
- Work to control long-term energy costs;
- Promote greater diversity and renewable resources (where appropriate and sustainable);
- Promote the increased availability of natural gas into Maine;
- Promote the development of alternative transportation fuels;
- Establish an ongoing advisory group on energy and the environment to evaluate strategies for including externalities in energy decision-making processes, changes to Maine environmental laws, and the cost-effectiveness of emissions taxes and/or caps; and
- Continue to work toward coordinated strategies on a regional basis that support Maine's goals and objectives related to energy and environmental planning.

Introduction

Few people recognize how important energy is to our daily lives and our economic prosperity. Almost every aspect of life in Maine in the 1990's depends on or is influenced by energy. And, in turn, producing, transporting and using energy often has a significant impact on the world around us. Recognizing these relationships and identifying our overall goals is the first step of developing sound energy policy. However, while most Mainers agree on what our broader energy goals should be, there remains a great deal of controversy over how to achieve them, and how to balance goals that are often in conflict with one another.

Today, Maine faces no imminent energy crisis. Despite price increases during the past three years, oil prices, adjusted for inflation, remain well below levels seen during the oil shocks of the 1970's and early 1980's. No fuel supply problems are expected -- absent extraordinary weather-related or political intervention -- and the region appears to have sufficient electricity supplies through at least the end of the decade. Today's energy challenges, therefore, are not related to responding to major price spikes or supply issues, but arise from how we use this period of relative calm to find the proper balance between frequently competing goals and objectives.

Energy choices made in the 1990's will have a profound effect on Maine's future. Today's energy policies must lead to responsible choices -- responsible in ensuring the ongoing availability of reliable and low cost energy supplies to meet the needs of Maine's energy consumers, and responsible in addressing the overall environmental and economic impacts of energy use and production. Most importantly, the citizens of Maine, including ratepayers, utilities, environmentalists, businesses, industries and policymakers, must realize that *there is no one way* to achieve a sustainable and affordable energy future. Rather, sound planning requires coordinated and well-balanced strategies. In addition, we must recognize that finding an appropriate balance will almost certainly involve tough choices and difficult tradeoffs.

Maine has clearly moved well beyond the era in which its energy future could be molded by a specific energy "plan" that anticipates and implements energy choices on a deterministic basis. The broad array of uncertainties surrounding future energy demand, price trends, the penetration of new technologies, and changes in regulatory standards, act together to require a flexible planning process, rather than a detailed roadmap. The goal of energy planning, therefore,

is to focus on the *process* of energy decision-making. This process must ensure that specific energy issues and resource options are discussed and decided upon in an open and balanced manner that weighs the positive and negative aspects of a particular energy decision against the State's broader policy goals and objectives. The purpose of this report is to identify and discuss this set of overall goals and objectives as a framework for engaging in responsible energy decision-making in the 1990's.

The Commission recognizes the importance of Maine's energy use to the economy and the environment of the State. Energy generation, distribution and consumption comprise well over 10 percent of the State's total economy. Efficient energy use is essential if Maine is to compete in the global economy. In addition, nearly all energy resources have an environmental cost as well: burning fossil fuels for electric energy, for industry, and in motor vehicles is leading to global climate change and is producing unhealthy air, resulting, on a national level, in billions of dollars annually in increased health care costs; nuclear energy produces radioactive waste for which there is still no safe means of disposal and potentially cancer causing background radiation; and damming Maine's rivers for hydroelectric energy and cutting Maine's forests for biomass production have environmental impacts as well.

Maine must develop a sustainable energy future -- a future that protects human health and the environment, and promotes economic prosperity. The cornerstone of this plan is increased energy efficiency in every sector of energy use. Efficiency is the key to reducing long-term energy costs, reducing pollution, and reducing dependence on imported energy. But conservation may not be enough to meet the State's projected energy needs. Recognizing that, one way or another, the public has to pay the real cost of energy, this plan also encourages increased reliance on clean resources, renewable resources, and a diverse mix of resources.

Overview of Past Energy Policy

> "The highest priority for the 1980's is that Maine develop a statewide energy policy that will enable the State of Maine to secure a reliable, adequate and low cost energy supply for the State's future." (1983 Maine Comprehensive Energy Resources Plan)
>
> "The overriding goal of Maine's energy policy is to promote the present and future economic well-being of Maine residents and businesses by ensuring the availability of reliable energy at the lowest possible cost." (1987 Energy Resources Plan)

Prior State energy plans produced by the Office of Energy Resources[1] focused predominantly on goals related to cost and reliability, with the specific objectives of reducing the State's dependence on oil through increased efficiency and through the development of renewable, indigenous resources. Throughout the 1980's Maine made great progress in these areas. In several respects, Maine has exceeded the three overall objectives set forth in the 1987 Comprehensive Energy Resources Plan:

- increasing energy efficiency 10 percent relative to 1985 levels;
- reducing Maine's reliance on petroleum from 58 percent of total energy needs to 55 percent (today's figure is closer to 50 percent); and
- increasing Maine's reliance on renewable and indigenous energy resources from 24 percent of total energy needs to 30 percent.

Maine law establishes several energy priorities with respect to regulated electric utilities. The State's "Small Power Act" (MRSA 33, §3302) states that Maine should "encourage the development of energy producing systems using renewable resources; particularly abundant, renewable resources or resources in close proximity to Maine." In addition, the "Maine Energy Policy Act" (MRSA 35-A §3191) gives preference, when the available alternatives are otherwise equivalent, first to conservation and demand management, and then to power purchased from qualifying facilities, otherwise known as "cogeneration" facilities. In many ways, as a result of these policies, Maine has become a national leader with respect to the development of non-utility generation and conservation, generally, and in its dependence on renewable resources.

[1] OER was eliminated as of December 31, 1989. Remaining functions were divided between the Department of Economic and Community Development and the State Planning Office.

Many of the priorities of prior State energy policy continue to serve as a starting point for energy goals relevant to the 1990's. For example, the 1987 energy plan outlined the following specific objectives:

- encouraging energy conservation;
- developing Maine's indigenous energy resources;
- reducing the cost of energy;
- increasing the availability of natural gas;
- working to encourage appropriate federal and State energy-related tax policies;
- encouraging diversification of Maine's energy resource base;
- working toward greater reliance on market mechanisms;
- enhancing energy education and public information; and
- pursuing opportunities for energy production for export that provide economic benefits and are consistent with State land-use and environmental goals.

With the benefit of hindsight, however, we can now see that, while these overall objectives continue to be relevant for the 1990's, attaining them is often more complicated than we may initially realize. This is partly because the modern energy landscape has become increasingly complex, and because energy issues are increasingly intertwined with other social and economic issues. In addition, some of the specific assumptions upon which past energy policies were based proved to be highly inaccurate.

For example, as a direct result of State energy policy during the 1980's, Maine is now a national leader in the development of non-utility power generation (i.e., cogeneration and independent power production). Today, such projects provide over 30 percent of the State's electric power needs. This policy has resulted in variety of benefits, such as increased diversification, heightened competition in electric power markets, and the increased development of Maine's indigenous resources. However, it has come with a price. Some of the early contracts between independent power producers and Maine utilities were based on oil price forecasts that predicted oil rising well above $40 per barrel by 1990 to upwards of $100 (and toward $200) per barrel by the year 2000. (Figure 1) This is reflected in the rates (known as the "avoided cost")

used to sign up earlier cogeneration and small power projects. These projects have a 1992 rate of well over $ .13 per kilowatt-hour, relative to later avoided costs of between $ .03 and $ .05/kwh. The heavy reliance on what, in hindsight, turned out to be incorrect assumptions provides a lesson for Maine with respect to developing future energy policies. At a minimum, we should realize how imperfect our forecasting abilities are, and not gamble too heavily on their outcome.

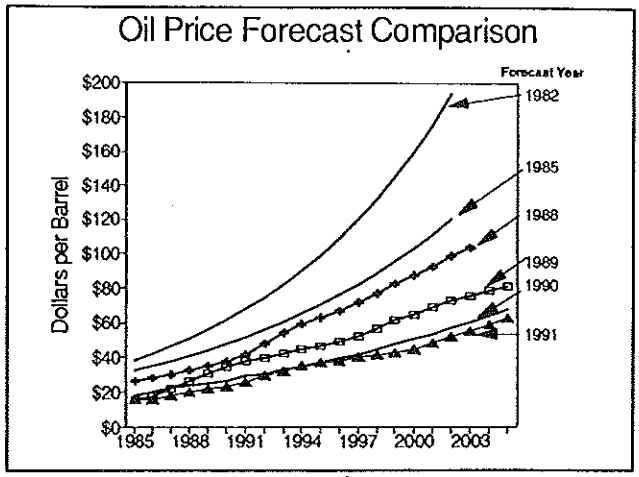

Figure 1 Historical oil price forecasts

The goal of promoting conservation and energy efficiency is also an area that is more complicated than many realize. Efficiency not only means using less energy to do the same job, but using the right types of energy for the right job. In some cases, it may be a more efficient use of primary energy to use a fuel (such as natural gas) directly for space or hot water heating than using the same fuel to produce electricity, which is then used for space or hot water heating. This is because there are conversion and transmission losses associated with electric power production, and because modern residential heating and hot water heating equipment is relatively more efficient than typical electric generation. In other cases, it may be more energy efficient -- and cleaner -- to use electricity for certain applications. One such application is electric vehicles, which represent a potentially more efficient and environmentally benign alternative to highly inefficient internal combustion car engines. Another example is in the case of heat pumps, which have an overall efficiency rating of over 100 percent -- an efficiency that cannot be matched when using fossil fuels directly. As technologies evolve, Maine may wish to promote certain types of energy uses that result in improved overall energy efficiency and a cleaner environment, even if it means constructing new facilities to meet the new demand.

An energy forecasting model currently under development at MIT suggests that the most economically and environmentally desirable energy strategy for New England is to combine aggressive conservation efforts and the conversion or replacement of the region's older, dirtier plants with modern generating technologies. In essence, the model suggests that energy conservation is generally the cheapest energy option, while replacing the older plants will have

the most profound environmental benefit. Thus, the MIT work strongly suggests the need for coordinated energy strategies that combine the best attributes of different options.

Strategies to implement Maine's overall energy goals, therefore, must be based on well-defined objectives and must be carefully targeted and coordinated to achieve those objectives. They should recognize the complexities inherent in almost any energy decision, and the risks involved with basing objectives on potentially inaccurate forecasts and assumptions.

Overview of Energy Use in Maine

Overall Trends

Energy use in Maine grew dramatically during the 1980's, driven largely by unprecedented economic growth. By 1989, Maine was using more energy than ever before in its history.[2] Total energy consumption increased by over 30 percent during the period 1980 through 1989, with the most significant growth occurring in the transportation sector. During the same period, Maine also experienced significant growth in the amount of energy used to generate electric power, following almost 40 percent growth in electricity use in Maine during the decade. At the same time, Maine continued to become more energy efficient, continuing a trend begun in 1971, and the State's total energy bill, adjusted for inflation, declined over the course of the decade. Figure 2 shows the relationship between total energy use, overall energy efficiency, and total energy expenditures in Maine during the period 1980 to 1989.

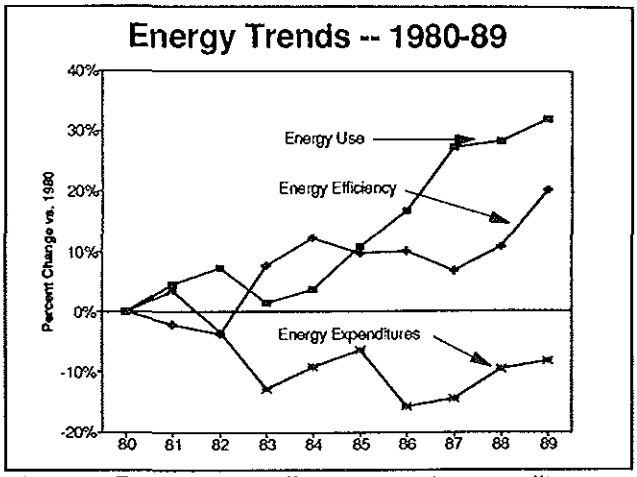

Figure 2 Energy use, efficiency and expenditures trends

Overall statewide energy efficiency is measured in terms of the energy intensity of the economy, and is determined by computing the amount of economic output produced (as measured by dollars of Gross State Product) per Btu (British Thermal Unit) of energy consumed. With the increase in energy efficiency seen over the prior two decades, it now takes half as much energy to provide the same amount of economic output as it did 20 years ago. Maine's trend of increasing efficiency (decreasing energy intensity) is similar to the national trend in this area.

Maine's 1989 energy bill was over $2.25 billion. However, during the 1980's the State's overall real energy bill (i.e., adjusted for inflation) declined, despite rising energy use. Falling real oil prices, beginning in 1982, helped reduce Maine's overall energy expenditures by 10 percent during the decade, even though total energy use grew by 30 percent. (Real expenditures for oil declined by over 20 percent during the 1980's, even though oil use grew by 30 percent.) During

[2] 1989 represents the most recent year for which comprehensive energy use data are available.

the same period, real expenditures for electricity increased by 24 percent, as Mainers used more electricity and paid more per kilowatt-hour for it. Given the outlook for future energy demand and energy prices (discussed below), it is likely that Maine's energy bill will rise throughout the 1990's.

Oil and Renewables

Both oil use and the consumption of renewable energy grew dramatically during the 1980's. Total oil consumption in Maine increased by almost 30 percent during the decade, led primarily by increased gasoline and diesel use. During the same period, Maine's use of renewable resources (hydro and wood, combined) increased by an average of almost 58 percent. Thus, while overall oil use grew during the decade, Maine's relative dependence on oil declined slightly. (Figure 3). However, Maine's oil dependence remains higher than the national average and growing oil consumption continues to represent a serious liability in the event of prolonged price volatility and/or supply disruptions. While significant progress has been made in reducing Maine's dependence on oil for electricity generation, the State continues to rely heavily on oil products for its basic transportation, industrial and home heating energy needs.

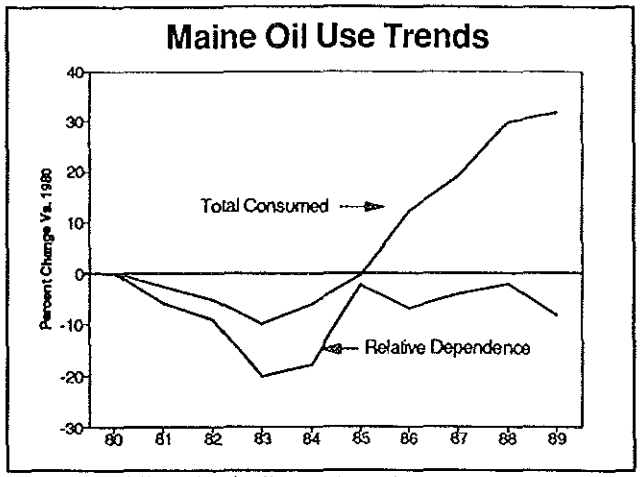

Figure 3 Historical oil use trends

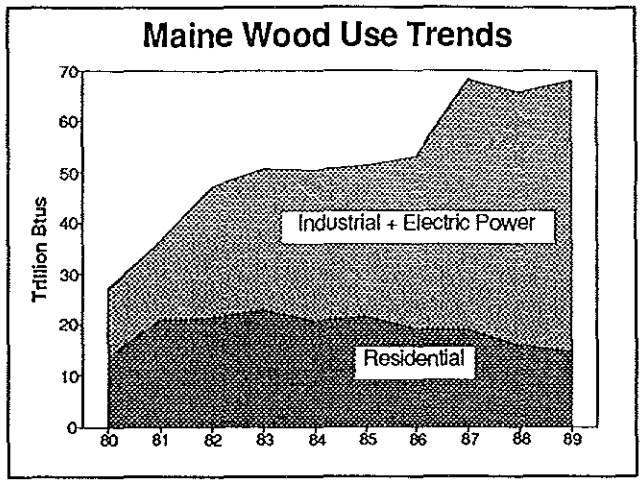

Figure 4 Historical wood use trends

The increase in renewable energy in Maine during the 1980's was largely a result of tremendous growth in the use of wood used for generating electricity by cogeneration and independent power plants. Overall, wood use grew by almost 150 percent during the 1980's, despite a decline in wood used within the residential sector during the latter part of the decade. Figure 4 shows Maine wood use trends during the period 1980 through 1989.

Maine's Energy Resource Mix

Figure 5 shows Maine's primary energy resource mix. Primary energy refers to the basic energy resources used to meet society's energy needs, including energy used to generate electricity. Maine's primary energy mix is unique in that Maine is more dependent on oil and more dependent on renewables than the nation as a whole. While coal and natural gas dominate the nation's overall energy supply, the availability of natural gas in Maine is limited, and coal has played a relatively small role in Maine's energy mix. During the 1960's and the 1970's, this lack of coal and natural gas left Maine with a dependence on oil of over 70 percent. However, with the introduction of nuclear power from Maine Yankee in 1972, and the development of renewable resources, Maine has been able to reduce its oil dependence to nearly 50 percent, much closer to the national average of 43 percent.

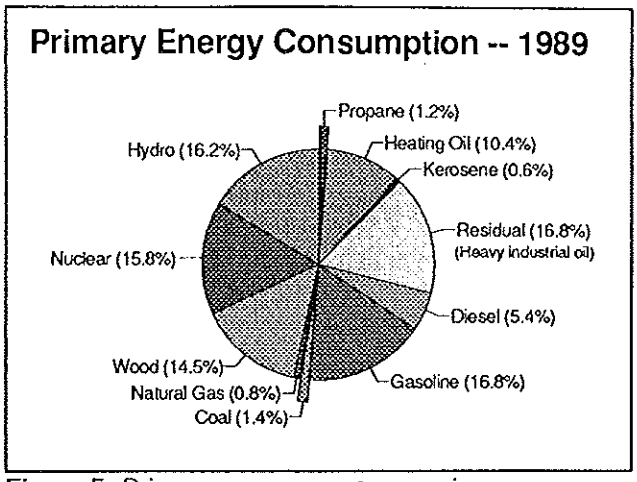

Figure 5 Primary energy resource mix

Energy used to generate electricity leads Maine's primary energy mix, followed by energy used for transportation, industrial processes, residential needs and commercial activities (Figure 6). Electricity use grew by almost 40 percent during the 1980's, resulting in a 67 percent increase in the use of primary energy within the utility sector. The dominance of the utility, or electric generation, sector[3] in the mix is because it takes approximately 3 Btus of primary energy to produce 1 Btu of electricity for consumption in an end-use capacity. This does not mean that electricity is a less efficient form of energy; in certain end-use applications, electricity may represent a more efficient use of primary energy than using a fossil fuel directly.

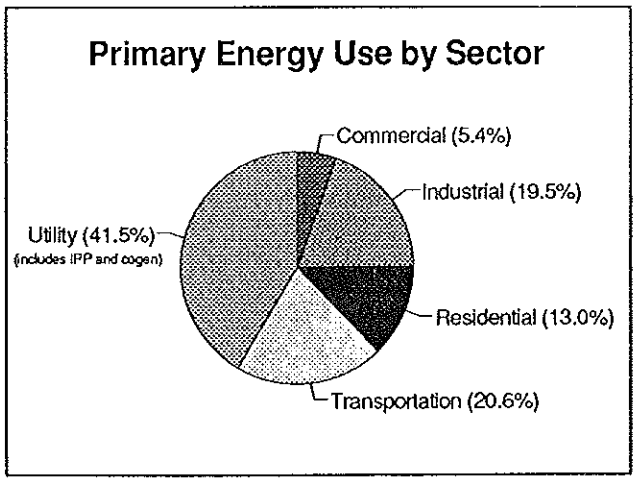

Figure 6 Primary energy use by sector

[3] For the purposes of this report, the term "utility" sector also includes energy used in industrial cogeneration and independent power operations.

Maine's Energy Consumption Mix

The State's energy consumption mix is measured in terms of "end-use" energy. End-use energy refers to the types of energy used directly by consumers, as opposed to energy that is converted into other types of energy (such as oil into electricity). End-use energy includes electricity (while primary energy does not) but excludes energy resources used to generate electricity (to avoid double-counting). Petroleum products supplied over 70 percent of all the end-use energy used within Maine in 1989, led by gasoline (27 percent), heating oil (17 percent), and residual (i.e., heavy industrial) oil (16 percent). (Figure 7) End-use energy consumption was spread fairly evenly between the transportation, industrial and residential sectors (38, 26, and 25 percent, respectively), while approximately 10 percent was consumed in the commercial sector.

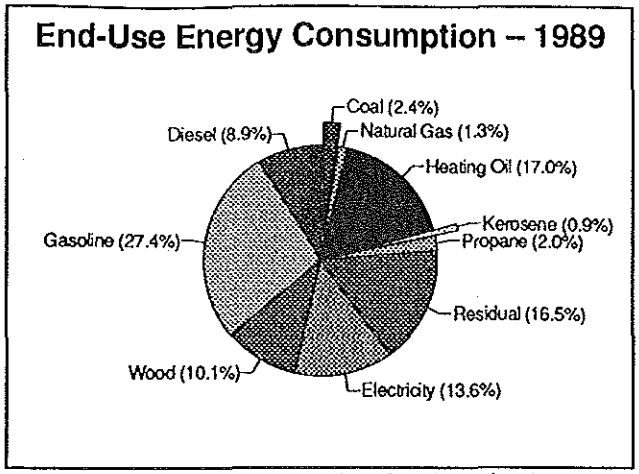

Figure 7 Energy consumption (end-use) mix

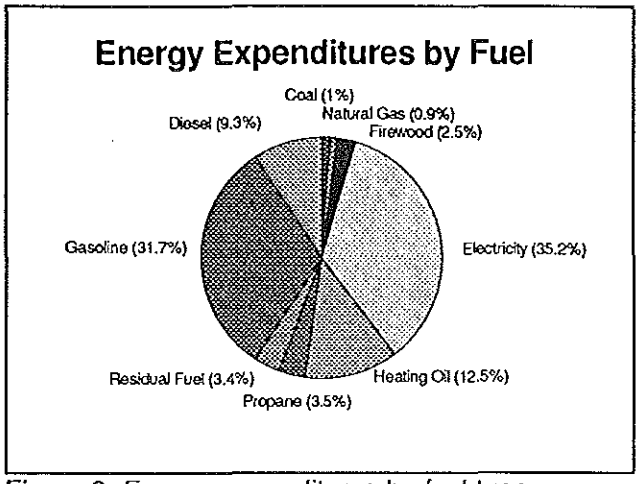

Figure 8 Energy expenditures by fuel type

Although electricity accounts for only 14 percent of the end-use energy consumed within Maine, it represents the single largest component of the State's total energy bill (i.e., total expenditures), when measured according to individual type of energy. This is because electricity is a more "refined" fuel and has a much higher cost per Btu of delivered energy. Over 35 percent of Maine's total 1989 energy bill was spent on electricity, followed by gasoline (32 percent), heating oil (12 percent) and diesel fuel (9 percent). (Figure 8)

Maine's Electric Power Mix

Figure 9 shows Maine's electric power mix on a capacity basis. This represents the installed capacity of the infrastructure used to supply the State's electric power needs. Figure 10 shows how these facilities were used to supply the electric power used in Maine in 1991. In other words, Figure 10 represents the fuel mix used to produce the average kilowatt-hour sold during the year.

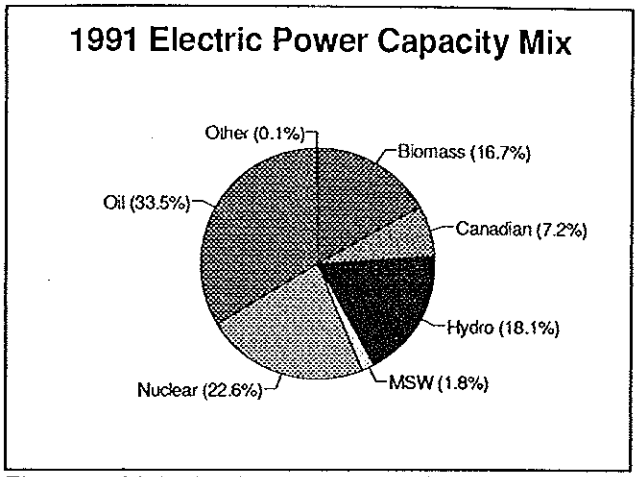

Figure 9 Maine's electric power mix -- capacity

The growth in renewable energy during the 1980's in Maine was most prominent in the electric power sector. Over 36 percent of capacity installed to supply Maine's electric power is based on renewable hydro and wood energy resources. This capacity supplied over 47 percent of the electric energy sold within Maine in 1991. Oil, on the other hand, represents over 33 percent of Maine's capacity mix, but was used to supply only 9.13 percent of the State's electric power in 1991. Nuclear power from Maine Yankee and other New England nuclear stations was the largest single contributor to Maine's 1991 electric power needs (31.8 percent), followed by wood (25.13 percent), hydro (22.4 percent), and oil (9.13 percent). Canadian imports supplied 5.77 percent, and Maine's waste-to-energy facilities provided an additional 3 percent of the State's electric power in that year.

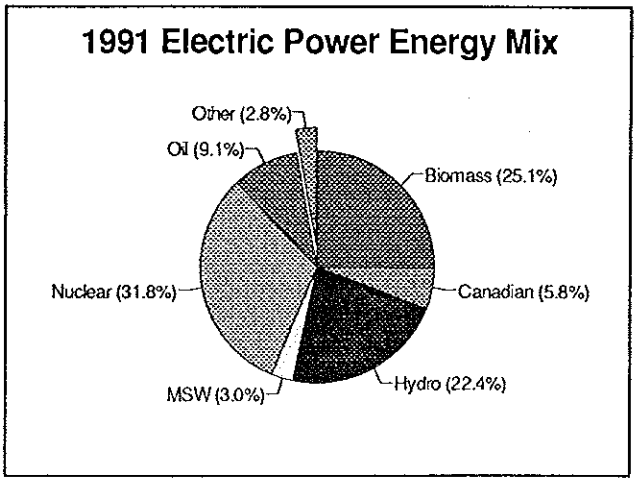

Figure 10 Maine's electric power mix -- energy

Transportation Energy Trends

Falling real gasoline prices (beginning in 1982) helped stimulate a steady increase in consumption during the 1980's. Combined gasoline and diesel use grew by over 40 percent during the decade, concomitant with an increase in total vehicle miles travelled of almost 60 percent. During the same period, the number of vehicles in Maine's fleet increased by 35 percent, while Maine's population increased by only 9 percent. As can be seen in Figure 11, growth in registered vehicles dramatically outpaced population growth, but growth in overall miles driven was the primary cause of the increase in the State's transportation energy use during this period.

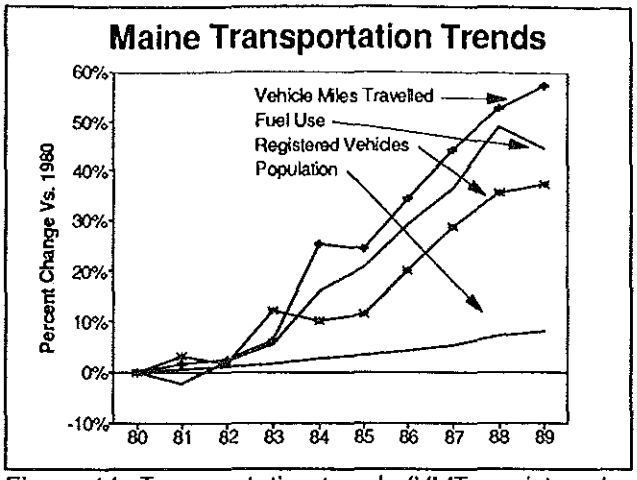

Figure 11 Transportation trends (VMT, registered vehicles, fuel use, population)

Figure 12 shows the relationship between gasoline prices and consumption in Maine during the period 1970 through 1989. The price trend is in constant (1982) dollars. The graph shows a clear indication of price-motivated conservation, although a price increase of over 64 percent led to a decrease in consumption of only 15 percent between 1978 and 1982. In contrast, a 71 percent increase in the real price of home heating oil led to a 45 percent decline in consumption during the same period. This suggests that, while consumption does respond to price, it does so much more readily where alternatives are available. While firewood was available to offset residential oil use, consumers had no ability to react to higher gasoline prices other than by reducing their driving.

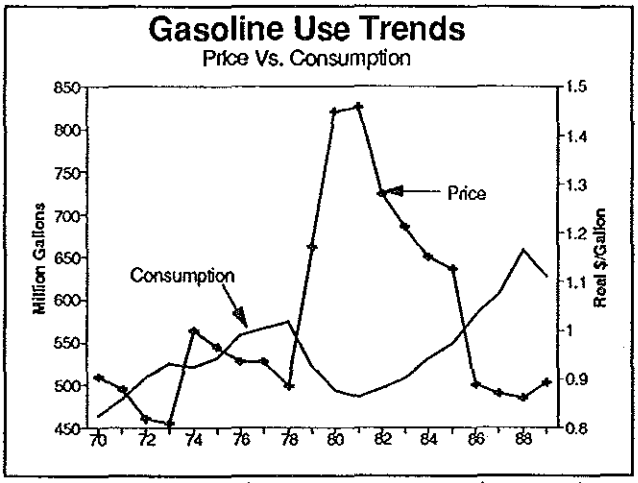

Figure 12 Historical gasoline use trends vs. price

Residential Energy Use Trends

Maine's residential sector represents the area in which the State has seen the most dramatic gains in energy efficiency. Between 1970 and 1989, per-household energy use fell by 38 percent, primarily due to weatherization efforts and replacement of inefficient heating systems in older homes, and the fast-paced growth in newer, more energy efficient homes. Per-household oil use fell by almost 50 percent over the two decades, although per-household electricity use increased by almost 50 percent. Residential wood use increased dramatically during the late 1970's and early 1980's, but declined through the latter part of the decade as oil prices recovered from earlier price shocks. Figure 13 shows the trend of total energy used per household (including firewood, propane, kerosene, etc., but excluding transportation energy).

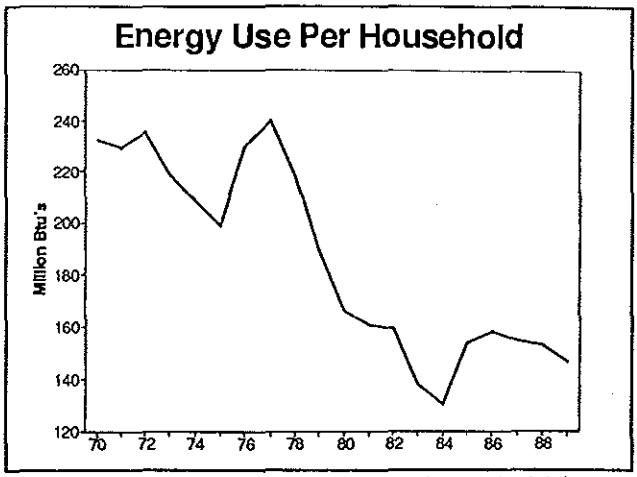

Figure 13 Annual energy use per household (non-transportation)

Figure 14 shows the trends for per-household electricity and heating oil use on a percentage change basis. The growth in electricity consumption follows the national trend toward the increased "electrification" of our end-use energy mix. Although appliances and other electrically-operated devices are becoming more energy efficient, more people are using more kinds of electrical equipment in their daily lives. Also, while consumers frequently upgrade to more energy-efficient appliances, they often choose larger models with more features that offset the gain in relative efficiency. The decline in per-household oil use is a combined function of weatherization efforts and the development of high efficiency replacement burners and new boiler and furnace technology.

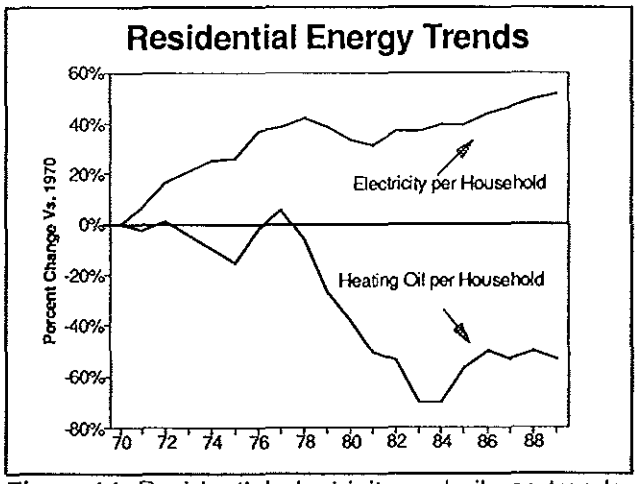

Figure 14 Residential electricity and oil use trends

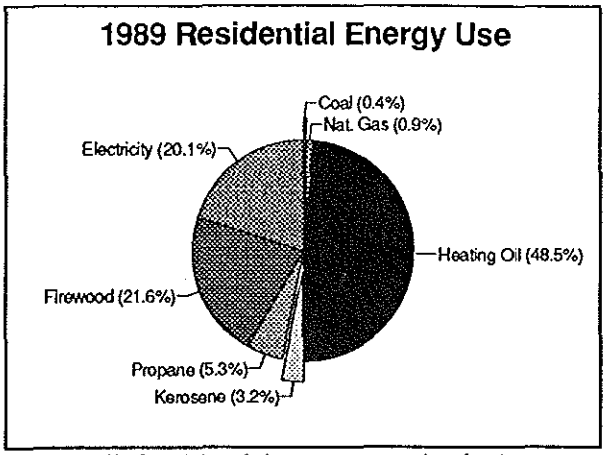

Figure 15 Residential energy use by fuel type

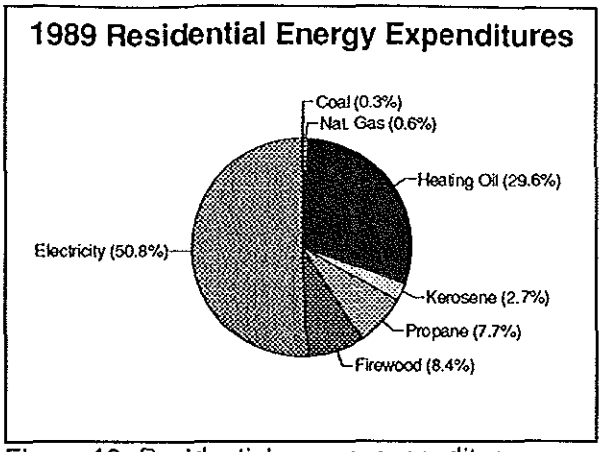

Figure 16 Residential energy expenditures

In 1989, heating oil led overall residential energy usage on a Btu basis at 48.5 percent, followed by firewood (21.6 percent), and electricity (20.1 percent). (Figure 15) Propane, kerosene, natural gas and coal play a relatively small overall role in Maine's residential energy mix, although residential propane usage grew by over 140 percent during the 1980's. Electricity dominates Maine's residential energy mix in terms of expenditures (50.8 percent), followed by heating oil (29.9 percent), firewood (8.4 percent), and propane (7.7 percent). (Figure 16) The disproportionately high level of expenditures related to electricity and propane is due to their relatively higher costs per Btu.

Regional and Federal Energy Issues

The development and implementation of Maine energy policy must recognize the inter-relationships between State-level approaches, regional approaches, and compliance requirements with federal energy and environmental standards. Energy (especially electricity) does not respect the sanctity of State borders, nor does energy-related pollution. While Maine can and should pursue State-based energy initiatives based on the goals and objectives developed by this Commission, we must look increasingly toward coordination at the federal and regional level to fully achieve a desirable energy future. This section looks at Maine's energy picture in the context of new and pending federal energy, transportation and environmental legislation, and discusses Maine's participation in a regional electric power arrangement known as NEPOOL.

The Clean Air Amendments of 1990

Recent revisions to the federal Clean Air Act have profound implications for Maine. The 1990 amendments address a broad range of energy-related issues, and will require significant reductions in energy-related air emissions related to acid rain, toxic air pollutants, and ozone smog.[4] The Act addresses both stationary sources (such as powerplants and industrial boilers) and mobile emissions (emissions related to transportation). While Maine may not be affected significantly by the acid rain provisions (insofar as we have to reduce our own emissions), certain regions of the State are classified by the U.S. EPA as ozone "non-attainment" areas, i.e., areas which exceed the maximum allowable ozone concentrations.

Much of Maine's ozone-related air quality problems do not result from emissions produced in-State. A large share of our problem results from air emissions produced along the eastern seaboard that interact with sunlight and produce ozone smog that migrates up the coast. On certain hot, summer days, visitors to Acadia National Park experience the same degree of unhealthy ozone seen in downtown Manhattan or Washington D.C. some hours earlier. Recognizing the inter-state nature of this problem, New England environmental officials have been developing coordinated strategies through Northeast States for Coordinated Air Use Management (NESCAUM), an association of regional air quality regulators, and Congress established the

[4] Ozone smog, or ambient ozone, is a health-related ground-level pollutant resulting primarily from photo-chemically reactive emissions of nitrogen oxides (NOX) and volatile organic compounds (VOCs) that interact with sunlight to produce unhealthy air quality.

Ozone Transport Commission (OTC) under the Clean Air Act. The OTC is composed of representatives of an 11 state region from the Washington, D.C. metropolitan area in the south to Maine, Vermont and New Hampshire in the north working to develop regional compliance strategies.

State and regional compliance efforts under the revised Clean Air Act will potentially stimulate profound changes with respect to energy use in New England and Maine. Existing utility and industrial boilers will be required to comply with much stricter emission limits, especially with respect to NO_x. The most significant changes, however, may occur in the transportation sector, since so much (over 50 percent) of the region's ambient air quality problems are related to auto and truck emissions. Ongoing strategies to address this issue include requirements for cleaner cars, such as what has become known as the California "low emission vehicle" (LEV) program, the development of "reformulated" gasolines that will burn cleaner in any engine, and the development of alternative transportation fuels, including propane, natural gas, methanol, ethanol and electricity. Maine is moving forward with its own compliance strategy that will include enhanced inspection and maintenance requirements for existing vehicles and the installation of vapor recovery systems at gas stations. However, Maine probably cannot meet Clean Air Act compliance deadlines without help from our upwind neighbors. Thus, Maine has become a regional leader in promoting the reformulated gasoline and California LEV programs in an effort to encourage other Northeast states to move forward quickly in this area.

Pending federal energy legislation

Congress is currently moving forward on legislation entitled "The National Energy Security Act of 1992." A bill was passed in the U.S. Senate on February 19, 1992 and is currently moving forward through the committee process in the House of Representatives. The bill is an effort to implement (as amended by Congress) President Bush's "National Energy Strategy," released initially in February of 1991. The Senate version of the bill establishes specific national energy goals and requires the Secretary of Energy to submit a report to Congress setting forth a plan for its implementation. The goals include: reducing the nation's oil dependence to 33 percent by 2010; limiting net annual oil imports to 50 percent or less of total U.S. oil consumption; increasing energy efficiency throughout the nation's economy by 2 percent per year over 1990 levels, to reach a targeted 40 percent improvement by 2010; and increasing the percentage of renewable energy in the U.S. energy mix from the current level of 8 percent to 14 percent by 2010.

In addition, the Senate bill would require that federal, state, municipal and private vehicle fleets acquire specific numbers of alternatively-fueled vehicles, and defines alternative fuels as methanol, ethanol, alcohol mixtures with less than 15 percent gasoline, natural gas, liquefied petroleum gas (propane), hydrogen, coal-derived fuels, electricity and other non-petroleum fuels. The bill also proposes a wide range of energy efficiency initiatives, including: the development of a federal energy efficiency building code; residential energy efficiency ratings and mortgages; and efficiency standards for lamps, showerheads and certain commercial and industrial equipment. The bill would also provide strong support to a range of energy education efforts, and would require least-cost energy planning to be adopted at the federal level. Finally, the bill addresses a range of nuclear and R&D-related initiatives. Issues related to increasing vehicle fuel efficiency and oil drilling in the Alaska National Wildlife Refuge are no longer part of the energy bill.

Federal transportation legislation

The Intermodal Surface Transportation Efficiency Act (ISTEA), passed by Congress and signed by the President in December 1991, establishes a new vision for surface transportation in America. While providing authorizations for highways, highway safety, and mass transportation for the next six years, the purpose of the Act is clearly enunciated in its statement of policy:

> "to develop a National Intermodal Transportation System that is economically efficient, environmentally sound, provides the foundation for the Nation to compete in the global economy and will move people and goods in an energy efficient manner."

Given the strong federal partnership in directing and financing state transportation programs, the policies and programs set forth in the ISTEA will play a significant role in shaping transportation at the state level well through the decade of the 1990's. Many of these policies intersect with Maine's energy and environmental goals. Among others, several major provisions of the Act include:

- A national highway system to focus Federal resources on roads that connect with other modes of transportation, are most important to interstate travel and national defense, and are essential for interstate commerce;
- More flexibility to state and local governments in determining transportation solutions, whether transit or highways;
- New technologies, such as magnetic levitation systems, advanced transportation systems and electric vehicles;

- A congestion mitigation and air quality improvement program directing funds toward transportation projects in Clean Air Act non-attainment areas for ozone and carbon monoxide; and

- Other activities that enhance the environment such as historic sites, recreation trails, highway beautification and mitigation banking.

The ISTEA is a comprehensive Act intended to maintain and expand the transportation system, foster a sound financial base for transportation, keep industry strong and competitive, promote safety, protect the environment and improve the quality of life, and advance technology and expertise.

The New England Power Pool (NEPOOL)

Twenty-five years ago, Maine electric utilities, for the most part, operated independently from each other and from other electric utilities in New England and Canada. In the intervening years, this situation has changed dramatically. One change has been the formation of the New England Power Pool (NEPOOL). As members of NEPOOL, Central Maine Power Company and Bangor Hydro Electric Company are members of a tightly knit power pool in which many of the day-to-day operations of generation are closely integrated with those of the other utilities in New England.[5] The second major change has been the development of large-scale transmission facilities that allow for major power transactions not only among NEPOOL members but also allow transactions outside New England, for example with New Brunswick.

The New England Power Pool was formed in the early 1970's, in part as a response to the Northeast blackout of 1965. In theory, there are two primary benefits to power pooling. The first is that a power pool with strong transmission ties among its members allows the pool as a whole to achieve a higher level of reliability from a given mix of generators. Similarly, over the long term, a pool allows its members to achieve a higher reliability level with less capacity than would be required without a pool and, therefore, at lower cost. To understand this, one must recognize that electricity is an unusual product; it is one of the very few products that cannot be stored but rather, must be produced at the same instant that it is consumed. This means that an electric utility, or a power pool, must maintain reserve capacity to protect against the twin possibilities that demand, at any instant, may be quite high and that some of a utility's generation

[5] Maine Public Service, Maine's third largest electric utility, is not a member of NEPOOL but is connected to the Canadian power grid through New Brunswick.

will be periodically unavailable due to maintenance and/or equipment failure. When a number of utilities band together and form a power pool, each member of the pool pledges to make its reserve capacity available to the other members if they should need it.

Typically, a pool requires lower reserve, as a percentage of the pool peak load, than individual members would require if they acted on their own. There are two reasons for this. First, where pool members experience their peak load at different times, each member would have surplus reserve at the time of other members' peaks. This is particularly true where, as in NEPOOL, some utilities peak in the winter due to space heating demands while other utilities peak in the summer due to air conditioning demands. The second reason why pooling lowers reserves is that it is highly unlikely that all members will have capacity that is unavailable simultaneously.

In addition to the reserve benefit, pooling may also result in lower fuel costs than each utility could achieve acting independently. This is because at any moment in time other pool members may have less expensive power available. Under a pool, if load increases then the pool determines which of its members has the lowest cost energy available and then directs that member to increase its output.

Even if pooling provides lower cost to all pool members taken as a group, it is possible that some individual members might see higher costs under the pool than they would see without it. (It is possible, for example, for one pool member to capture 110 percent of the savings which result from pooling while a second member sees a loss equivalent to 10 percent of the pool savings.) This potential concern is relevant in Maine because our two NEPOOL members make up only about 10 percent of the pool and, therefore, have only about 10 percent of the voting power. Our best protection against inequitable treatment under the NEPOOL agreement is to periodically consider whether we would be better off without the pool. Under Maine law (MRSA 35-A, §3134-A), utilities are required to analyze whether there are continuing benefits to pool membership and to submit a report to the PUC every 3 years. In general, these reports have found that there were continuing benefits -- although they have often suggested that in the future, (in 10 to 15 years) it might be desirable to leave the pool. Generally speaking, findings that indicate that leaving the pool may be advantageous are predicated on Maine utilities entering into some other pool or a similar arrangement that would provide at least some of the benefits of

pooling.[6] Obviously, these conclusions are dependent on being able to obtain alternative arrangements on attractive terms.

In addition to pooling, the last 20 years, and particularly the last 10, have seen an increasing reliance on power purchases from relatively distant generators that are "wheeled" (transmitted) fairly long distances to the buyer. For example, the MEPCO (Maine Electric Power Company) line to New Brunswick was completed in the early 1970's with each of Maine's three largest electric utilities returning revenues from the MEPCO line to their own ratepayers in subsequent PUC rate cases. Since that time a number of New England utilities have purchased power that has been wheeled over the MEPCO line and, in the case of southern New England, over other lines in Maine and New Hampshire to the ultimate user. Each of these transactions has provided revenues, which has reduced electricity costs to ratepayers in Maine. There have also been instances of non-utility generators building plants in Maine and selling their output to remote Maine utilities or to southern New England utilities. Again, the dollars received from these wheeling transactions, and from short-term power sales by Maine's electric utilities to wholesale customers in other states, have represented a source of revenues for keeping down electric rates in Maine.

The real effect of both the pool and of power purchases that are wheeled to the buyer has been to place Maine squarely in a dynamic regional market for wholesale electric power transactions. Shortly before World War I, Maine enacted the Fernald Law, which prohibited the sale of hydro-electric generation in Maine to utilities outside the state. The law stayed on the books until the 1950's when it was repealed. Through much of the law's life, there were serious questions raised as to its constitutionality. A similar policy enacted today would not only face similar constitutional questions, but also would represent an attempt to turn our backs on the laws of physics, where the electrons flow according to physical rather than political phenomena. Moreover, ratepayers and Maine's utilities would forfeit the economic advantages of being able to tap into a far-reaching and active market in wholesale power.

[6]The conclusion that Maine ratepayers are best served by some sort of pooling arrangement is largely derived from the fact that a very substantial portion of our capacity is in only 2 very large generators, Maine Yankee and the oil-fired Wyman Unit 4.

Future Energy Demand in Maine

A broad array of factors will affect the future demand for energy in Maine. These include the price of oil and other energy supplies, the health of the State's economy, federal and State regulatory initiatives, improved efficiency and technological advances, and consumer preferences. Unfortunately, none of these are predictable with any great degree of accuracy. Even the most sophisticated energy forecasts rely heavily on assumptions that frequently prove to be highly inaccurate.

It is unlikely that overall energy use in Maine will continue to grow at the 3.2 percent annual growth rate seen during the 1980's, due to slower economic growth, relatively higher energy prices, and continued conservation efforts. Maine's energy mix may change, however, as competing energy types lose or gain relative market share, meaning that some types of energy will experience above or below average growth. Growth in electricity consumption is likely to continue to outpace growth in overall oil use. This projection assumes moderate, but stable, economic growth in Maine through 2010, and oil prices that remain relatively stable when adjusted for the effects of inflation, but still higher than those seen during the late 1980's. This assessment also assumes that Maine will continue to become more energy efficient at the same rate seen over the past 10 years. Growth in energy consumption, therefore, will occur despite gains in overall energy efficiency, unless efficiency improves at much higher levels than currently anticipated.

Economic Activity

The pace of economic growth is perhaps the single greatest determinant of energy demand in Maine. During the 1980's, growth in the State's economy outpaced the rate of overall economic growth in the U.S., and overall energy use in Maine grew significantly as a result. Throughout most of the 20th century, the rate of growth in energy use roughly paralleled growth in overall energy use. During the 1980's, however, growth in

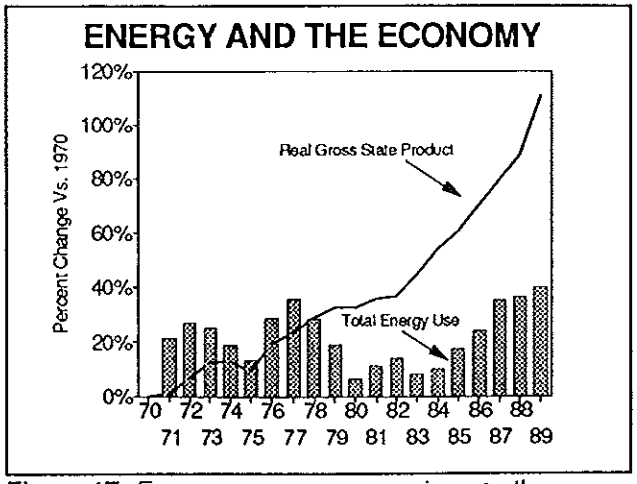

Figure 17 Energy use vs. economic growth

the State's economy outpaced growth in energy use by a factor of 2 to 1 (Figure 17). This trend reflected gains in overall energy efficiency, combined with the growing importance of the non-manufacturing sector in Maine's economy relative to the more energy-intensive manufacturing sectors of the economy.

During the 1990's and into the beginning of the 21st Century, economic growth in Maine and the U.S. is expected to slow considerably. Consequently, many of the factors that drive energy demand, such as household formation, industrial development, business expansions, tourism and business travel, will all be more moderate than in the past decade. When combined with continued energy conservation efforts and increased overall energy efficiency, growth in energy demand will probably slow considerably through 2010. Thus, economic forces will continue to play a preeminent role in influencing future energy demand in Maine.

Long-term economic forecasts developed by the State Planning Office (SPO) suggest that Maine's economy has reached a relative plateau in activity. These forecasts anticipate that Maine will neither return to the breakneck pace of economic growth seen during the past decade, nor will economic activity regress to the level of the early 1980's. Instead, the SPO forecasts predict that Maine's real Gross State Product (the value of all goods and services produced in Maine, adjusted for inflation) is expected to increase by approximately 2 percent annually between 1991 and 2000, down from the average 5.6 percent annual growth seen between 1979 and 1990.

The following chart compares the SPO forecast with other forecasts of the Maine economy as depicted in the most recent energy forecast produced by Central Maine Power Company.[7]

[7] Long-Range Forecast of Electric Energy and Peak Load 1990-2020, CMP, June 1991.

Table 1 -- Comparison of Economic Forecasts

Annual Compound Growth Rates:	SPO 4/91	NEPP 4/91	DRI 2/91	CMP 5/91[8]
Gross State (Regional) Product	1.9%	2.2%	n/a	2.2%
Population	0.8%	0.7%	0.5%	0.9%
Real Personal Income	2.3%	1.7%	1.9%	1.9%
Employment	0.9%	0.9%	0.9%	1.0%
Manufacturing	-0.4%	-0.5%	-0.9%	-1.0%
Non-manufacturing	1.1%	1.2%	1.2%	1.3%

Sources: SPO=State Planning Office (forecast to 2000); NEPP=New England Power Planning, Maine: The NEPOOL Economic and Demographic Forecast, 1990-2006; DRI=DRI/McGraw-Hill, Maine State Forecast, February 1991 (forecast through 2005); CMP=Central Maine Power Co. (Forecast through 2005.)

While these economic forecasts suggest slow but steady growth in energy use over the long-term, over the short-term, energy use in Maine will be determined more by relatively higher energy prices and a weak economy. During the 1980's Maine enjoyed declining real energy prices and a thriving economy. Falling energy costs not only helped stimulate rising energy consumption, but also contributed to the State's dramatic economic growth in the late 1980's. It is no accident that periods of high economic growth frequently coincide with stable or declining energy prices, while recessions appear to coincide with periods of rising energy prices -- since energy is such an important input into the economy.

With this in mind, the apparent reversal of the 1980's trend of falling real energy expenditures may prove to be a portent for the 1990's. To some extent, rising electricity rates and higher oil costs will almost certainly act to curtail economic growth over the near-term.[9] It is also notable that Maine is losing its relative advantage with respect to electricity rates compared with New England as a whole (Figure 18). Not only have recent rate increases eroded this advantage on a regional basis, but Maine's rates are increasingly higher than the national average, making

[8] CMP Service Area

[9] The 1990 Clean Air Act amendments are also likely to place upward pressure on electricity rates (at least on a regional basis) and gasoline and diesel prices.

it more difficult for Maine to attract -- or keep -- businesses that are sensitive to electricity prices. At a minimum, under present circumstances Maine should proceed very carefully with the implementation of any energy policy that would further exacerbate rising electricity costs, generally, and the State's competitive position vis-a-vis the U.S. and New England average.

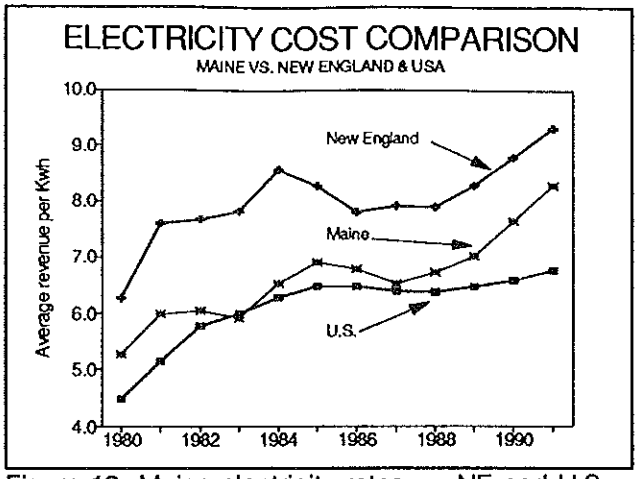

Figure 18 Maine electricity rates vs. NE and U.S.

Oil Prices

Oil prices will also be an important factor affecting future energy consumption in Maine. As can be seen in Figure 19, overall energy use in Maine reacted strongly to rising and falling oil prices throughout the 1970's and 1980's. Rising prices in the early years of each decade stimulated an actual reduction in total statewide energy use, while falling oil prices, particularly during the period 1983-89, helped stimulate a dramatic increase in overall energy use in Maine, as well as helping to stimulate the economic growth seen in Maine during the late 1980's. As seen during the 1980's, the demand response to higher prices is different for different types of energy uses. Areas in which alternative forms of energy are more readily available, such as home heating, can be expected to exhibit greater price sensitivity than areas that depend more heavily on one type of energy, such as transportation. However, the transportation energy mix may change fairly dramatically as the penetration of alternative fuels increases in response to environmental concerns, although it is too soon to tell whether efforts to comply with Clean Air Act mobile source standards will favor alternative fuels (such as propane, methanol, natural gas, electricity, etc.) or reformulated gasolines that would remain petroleum-based. Maine has opted in to the federal reformulated gasoline program and is also encouraging the development of alternative fuels through State and regional demonstration projects.

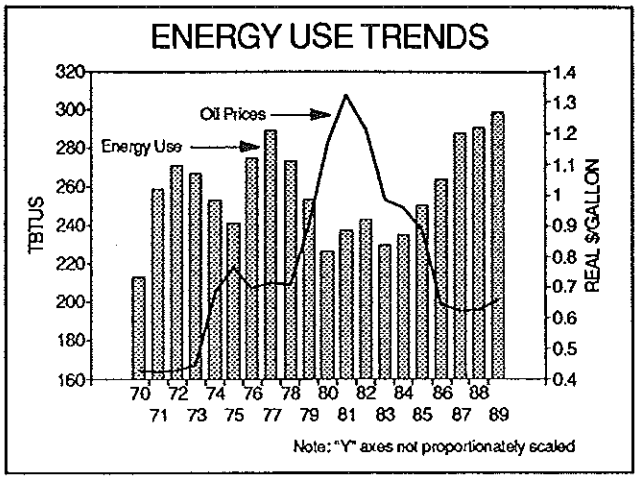

Figure 19 Total Maine energy use vs. oil prices

In 1983, the Maine Office of Energy Resources (OER) predicted that oil prices would rise to $60 per barrel by 1990 and $90-$100 per barrel by 2000. Recognizing the inability of oil producers to hold prices artificially high after prices began to collapse throughout the mid-1980's, OER revised its estimates downward in 1985 and again in 1987. The 1987 forecast predicted continued volatility in the oil market, with prices rising to between $40 and $50 per barrel by 1995, falling to $30 per barrel, and then rising toward $50 per barrel by 2005. While the prediction for continued volatility was correct, actual prices have remained well below the 1987 forecast. Today, oil price projections performed at the national level recognize that prices cannot be predicted accurately over long periods and, instead, forecasters try to predict a possible range of prices that might be experienced under a variety of scenarios. The most recent long-term oil price forecast published by the U.S. Department of Energy suggests the following price projections for 2010:[10]

Table 2 -- Projected Oil Prices Through 2010

Constant (1990) $	Reference Case	Low Case	High Case
World Oil Price	$33.40/bbl	$22.60/bbl	$40.70/bbl
Gasoline	$1.58/gal	$1.30/gal	$1.74/gal
Heating Oil	$1.19/gal	$ .96/gal	$1.32/gal

As can be seen, the DOE forecast suggests that real crude oil prices (i.e., prices that are adjusted for inflation), may remain relatively constant through 2010, on the low side, or they may double, on the high side.

These predictions assume that, while actual world oil supplies will remain more than sufficient to meet expected demand (in fact, oil supplies are expected to remain sufficient well beyond the DOE forecast period ending 2010), the supply will become increasingly concentrated in the hands of fewer suppliers, as domestic and other non-OPEC oil production begins to wane and OPEC's market share increases. As the OPEC nations' combined world market share rises, there will probably be less incentive for individual cartel members to undercut prices or exceed production quotas. This could, in turn, lead toward a higher price path. The low oil price path

[10] United States Department of Energy, Energy Information Administration, 1992 Annual Energy Outlook, January 1992.

assumes aggressive expansion of OPEC production capacity and utilization, with little or no artificial price manipulation. The high oil price scenario results in large part from a deliberate strategy to slow production or otherwise hold prices artificially high. Note, however, that even under the high price path, oil prices are not projected to exceed, or even attain, early 1980's prices during the forecast period (Figure 20).

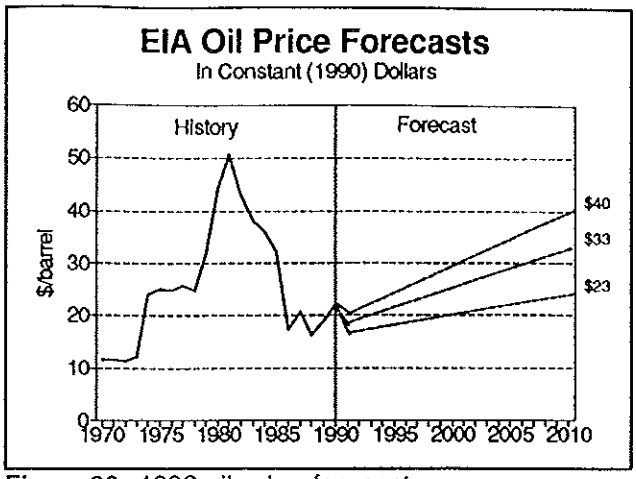

Figure 20 1992 oil price forecast

There are several reasons why the low price scenario may be more likely than the high average price path. First, historical experience suggests that, in the event of a prolonged price spike, consumers have a significant degree of leverage in terms of being able to adjust their demand enough to force oil prices to return to what are considered "reasonable" levels. In addition, it is likely that oil prices will be subject to increasing competitive pressure from other fuels, such as natural gas, and a variety of demand-reducing technologies, such as higher mileage new cars. History has shown that the relative share oil enjoys in the State's energy mix is highly sensitive to price. It may, therefore, be reasonable to assume that, while OPEC's relative dominance over world oil supplies will continue to increase, there may be natural limits on the extent to which producers can artificially sustain higher oil prices over any significant period. Oil prices are likely to react more to fundamental supply and demand conditions (as influenced by competition from alternative fuels, increased levels of energy efficiency, etc.) than to political factors. While oil price volatility should be expected (i.e., significant price swings of relatively moderate duration), the long term trend is most likely toward relatively stable world oil prices rising at, or slightly to moderately above, the level of inflation. However, the single most important factor affecting oil prices may again prove to be consumers' ability to respond to higher prices by lowering their demand. Because of this, maintaining this capability, and improving it where possible, is very important for Maine, especially in the transportation sector.

Apart from the broader worldwide forces of supply and demand on prices for crude oil and certain refined products, the implementation of the recently revised Clean Air Act appears likely to have an upward effect on prices for transportation fuels. Compliance strategies under the Act's ambient air quality provisions that require the development of alternative fuels or reformulated

gasolines will result in higher priced motor fuels. Thus, while overall oil prices will probably remain stable, prices for transportation fuels are likely to increase as a result of the implementation of the nation's environmental policies. Whether the impact of these expected fuel price increases will be offset through increased vehicle energy efficiency remains to be seen.

Maine Energy Demand

During the 1980's, total "end-use" energy consumption grew at an average annual growth rate of 3.2 percent. During the same period, electricity use grew at an annual rate of 3.8 percent, while oil use grew at a rate of only 2.1 percent. This growth occurred despite relatively significant gains in energy efficiency in each area during the same period. For the foreseeable future, it is likely that Maine will experience slower growth in overall energy consumption, although the rates of growth for certain types of energy may vary as the market share of different energy types shifts within Maine's overall energy mix.

Electricity:

Central Maine Power Company's June 1991 forecast predicts that electricity sales in their service area (representing approximately 80 percent of all electricity sales in Maine) will grow at an annual rate of just over 2 percent through 1995, falling to just over 1.5 percent through 2000 and beyond (relative to 4.1 percent annual growth during the period 1976-1990). These projections, however, do not include the potential effects of utility-sponsored (or other) conservation efforts, since the forecasting methodology views conservation as a potential resource in addressing future energy demand. Therefore, actual growth in electricity consumption under the CMP forecast scenario is likely to be somewhat lower.

Several additional factors will affect future electricity demand in Maine. One unanswered question is how consumers will react to recent increases in electricity rates (of over 38 percent in 3 years, for CMP). At the residential level, it is possible that these rate increases may reduce demand substantially by encouraging the replacement of electric space heat and electric hot water systems with oil, gas, or other systems that offer lower total life-cycle costs. This could lower growth rates even further, and could lead to even higher rates as utility system costs are borne across a smaller sales base. At the same time, Maine is following the national trend toward the increasing "electrification" of modern society. Although electrically-operated devices are continually becoming more energy efficient, consumers are using more types of electric appliances in their daily lives and in commercial and industrial applications. Demographic

changes also place upward pressure on growth in electricity use. As the number of persons per household continues to decline, the relative number of basic electric appliances per person grows. However, the extent to which these types of competing trends may offset one another remains largely unknown.

Oil:

Future demand for petroleum energy in Maine will also remain subject to a variety of forces. When viewed from an historical perspective, it is likely that oil *prices* will probably continue to play the most significant role in determining Maine's future level of oil consumption. In the residential sector, oil use will be determined by additional factors such as oil-heated new home starts, the efficiency characteristics of Maine households, and the degree to which consumers switch to oil from electricity in response to rising electricity rates. In the transportation sector, oil use will depend upon a combination of vehicle miles travelled (VMT), increases in overall fleet efficiency and the penetration of non-petroleum motor fuels. Today, gasoline enjoys what is possibly its lowest price in history, when adjusted for the effects of inflation. Motor fuel prices are not, therefore, likely to play a major role in reducing VMT unless they rise significantly. Changes in VMT will instead be influenced by economic and demographic factors rather than fuel prices. It is unlikely that Maine will experience the same rate of extraordinary growth in VMT (of almost 6 percent per year) seen during the 1980's. VMT actually declined slightly in 1990.

In the commercial and industrial sectors, oil use will be influenced by oil's position relative to competing fuels, efficiency gains, and economic activity. In terms of end-use energy applications, oil remains the dominant fuel for most space heating, almost all transportation, and supplies a large share of the energy for Maine's industrial base. This is likely to continue in the absence of competitive alternative fuels or substantially increased conservation efforts.

Natural Gas:

Natural gas use grew by an annual rate of over 6 percent per year in Maine during the 1980's. However, natural gas still comprises only a small percentage (just over 1 percent) of the State's energy mix and is only available in southern Maine and in the Lewiston-Auburn area. The single most important factor affecting future growth in natural gas use is whether the availability of gas in Maine can be expanded. The currently available supply is not adequate to serve large industrial or electric generation projects under long-term commitments, due to restricted pipeline capacity. If the availability of natural gas is expanded, it is estimated that there are significant

opportunities for the additional penetration of natural gas within Maine's energy mix, some of which include natural gas-fired cogeneration applications, the substitution of natural gas in paper mills and other industries that currently rely on #6 grade heavy industrial fuel oil, continuing growth in natural gas used for residential energy needs, and the use of compressed natural gas as a transportation fuel.

Indigenous Energy Resources

Maine is likely to continue to depend upon imported energy resources -- such as gasoline, diesel, heating oil, kerosene, propane and coal -- to meet its energy needs well into the next century. However, Maine has historically depended heavily on its indigenous hydro and wood resources for energy production. Were it not for these resources, Maine's current level of dependence on energy imports would be much higher.

This section focuses on the potential for, and issues related to, the continued development of indigenous State energy resources that hold significant promise in meeting a growing share of Maine's long-term energy needs. Hydro, biomass, wind, and solar are the resources that hold the most near-term promise. Other indigenous resources, such as tidal and peat, do not appear to be potentially significant contributors in the context of this planning horizon (1992-2010), although future technologies or other developments may change this. Municipal solid waste (i.e., trash-to-energy) currently does contribute to the State's energy mix, but should be viewed in the context of Maine's approach to solid waste management, rather than being addressed as a matter of energy policy. It should also be noted that, irrespective of the fact that the development of any particular resource may be consistent with Maine's energy goals, the development of any energy project must be consistent with other State goals and policies, and must comply with all applicable regulatory mandates.

Hydro

Maine has a long history of harnessing water for power due to the State's abundant river systems and their suitability for the development of hydropower. Today, Maine's energy mix includes 124 hydroelectric generating dams that produce power for sale to consumers through utility systems, and dams operated by Maine industries that produce power for their own use. These facilities represent a combined installed generating capacity of 729 Megawatts (MW). They supply over 16 percent of Maine's total energy needs, and approximately 23 percent of the electricity used in Maine that is purchased through the utility grid. Overall hydro production in Maine grew by 115 percent during the period 1970 through 1989.

Hydropower is highly reliable, renewable and generally non-polluting. Hydro projects frequently have useful operating lives of over 50 years, and enjoy no fuel costs, and low

maintenance and operating costs. Hydro, however, is subject to what is, possibly, the most stringent set of regulatory requirements of any energy resource other than nuclear. Additional challenges to further hydro development include high initial capital costs and potentially negative environmental impacts such as oxygen depletion, nutrient flow curtailment, impact on fish migration, and other impacts on the aquatic environment, although many of these can be at least partially mitigated. An additional challenge is the seemingly increasing public opposition to such projects, and how to balance the variety of competing demands on Maine's river resources.

Maine currently has the unique distinction of having more hydro power sites whose original federal licenses are about to expire than almost any other State in the nation. These projects represent 44 percent of Maine's total hydropower capacity and approximately 10 percent of Maine's electricity supply. Maine's dam owners are aggressively pursuing the relicensing of existing dams. However, new, more stringent requirements may place some portion of this capacity in jeopardy.

With respect to new hydro development, current estimates indicate that approximately 297 MW of additional hydropower could feasibly be developed in Maine. This figure includes new projects, the revitalization of older dams, and capacity upgrades at existing facilities, and only includes sites on river stretches on which hydro is not prohibited under the 1983 Maine Rivers Act.[11] Apart from relicensing activity, however, hydro development in Maine has slowed dramatically. Future hydro development will depend upon economic conditions in the energy market, such as oil prices and utility avoided cost rates, the overall competitiveness of hydro relative to other available alternatives, and the ability of specific hydro proposals to meet federal and state environmental regulatory requirements. Currently, there are no new hydro projects under construction in Maine, although several are in the "proposed" stage.

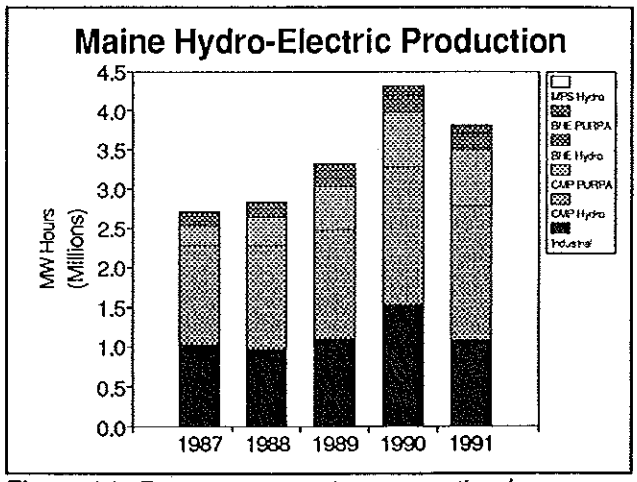

Figure 21 Recent year hydro generation by source

[11] This figure includes controversial projects such as Big A, Basin Mills, and Edwards.

Biomass (wood)

Wood has always been an important energy resource for Maine. In 1991, Maine used approximately 600,000 cords of wood for home heating, down from 1.2 million cords used in 1980. This decline was due primarily to lower oil prices and the relative inconvenience of operating woodstoves. However, the production of electricity from wood during the past decade and a half has revitalized the importance of wood in Maine's energy mix and has helped Maine control what otherwise would potentially have been a significant increase in its dependence on oil. (For the purposes of this draft, the term "biomass" refers to wood and wood waste, including paper mill sludge, burned in multi-fuel boilers for electric energy production. Biomass does not appropriately refer to municipal solid waste, even though some of that waste may be composed of biomass materials.)

The use of wood as an energy resource increased by 150 percent in Maine during the 1980's, despite an overall decline in residential firewood use. Most of this increase occurred because of growth in wood consumed to generate electricity in cogeneration and stand-alone independent power operations. Maine currently has 20 wood-burning power-plants that provide almost 500 MW of electric generating capacity. Nine of these are free-standing (i.e., plants not associated with any other industrial application) and produce a total of 212 MW. Five large cogeneration facilities situated in pulp and paper mills account for 234.5 MW, and 7 smaller wood-fired cogeneration plants are associated with sawmills for an additional 23 MW of electric generating capacity. With these plants on line, wood is now roughly equal to nuclear and hydro in terms of its contribution to the State's electric power supply. Wood energy accounts for over 14 percent of the State's overall energy mix, and was used to supply over 25 percent of Maine's 1991 electricity needs (See Figure 10, above). One additional free-standing plant is currently under construction and several others are planned.

In addition to its contribution to Maine's energy mix, the biomass energy industry also provides significant economic benefits to the State. Wood-fired cogeneration and independent power plants were responsible for a capital investment of almost $1 billion during the 1980's and have a direct annual impact of approximately $73 million in payroll expenditures, fuel purchases, local spending, and sales and property taxes -- energy dollars that otherwise would leave the State in the case of consumption of non-indigenous resources.

A central question concerning the future resource potential for biomass generation is the extent to which additional wood-fired power development can occur within the sustainable yield of the Maine forest. The current demand for wood biomass in Maine is being met from mill residues (30 percent) and whole tree chips (70 percent) produced from logging residues and stand thinnings. The supply of wood fuel for powerplants in the short term is limited by the quantities of logging residues available as the result of general timber harvesting activities and the existing reserve of culls, standing dead trees, and excess trees on harvested areas. The long-run sustainable supply will be determined by the realized productivity of Maine's managed forests.

The total physical supply of suitable biomass energy materials currently existing on Maine forest lands is very large -- up to 128 times larger than current consumption. The potentially available biomass residue from current levels of general harvest activities is between 6 and 12 million tons -- enough to support an additional 200 to 600 MW of biomass-fired electric power capacity. When the harvest levels for all wood products are balanced over the long-term, the sustainable biomass yield is approximately 18 million tons annually, resulting in a potential biomass resource capable of supporting a total of 1500 MW of electric generating capacity.

These estimates, however, measure only the total gross resource potential, and do not indicate the amount of economically feasible biomass development, or a level that might necessarily be desirable in terms of Maine's other goals pertaining to the use of the State's forest resource. As with hydro, the ultimate potential for additional biomass-fired electricity generation in Maine will also depend on prevailing prices for competing types of energy, utility avoided cost rates, access to transmission lines, and compliance with State and federal regulatory standards.

Wind

Wind is currently the subject of increasing interest in Maine, and represents an area of great promise in terms of its renewability and clean air characteristics. Two independent power producers are currently in the initial development stages of utility-scale wind projects that might be placed at various locations in northern and western regions of the State. The gross resource potential for wind has not been precisely quantified but may be in the range of several hundred to several thousand megawatts. As with other indigenous resources, the economic potential for wind energy will be greatly influenced by the market price for new capacity (i.e., avoided cost), and the ability to site and license such projects.

Solar

While the gross resource potential for solar energy is obviously huge, utility-scale active solar energy projects, such as those now operating in Southern California, do not appear to be well-suited to Maine. The near-term potential for solar energy in Maine is more likely to be available in the form of passive solar applications in building design, and solar systems for domestic hot water. Significant additional development of active solar electric systems, such as widespread residential photovoltaic arrays, will depend on technological breakthroughs that reduce the cost of such systems.

While solar energy did not take off as projected by early 1980's estimates, solar has established itself to a limited degree in Maine, most notably with respect to incorporating passive solar characteristics in modern building design. The Commission also received testimony from a significant number of consumers who use photo-voltaic systems in meeting their own energy needs. Most of these occur in areas where the expense of connecting to the utility grid makes such projects cost-effective, although some consumers have installed solar systems as a matter of principle.

Energy Policy Goals

The goals of securing reliable, low-cost energy supplies continue to be fundamentally important to Maine today. This is especially true in view of the rising energy costs seen in recent years and our renewed recognition of the dangers of being exposed to the potential volatility of international oil markets. In addition, the Commission believes that energy policy today also must pay careful attention to issues related to the impacts of energy use on the environment, and how our energy decisions affect the Maine economy.

The Commission finds that Maine energy policy should address the following four fundamental aspects of sound energy policy:

- Cost
- Reliability
- Environmental Impact
- Economic Impact

"**Cost**" refers both to direct energy prices (i.e., dollars per gallon or cents per kilowatt-hour) as well as to overall energy costs (the total bill for energy used). "**Reliability**" refers to the assurance of adequate necessary supplies of energy, and includes issues related to energy security. "**Environmental Impact**" refers to the wide variety of air, land, water, and health impacts that result from energy production, transportation, and use. "**Economic Impact**" refers to how energy policy will affect the economy, in terms of jobs, competitiveness, and general economic health.

Thus, the goal of Maine energy policy should be to meet the State's energy needs with reliable energy supplies at the lowest possible cost, while at the same time ensuring that our energy production and use is consistent with Maine's goals for a healthy environment and a vibrant economy. Failing to pay adequate attention to cost, reliability, environmental impact, or economic impact could have severe consequences for Maine's future. At the same time, balancing these four aspects of energy policy represents an opportunity to pursue objectives that will provide long-term benefits to Maine. Unfortunately, there is no

"perfect" energy option that will achieve this goal. Maine must develop an energy *portfolio* which, when taken as a whole, achieves the desired result.

It is also important to realize that the order in which these attributes appear is not as important as understanding the importance of each, and their inter-related nature. For example, cost and reliability are not necessarily more important than environmental and economic impact. Each of these attributes is fundamentally important. Strategies that look only at environmental or economic impacts, and ignore cost and reliability issues will not help Maine achieve a well-balanced energy mix. Similarly, energy strategies that look only at cost and reliability issues, and do not address impacts on the environment or the economy also fail to strike a proper balance.

Energy Policy Objectives

Maine can enjoy an energy future that balances cost, reliability, environmental impacts and economic impacts by focussing on the following set of objectives.

- Promoting energy efficiency and conservation
- Supporting energy education
- Controlling energy costs
- Ensuring adequate levels of competition and promoting market-based approaches to energy problems, and overcoming market barriers and distortions
- Ensuring equity in how energy supplies and costs are allocated among Maine energy consumers
- Promoting greater diversity in Maine's energy resource base
- Promoting the continued development of renewable indigenous resources
- Improving the State's flexibility to respond to unforeseen price volatility and supply disruptions
- Reducing/avoiding environmental degradation
- Promoting consistency among energy policies and programs and coordination between energy policy and other State goals and objectives

As with the energy policy goals noted above, the order in which these objectives are iterated is not as important as understanding that each is important, and that none stands on its own without some (and often many) inter-relationships with the others.

Energy efficiency is clearly a key element in meeting Maine's energy goals with respect to regulated energy types, such as electricity and natural gas, as well as unregulated fuels, such as heating oil and gasoline. Improved energy efficiency leads to reduced energy costs, enhanced environmental quality, improved energy security and enhanced economic competitiveness. Energy efficiency should not be viewed in terms of reducing comfort or convenience, but as achieving the same or greater comfort, productivity, etc., while using less energy and minimizing waste.

Energy education represents a great challenge for Maine. Relatively few consumers are aware of many of the most basic economic and regulatory relationships involved in meeting their energy needs. Many consumers, for example, remain unaware of how highly regulated Maine's utilities are, or that Maine imposes no price regulation whatsoever on fuels such as heating oil, propane and gasoline. There is also little awareness about the regional nature of our electricity grid, and the complex and inter-dependent nature of the global oil market. And, despite aggressive efforts to encourage conservation, many consumers even today remain ill-informed about how to make cost-effective energy choices, and about the relationship between energy use and broader social, economic and environmental issues. The result is that many opportunities to increase energy efficiency remain unfulfilled.

Controlling energy costs is important with respect to the inherent relationship between energy and the economy. Current high energy prices place a great strain on Maine's citizens and businesses, especially since they coincide with a recession. Energy costs are determined both by the amount of energy used and the price at which it is purchased. Conservation and energy efficiency can help control energy costs since lowering energy use also lowers energy bills. At the same time, Maine must pay adequate attention to ensuring that energy prices are fair and reflect the full cost of impacts associated with energy production, transportation and use.

Competition is the cornerstone of setting prices and allocating energy supplies for unregulated fuels such as heating oil, firewood, and gasoline. Competition also has become a much more significant force with respect to electricity, given the State's encouragement of

generation by independent power producers. In addition to this trend toward increased competition, Maine must continue to ensure that the marketplace works and that market barriers and imperfections are overcome through appropriate regulatory and other actions. Market-driven approaches to energy issues should be pursued whenever they are more efficient than direct regulatory solutions. For example, policymakers cannot predict which energy choices, such as types of alternative fuels or vehicle emission technologies, will turn out to be most effective in meeting new Clean Air Act compliance deadlines. In this instance, market-based forces should be allowed to determine the best combination of cost-effective alternatives.

Equity refers to ensuring that energy costs are allocated fairly and that residential, commercial, and industrial customers each pay their fair share of maintaining the utility infrastructure. Equity also becomes an issue with respect to how energy policy affects low-income consumers, and with respect to ensuring adequate oversight of markets for non-regulated energy supplies, such as heating oil, propane and gasoline. Equity is also an issue with respect to how energy policies affect consumers who relied on past energy policies that may have subsequently changed.

Energy diversity means that we avoid relying too heavily on any one type of fuel or energy service, and that we remain capable of switching quickly to other fuels when necessary. It is an especially important objective for Maine, due to the State's above-average dependence on oil and the relative lack of coal and natural gas in its energy mix. No energy resource is ideal in every way, and each represents varying degrees of potential benefits and risks. A well-balanced energy portfolio is the best way to enhance potential benefits and minimize those risks. Maine should strive to reduce its dependence on oil through increased efficiency and reliance on renewable energy resources. In particular, investment in and promotion of alternatives that address transportation energy use offers the single greatest opportunity for reducing oil use in Maine, followed by programs that reduce oil use in Maine's industrial sector (such as fuel switching to natural gas).

Renewable energy resources should continue to be viewed as a means of increasing the diversity in Maine's energy mix, improving environmental quality, mitigating Maine's historically high level of oil dependence and enhancing the long-term sustainability of the State's energy profile. While the land- and water-use impacts of these resources have become increasingly controversial, there remains significant potential for additional development of Maine's hydro and

biomass resources, as well as ongoing efforts to develop Maine's wind resource. Today, Maine is a national leader in its reliance on renewable resources, and further opportunities for such development exist. The present challenge, however, is to ensure that any increased reliance on indigenous resources is consistent with State objectives for the proper use and conservation of those resources.

Flexibility and responsiveness mean being prepared for uncertainties and recognizing that we cannot foretell our energy future. If we have learned anything from energy planning during the 1980's, it is that we cannot predict with any accuracy future oil prices, economic trends or other factors that affect how we will use energy in the future. But while we cannot always anticipate what energy challenges may lie ahead, we can work to improve our ability to respond to them quickly and appropriately as they arise.

Reducing and avoiding environmental degradation is becoming an increasingly important issue as energy policymakers recognize that almost every aspect of modern energy use creates significant and often unwanted environmental impacts. While many of these impacts can be addressed through stronger environmental laws and regulations, energy planning can play an important role in terms of ensuring that Maine's energy future is consistent with the State's environmental goals.

Consistency is an important objective of State energy policy in the sense that policies should strive to enhance predictability over time, and in terms of ensuring that energy policy is as consistent as possible with respect to other State policies, goals, and regulatory mandates. Consistency does not mean, however, that policy should not change or react to new knowledge or new needs.

Strategies and Recommendations

Promoting energy efficiency and conservation

Energy efficiency[12] enables us to achieve a wide range of positive effects with little or no negative impacts. The Commission is unanimous in its belief that improving the efficiency with which Maine uses energy is tremendously important to our future prosperity and the health of our citizens and the environment. A high level of energy efficiency will be an essential element in the ability of Maine businesses to compete in a world economy. Energy efficiency also leads to cleaner air, cleaner water and less impact from threats such as global warming. It is difficult to over-emphasize the long-term value of energy efficiency to Maine, to the nation and to the world. The Commission is unanimous in its support for increased energy efficiency as an essential element in meeting the State's energy goals and the State's environmental goals. In addition, the Commission feels that State Government should itself make energy decisions that lead energy policy through example, and that the State should adhere to all applicable energy-related regulations for building standards, etc.

Achieving increased energy efficiency will require a broad range of new initiatives and resolution of several ongoing debates. The problem arises in that consumers are often reluctant to change their behavior or make cost-effective energy saving investments without some form of effective encouragement or direct subsidy. It is important to note that, while conservation is often an excellent investment -- in terms of reducing energy costs, enhancing reliability, and providing positive environmental and economic benefits -- replacing inefficient motors, lights, and appliances, improving insulation levels, etc., is not without cost. Someone must provide funds for the investment, and identifying who pays these costs, and under what tests for cost-effectiveness, is a central issue.

To the extent that price signals, alone, are not enough to stimulate a desirable level of conservation-oriented investment and behavior, Maine must decide how to fund and deliver conservation programs that use inherently limited personnel and financial resources in the most efficient manner possible. Moreover, these efforts must be consistent with other energy-related

[12] For the sake of brevity, the term "energy efficiency" here refers both to using less energy to do the same job, and to "conservation," which typically refers to a behavioral or other change that results in lower energy use (turning down thermostats, reduced driving, etc.)

goals and objectives. A first step is to identify the specific goals that should be addressed through conservation programs. For example, some conservation strategies may be more effective at minimizing certain types of air emissions, while others would be better at enhancing economic development, or minimizing the energy costs of low-income citizens. Targeting conservation programs can also help avoid possible unwanted results, such as imposing undesirable cross-subsidies, paying too much for, or not achieving, the desired level of energy savings, or encouraging uneconomic bypass by large customers or fuel switching in cases that may not be consistent with other State goals.

Historically, Maine has used so-called oil overcharge funds and federal funds to provide direct State-sponsored energy conservation services. Current law requires electric utilities to offer (or contract for) conservation programs as a way to meet their resource needs.[13] Since the electricity industry is highly regulated, it has frequently been easier to pursue conservation through utility-sponsored programs than to pursue efficiency improvements that affect unregulated types of energy, such as gasoline and heating oil. These resources, however, are arguably dirtier and less secure than electricity, in view of Maine's electricity mix, which is dominated by clean and renewable energy resources. Non-electric energy types, therefore, represent relatively more desirable targets for conservation from an environmental perspective. Thus, one aspect of the conservation issue is how to achieve efficiency improvements in areas outside the PUC-regulated energy arena -- specifically, how to fund and implement State-sponsored energy conservation efforts. Another set of issues relates to conservation programs implemented within the utility regulatory structure (known as "demand-side management," or DSM programs), and how conservation strategies are balanced and coordinated with respect to supply options.

Recommendations:

1) Funding for State-sponsored conservation programs

The Commission recommends that the Maine should explore ways to fund conservation and efficiency initiatives that would be offered directly through State government. A wide variety of programs in States such as Iowa and California could be used as models. Such programs could include enhanced technical outreach, low-interest loans and/or revolving loan funds, appliance incentive programs, etc. (in addition to education programs noted below.) Historically, Maine has used so-called oil overcharge funds to subsidize weatherization efforts and other

[13] As noted earlier, the Maine Energy Policy Act establishes a preference for conservation programs within a utility's least-cost planning process.

conservation programs. These funds, however, are now largely gone. The State is currently able to maintain a modest energy education and outreach program but is no longer able to provide the types of direct subsidies that were available in prior years. Moreover, the bulk of these programs will terminate at the end of the current biennium unless additional funding sources are found.

The Commission recommends that the State Planning Office study the feasibility of funding State-sponsored energy programs through bonds, energy taxes, the general fund, or other mechanisms. This study should be completed and a report made to the Legislature and the jurisdictional committees by March 1, 1993. It is the sense of the Commission that bonds should be viewed as the most likely near-term option. The report also should include an assessment of funding conservation programs in subsidized housing units. The Commission also recommends that State-sponsored conservation efforts be targeted toward low-income citizens, schools and municipalities, and small businesses.

2) Utility-sponsored programs

The Commission recommends that current law and PUC regulations requiring utilities to pursue cost-effective conservation as a preferred resource option be maintained.[14] At the same time, the Commission recognizes that certain aspects of utility-sponsored conservation justify ongoing consideration as Maine's energy policy evolves through the 1990's and beyond. Some members of the Commission believe the utilities' annual conservation budgets (approximately $20 million in CMP's case) represent a hidden tax, and that the cost of such programs to non-participants represents an unfair cross-subsidy and promotes uneconomic fuel switching to oil and gas. Other Commission members believe utility DSM programs do not represent any more of a tax than if ratepayers funded a new generation resource instead of a conservation program, and that small percentage rate increases are justified by lower energy bills to ratepayers who have taken advantage of the conservation programs, by lower overall utility system costs, and by other benefits that result from more efficient use of electricity, such as reduced energy-related air emissions, enhanced resource sustainability, and lower long-term costs for all ratepayers. A summary of CMP's most recent report on their ongoing demand-side management programs is attached as Appendix E to this report.

[14] This recommendation is not intended to imply that current PUC regulations should be "frozen."

3) Publicly-owned buildings

Maine should study and pursue opportunities to increase the energy efficiency in its own buildings. The State has spent over $1 million in oil overcharge money to improve the efficiency of State buildings, but current estimates suggest that much more can be done. Investments in efficiency improvements at the State level (including municipal and school facilities) provide a direct return to taxpayers, and can be used as an example to help promote similar private sector investment. Bond issues should be considered as a means of funding such initiatives. In addition, the State should seek opportunities, where practical, to encourage the development of new technologies and alternative fuels when making its own energy decisions.

4) Building standards

The Commission recommends that Maine's current energy efficiency building standards be strengthened (and updated as necessary) and that current exemptions be removed, or at least limited to the extent possible. The Commission also recommends that Maine develop and fund appropriate education, monitoring and enforcement capabilities. Testimony during the Commission's public hearing strongly suggested that Maine's current standards are not being complied with, and that engineering firms that attempt to comply with the law are often at a competitive disadvantage since other firms are willing to provide design-and-build services that ignore the law. In addition most residential construction is entirely exempt from the standards. Building standards are often the most efficient and cost-effective way to limit energy waste, since the additional investment at the time of construction is fairly small and much lower than achieving the same energy savings during a retrofit. Building standards result in long-term conservation gains for all types of heating fuels. However, the Commission believes that efforts to improve building energy efficiency characteristics should also include adequate attention to indoor air quality.

The failure to enforce current standards could be remedied in a number of ways, as in these examples: by providing adequate funding for the enforcement responsibilities of the agency currently responsible for building efficiency standard compliance (DECD); by requiring builders of new residential construction to present to the electric utility a certificate declaring that the building satisfies the State standard, or pay a fee for non-compliance; or by requiring that a deed may not be recorded at the registry of deeds for the transfer of newly built property without a certificate of compliance with the building standard.

5) Energy Rating Systems

The Commission recommends that Maine establish an energy rating program for all types of buildings. At a minimum, a standardized rating system would allow building owners and prospective buyers or tenants to measure the relative energy efficiency of a particular unit, allowing consumers to make better-informed choices. In the residential sector in Maine, energy costs are typically the second largest household expense, after mortgage costs and before property taxes. Current real estate marketing and mortgage lending practices do not fully recognize the value of energy efficiency in the housing marketplace. Home energy rating systems that are currently in place in other states are designed in coordination with the lending community. This allows banks to offer more favorable mortgage terms to buyers of more energy efficient housing, based on the improved relative cash flow that results from lower energy costs.[15] The rating can also include an analysis of cost-effective suggestions to upgrade an inefficient home or building, and could be used to determine compliance with State energy building standards. This type of program addresses the energy efficiency of existing buildings, while building standards focus only on new construction.

The State Planning Office is currently working on the technical development of a residential home energy rating system for Maine. This project will result, by the end of FY 1992, in a computer-assisted rating methodology that rates new and existing homes relative to Maine's current building efficiency standards and provides analysis on the cost-effectiveness of efficiency upgrades. This program will be marketed through seminars targeted toward Maine's shelter industry (banks, brokers, builders, etc.) beginning in FY 1993. Funding for the current program expires mid-way through FY 1993. The Commission endorses this project and urges that additional funding be pursued.

[15] Appendix F provides further information on energy-rated homes and energy efficient mortgage (EEM) programs in other States and at the federal level.

6) Transportation

Energy use in the transportation sector is one of the most challenging aspects of a comprehensive State energy policy. Transportation represents Maine's largest energy consuming sector, with 1989 expenditures for gasoline and diesel of over $900 million. It also represents an area of concern with respect to energy security, since virtually all transportation energy in Maine is petroleum. Transportation energy use is also responsible for a relatively large share of Maine's energy-related pollution (see Appendix G). While most of Maine's transportation-related air pollution results from emissions that occur beyond the State's borders, the effect of Maine-generated emissions is of growing importance.

Historically, the transportation sector has been relatively less responsive to oil price and supply volatility than energy consuming sectors where alternatives are more readily available. This may change, however, as alternative motor fuels become available under efforts to comply with the ambient air quality provisions of the federal Clean Air Act, as amended in 1990.[16] The Clean Air Act now requires that emissions from motor vehicles be reduced dramatically. Many compliance initiatives are also likely to produce significant gains in energy efficiency (although some may not). In addition, the Maine Sensible Transportation Policy Act, adopted by referendum in 1991, requires that State transportation planning decisions, capital investment decisions and project decisions reduce Maine's reliance on foreign oil and promote energy-efficient forms of transportation. The new policy gives preference to demand management solutions over highway construction options. The newly enacted federal transportation bill also gives to the states greater flexibility to spend federal dollars on mass transit.

The Commission recommends that Maine actively promote improved energy efficiency in vehicles and vehicle usage. The Commission also recommends that Maine continue to support the development of alternative transportation fuels, in coordination with federal and regional efforts to enhance energy security and comply with Clean Air Act mobile source provisions. Maine's energy and land use policies should encourage strategies that reduce the amount of energy used to move people and goods, reduce waste and unnecessary energy use, and encourage the use of alternative transportation fuels and technologies. Such strategies should include:

[16] Recent energy legislation passed by the U.S. Senate would also strongly encourage the development of alternative transportation fuels.

- Policies at the State and local level that encourage innovative land use practices that permit the clustering of residential, shopping and employment uses to increase the viability for energy efficiency passenger transportation such as rail or mass transit;

- State support for an increase in corporate average fuel economy (CAFE) standards;

- Energy efficient forms of transportation such as high mileage vehicles, and the development of efficient inter-modal systems that place greater emphasis on rail and marine transportation for moving heavy freight or which emphasize public transportation for moving people;

- Increasing carpooling, vanpooling and ridesharing along with the development of additional park-and-ride facilities throughout the State; and

- Aggressively pursuing the revitalization of rail service where appropriate to maximize the transportation cost savings, energy conservation and environmental advantages that rail service can provide in both the movement of passengers and heavy freight.

It is important to recognize the relationship between transportation energy use and land use practices. For example, cluster housing and other types of planned development that help keep homes closer to commercial and employment areas can save significant amounts of energy. This type of land use planning can also encourage the development of micro-cogeneration and district heating systems, such as are becoming more common in Europe, again with significant energy and cost savings.

In addition, transportation energy use in the Northeast is responsible for about half of the region's ambient ozone-related air pollution, due to the emissions of carbon monoxide, nitrogen oxides and volatile organic compounds associated with the combustion of motor fuels. Although many initiatives in this area will occur on a federal or regional basis, Maine should initiate State-sponsored strategies designed to reduce any incremental contribution to mobile source emissions associated with transportation energy use. In particular, these should include strategies designed to improve transportation system efficiency, improve the efficiency of vehicles and vehicle usage, and diversify the State's mix of transportation fuels.

Supporting energy education

Maine should establish education as the front line in terms of encouraging consumers to make cost-effective and responsible energy decisions. Education may be the least expensive approach, since it involves relatively little overhead and no subsidies. In addition, the

implementation of specific energy-related programs should be coordinated with education and outreach, since the implementation of certain types of programs often requires that consumers are knowledgeable and willing participants. Maine currently runs energy education programs through the Department of Economic and Community Development funded with oil overcharge money, supplemented with energy industry support. The State share of these funds expires at the end of the current biennium.

Recommendations:

The Commission recommends that Maine continue to encourage direct energy education programs in grades K-12. The Commission believes that the curriculum of these types of programs must be comprehensive, factual, objective and unbiased. In addition, the State should continue to provide individual citizens of Maine, through Maine's Energy Extension Service, the educational and technical assistance necessary for them to make the most prudent investments in energy conservation. The Commission believes that, at a minimum, the State's current capabilities in this area should be maintained, and should be pursued in coordination with (and funded in the same manner as) other State-sponsored conservation programs. The Commission also recommends that Maine develop education efforts targeted toward energy efficient appliances, to enhance the implementation of federal appliance efficiency standards and to educate consumers about the merits of purchasing the most energy efficient appliances that are available.

In addition, the Commission believes that the State should make a much greater effort in combining educational outreach with public policy initiatives. Consumers do not often realize that issues or projects that are of concern to them often are the direct result of, or are heavily influenced by, the implementation of State policy. Similarly, policies frequently fail unless the broad array of affected parties understand (and, hopefully, accept) why the program has been put in place. In this sense, the State should more actively "market" its policies to assure more effective implementation.

Controlling energy costs

Energy prices are of great concern to a broad range of constituencies. This Commission's public record indicates that many consumers think energy already costs too much, while others express the view that current energy prices are too cheap and fail to reflect the "true" cost of producing and using energy. However, the economic impacts of imposing artificially higher

energy costs on the people of Maine are much easier to identify and quantify than the hoped-for benefits of such a policy. Many energy consumers in Maine may not be able to absorb higher energy costs without hardship, especially within the context of already higher energy prices than were seen during the 1980's.[17]

As of 1989, electricity had become the single largest element of the State's total energy bill (when measured by fuel type, as opposed to transportation, which represents the largest part of Maine's energy bill measured by type of use). The growing importance of electricity rates as a percentage of overall State energy costs is likely to continue, given pending fuel-clause increases and rate requests, and the growing "electrification" of modern society. By mid-1992, rates for the State's largest utility will have risen by more than 30 percent, or approximately $300 million, relative to 1988 levels. Some predictions have rates (adjusted for inflation) stabilizing from late 1992 on, after the final increases related to non-utility power projects are fully included. However, these predictions may not fully anticipate how much fuel switching could occur as consumers react to higher rates. If significant fuel shifting does occur, the loss of kilowatt-hour sales will place additional upward pressure on rates.

During the past two years, consumers have also seen higher prices for heating oil and gasoline -- increases that cost Maine consumers a total of up to $220 million over the past two years above their costs in 1989. These higher prices are clearly having a significant economic impact on Maine, especially in the low-income community, and may have served to hasten Maine's slide toward recession. This is occurring at the same time that federal energy assistance funds are being cut and oil overcharge funds are largely exhausted. As noted above, it appears that the trend toward declining real energy prices and total real energy expenditures seen during the 1980's is unlikely to continue through the 1990's.

Rising energy prices, therefore, may be inevitable, given broader market factors and the need to comply with increasingly strict environmental and other energy-related mandates. However, as a matter of policy, Maine should make every effort to ensure that long-term price increases are minimized. In many ways, consumers can control energy costs through conservation and efficiency efforts, and have a direct impact on the State's energy total bill by lowering energy use. At the same time, Maine must also pay sufficient attention to actual energy

[17] See also Ready for Winter? Final Report of the Blue Ribbon Commission on Energy Policy for Maine's Low-Income Citizens, November 1990. (Office of the Public Advocate)

prices. While some consumers care only about their total energy bill, irrespective of its actual unit price, many consumers are highly price-sensitive. This is especially true with respect to energy-intensive industries, who will invest elsewhere if energy becomes too expensive. Rising prices also place a severe burden on low-income and other consumers who often do not have the flexibility to lower their energy use in response to higher prices. In addition, price signals will become very important in determining future technology choices. This trend is of special concern with respect to electricity, where rising rates may reduce the cost-effectiveness of electric vehicles and other energy efficient and clean technologies that Maine may wish to promote. Therefore, it is important that energy policy focus both on reducing total energy costs and controlling energy prices.

Recommendations:

1) Energy Prices

The Commission recommends that State energy policy explicitly establish the goal of stabilizing, and, where possible, reducing, energy prices over the long term. At a minimum, Maine should ensure that any energy initiative that does have a price impact is carefully weighed against its potential benefits and within the context of possible cross-over effects relative to other State goals. The Commission believes that the goal of reducing long-term electricity prices can best be achieved through least-cost planning strategies.

2) Special Electricity Rates

The Commission also recommends that efforts continue to explore the development of temporarily lower rates to businesses and industries in Maine. The goal of these special rates is both to help Maine recover from its current economic difficulties and to minimize the rates that all classes of ratepayers must pay.

Promoting greater diversity and renewable resources

Reliability isn't often seen as an issue by many consumers until a hurricane causes a blackout or a political event overseas leads to lines at the gas pumps. However, once reliability becomes an issue, it becomes an issue of singular importance. Reliability "events" not only have a direct health and safety impact, but a potentially significant economic impact as well. During the propane supply crisis in December 1989, and during the war with Iraq, many consumers were noticeably less concerned with energy prices than with ensuring adequate heating season supplies.

Oil is commonly felt to be the energy resource that is most at risk in terms of reliability. As the past two years have clearly demonstrated, oil prices remain subject to sudden and dramatic changes based on meteorological and political events well beyond the State's control.[18] Contrary to popular opinion, Maine's vulnerability to oil price shocks is not determined significantly by the nation's level of dependence on oil imports relative to domestic production. It is instead a factor of the State's overall dependence on oil, our ability to switch quickly to other fuels, and the amount of reserves and surge capacity available in Maine and in the U.S. oil distribution system. (Surge capacity refers to the ability of transportation and distribution systems to react quickly to unforeseen events.) The amount of oil in dealer storage and consumers' basements has a direct effect on this responsiveness, as does the availability of additional tanker, pipeline, and refining capacity. The nation's Strategic Petroleum Reserve, and the pending Regional Product Reserve, greatly improve surge capacity in the U.S.

Most of Maine's oil comes from the U.S., Canada, and Venezuela, with relatively little coming directly from the Middle East. This does not, however, insulate Maine consumers from prices that are established in a truly inter-dependent world oil market. Any event that affects world oil prices or supplies will affect Maine, irrespective of the physical origin of heating oil or gasoline used in Maine. At the same time, the price spike in December 1989 and the market reaction to the war with Iraq can be viewed as examples of the fundamental stability of today's world oil market. During the past two years, we have seen a major military conflict in the world's largest oil producing region (the Middle East), a failed coup attempt in the world's largest oil producing country (the former USSR), and the near-term loss of oil production from Iraq and Kuwait. Despite short periods of dramatic volatility in 1989 and 1990-91, the market self-corrected and the periods of volatility were of relatively short duration. No significant supply problems actually developed.

In addition, we have witnessed a profound change in strategy among the OPEC nations over the past decade. In the 1970's, OPEC's primary goal was to adjust supply to support the highest possible world oil price. Today, OPEC's objectives are to maintain production levels that serve to maintain their long-term markets. Thus, while oil remains somewhat uniquely prone to potential price and supply volatility -- and Maine remains relatively more vulnerable to such events due to its higher-than-average level of oil dependence -- over the long term, oil is likely to remain

[18] See also: An Analysis of Winter 1989-90 Heating Oil Prices, Maine State Planning Office, July 1990.

a major and reasonably stable means of meeting Maine's energy needs. To mitigate unnecessary risks, Maine should at least reduce the percentage of petroleum in the State's energy mix to more closely match the national average of approximately 43 percent, relative to today's level of 50 percent.

Pending the development of a "perfect" energy resource, Maine should continue to diversify its energy resource base to avoid the risks of being too dependent on any single resource, and to reduce its dependence on oil. Achieving this goal is best accomplished through a combination of increased energy efficiency and increasing the relative share of alternative fossil and non-fossil energy resources in the State's energy mix. Maine has made significant progress in promoting renewable energy as a resource for electric power generation. Efforts should continue in this area, as well as heightened efforts in the transportation, residential, commercial and industrial energy use sectors.

Recommendations:

1) Renewable Energy

The Commission recommends that Maine actively encourage the development of wind and solar energy resources and support the continued utilization and further development, where appropriate, of the State's renewable, indigenous hydro and biomass energy resources. Renewable resources are sustainable, and, generally, have more positive environmental attributes than traditional resources. Developing indigenous energy resources also keeps energy dollars within State, flowing through the Maine economy. However, the Commission believes that any significant increase in the harvesting of Maine's forests for biomass must be sustainable over the long term. Research on the long term impacts on soil nutrient levels, wildlife habitat, and land uses in Maine's forest lands should be a priority before Maine significantly increases reliance on this energy resource, in addition to research on the effects of acid rain and other air pollution on resource sustainability and reforestation. In addition, like all other energy options, individual proposed projects should remain subject to all appropriate environmental permit requirements.

In addition to supporting utility-scale renewable energy projects, the Commission also recommends that the State consider incentives, such as sales tax exemptions or tax credits, for small-scale alternative energy investments, such as residential and commercial solar, wind or biomass energy systems (including incentives for passive solar construction). While the Commission recognizes that these types of incentives may prove to be unrealistic in the near-term

in view of current budget pressures, over the long-term Maine should continue to explore ways to encourage desirable energy choices through State-sponsored financial incentives.

2) Natural gas

The Commission recommends that Maine regulators and policymakers should continue to encourage the increased availability of natural gas. Natural gas is currently limited to a relatively small residential and commercial base in southern counties and in the Lewiston area, and currently accounts for only one percent of the State's energy mix. In contrast, natural gas (not to be confused with "bottled gas," or propane) supplies fully 25 percent of the nation's mix and over 50 percent of total U.S. residential energy needs. The restricted availability of this resource is a major factor underlying the State's higher-than-average level of oil dependence, and has precluded the development of natural gas-fueled industries and electric power resources.

As with any other energy resource, there are a variety of uncertainties associated with natural gas, particularly with respect to future prices and reliability. However, natural gas is, arguably, a more secure energy resource than oil, since its price and supply is not as subject to international political upheavals. There are also concerns pertaining to the degree to which increased natural gas dependence among interruptible class users can result in a demand spike on the heating oil market during unusually severe peak periods, such as occurred in December 1989. However, the Commission believes that, while these issues should be monitored closely, natural gas should be supported in the context of being an additional *option* available to all classes of consumers. Natural gas opportunities include providing a cleaner resource for electric power generation, displacing oil in the residential, commercial and industrial sectors, and, over the longer term, providing additional opportunity for natural gas-fueled vehicles. Quantifiable environmental benefits could be derived if Maine had sufficient natural gas for it to be considered as a cost-effective replacement thermal energy source.[19]

3) Alternative Transportation Fuels R&D

The Commission also recommends that Maine establish a long-range program of research in energy from renewable resources related to the transportation sector. Such a program should include: 1) Developing a strong university-level application-oriented academic program for transportation energy-related studies; 2) Developing a program to provide Maine entrepreneurs

[19] Appendix G illustrates the benefits of natural gas with respect emissions of sulfur and nitrogen oxides relative to current levels of residual (heavy industrial) oil use in Maine's industrial sector.

with the capital needed to develop demonstration prototypes of new technologies that promise to reduce or displace gasoline consumption; and 3) Offering discounts or tax incentives to Maine residents who purchase qualified vehicles that are powered by electricity or other alternative fuels.

Reducing and avoiding energy-related environmental degradation

The Commission's inquiries have raised several issues related to the relationship between energy policy and environmental protection. The Commission is unanimous in supporting the goal of addressing the environmental effects of energy production and use as a fundamental objective of State energy policy. A central outstanding issue is how and to what extent to address environmental impacts that are not already addressed sufficiently through current or expected environmental regulation, such as the Clean Air Act amendments of 1990.

The term "externalities" is often used to express the issue of "unaccounted-for" costs. From a technical perspective, externalities refer to both positive and negative attributes associated with the production, distribution and use of a commodity that are not included directly in the commodity's price. Externalities can refer to both environmental and other characteristics, such as the economic impacts of locating energy facilities within State, rather than purchasing imported power. The concept of externalities is generally used to reflect that fact that the "total" economic cost of energy, such as the health costs of coal-fired electric generation, may not be fully reflected in the price consumers pay for electricity, but is instead reflected in higher health-care costs, environmental cleanup costs, etc. Costs that are reflected directly in the price are "internalized"; costs that are not reflected in the price are, by definition, external, hence the term externalties.

In 1990, the Legislature directed the PUC to "undertake an analysis of the extent to which the environmental and economic impacts of alternative energy resource plans should be included in the electric energy planning process" under PUC jurisdiction.[20] In directing that the PUC undertake such a study, the Legislature expressed its awareness of the complexities involved in addressing unaccounted-for environmental costs, stating that,

> ".. the development of an appropriate method to implement such a policy requires careful consideration of a number of substantive and procedural issues and that the failure to design an appropriate method may preclude or delay the development of reasonable alternatives and increase rates to electric ratepayers without a commensurate environmental benefit."

[20] Chapter 110, P&S Laws, 1989

The PUC subsequently found that significant additional research should be undertaken, both in Maine and elsewhere, before externalities methodologies are specifically incorporated into Maine's existing least-cost planning process,[21] although the PUC believes it is not so much a matter of whether, but when and how, such a process will occur. In the interim, Congress passed the Clean Air Act amendments of 1990, which will require significant reductions in energy-related air emissions in the utility, transportation and industrial sectors. In many ways, Clean Air Act compliance efforts will require a new level of collaboration between energy and environmental planners and involve several issues that must be addressed on a regional basis.

Defining the appropriate range of externalities that should be included in energy planning is a difficult and subjective task. For example, prices paid for nuclear-generated power currently include an estimate for the cost of decommissioning and ultimate storage of high-level waste. However, it remains to be seen whether these internalized costs will prove to be sufficient, or whether other impacts of nuclear power should be monetized and added to the price of power from such plants. Proponents and opponents of nuclear power are likely to disagree strongly on this issue. Further complications arise from the fact that, while a wide range of potential environmental (and other) impacts can be measured or projected, these cannot always be translated into specific costs that can then be accurately compared with other quantifiable costs associated with energy planning. While it is possible simply to develop hypothetical costs, such an approach involves as much guesswork as science and may be no more useful than a set of purely subjective weighting factors.

It is also difficult to address externalities issues with respect to the environmental impacts of non-regulated energy. Maine has no least-cost planning framework applicable to heating and motor fuels. Thus, incorporating an adders-like approach to energy types other than electricity would mean adding a tax to the price of fuel designed to reflect the "hidden" costs or alleged cross-subsidies associated with those fuels. However, making energy more expensive does not guarantee reduced emissions or improved efficiency, since some consumers may be unable or unwilling to change their behavior or make responsive energy investments. Such an approach also raises a number of equity issues, since energy taxes are regressive, in that they burden low-income consumers disproportionately. Moreover, imposing higher costs on regulated energy prices, and failing to address the unregulated energy arena, could promote unwanted fuel

[21] Environmental and Economic Impacts, Maine Public Utilities Commission, May 1991 (Commissioner Harrington dissenting).

substitution, with a negative environmental impact, such as when consumers switch to oil in response to high electricity rates.

The focus of the debate is whether unaccounted-for environmental impacts are more appropriately addressed through environmental policy and environmental regulation, whether these impacts should be considered in the energy planning process itself (e.g., the least-cost planning and competitive bid process administered by the PUC), or whether some combination of both can be developed. The Commission recommends that Maine use this period of excess electric generating capacity to prioritize the State's energy-related environmental goals, analyze their associated risks, and study and develop appropriate mechanisms for ensuring that Maine's future energy mix includes the best possible balance of clean, low-cost and reliable resources, and recommends that this be achieved as soon as possible. Energy planning cannot go forward without recognizing that almost every energy strategy involves some degree of positive or negative environmental impact. Future energy strategies must, therefore, be as coordinated as possible with State and federal environmental policies and regulatory mandates.

Recommendation:

The Commission recognizes that it has not fulfilled the specific charge set forth in Sec. 4, Paragraph 2 of its implementing legislation with respect to examining environmental externalities for each energy option (See Appendix A). The Commission believes that Maine should incorporate unaccounted-for environmental costs directly into the public policy and regulatory processes that affect Maine's energy future, but is not able to endorse any specific method at this time. The Commission believes that further research into externalities is necessary and must take place within the context of the new federal compliance standards under the Clean Air Act. The Commission has found that fully examining the predicted cost, reliability and environmental impact of future energy choices is a highly complex task that is beyond its current resources and requires significant ongoing analysis.

The Commission, therefore, recommends that Maine establish a broad-based advisory group on Energy and the Environment to examine fully, in an ongoing manner, how to develop and implement mechanisms to incorporate environmental impacts that are not already internalized in the price of energy into the State's energy decision-making process. The Commission believes that such an advisory group should be multi-disciplinary in nature, and should include

representation from both the public and private sectors. The advisory group should be charged with:

- 1) Identifying State environmental policies and needs affecting energy policy;
- 2) Assessing the effectiveness of existing State and federal environmental laws and regulations in implementing those policies; and
- 3) Determining options for reconciling any discrepancies between policies and existing laws and regulations.

Options to be evaluated should include:

- a) Strategies for including externalities in energy decision-making processes;
- b) Changes to Maine environmental laws; and
- c) Emissions taxes and/or caps.

The Commission also believes that the advisory group should look at all types of energy use across all energy use sectors, so that well-balanced strategies can be developed that avoid unwanted cross-over effects that may occur when all energy resources are not looked at simultaneously.

Consistency, ongoing planning, and siting and local impacts

One of the most compelling issues raised during the public forums is the perceived need for a clear and concise state energy policy. However, there is little, if any, consensus on exactly what this policy should be. Maine's energy suppliers want energy policies that are consistent and do not distort the competitive posture of any one type of energy relative to others. Maine's businesses and industries are mainly concerned with prices and rate design, and want energy policies that, to the extent possible, enhance their ability to make long-term investment decisions and remain competitive. Opponents and supporters of specific energy proposals would like a policy that directly addresses their specific concerns.

Other consumers appear divided over whether energy policies should generally strive to keep energy prices as low as possible or whether Maine should be less concerned with direct costs than with promoting efficiency and alternative sources of energy. Some of the comments presented to the Commission stressed increased reliance on market forces, while others urged a greater degree of centralized planning that avoids setting energy policy on an ad hoc, case by case basis.

It is difficult to predict with any accuracy the future demand for any specific energy resource, since we cannot predict future oil prices, overall economic trends, technological advances, the impact of current and future regulatory mandates, or consumer preferences. Maine can, however, establish specific goals and policies that, taken together, lead us toward a balanced and flexible energy mix. To the greatest extent possible these should be consistent and well-understood by members of the industry and the public. In addition, various State agencies whose jurisdictions overlap with respect to certain energy issues should strive to maintain a continuing dialogue and, possibly, work to establish a formal mechanism for ensuring ongoing coordination and collaboration of expertise and effort.

Many members of the Commission support the consolidation into a single independent agency of the energy personnel that are now located in several agencies of State government (the State Planning Office and the Department of Economic and Community Development) in order to provide a permanent source of expertise to assist in future comprehensive energy plans. Other members of the Commission take strong exception to this recommendation because of current State funding problems and doubts about the wisdom of creating a new State agency.

Another aspect of consistency in energy planning arguably involves not how Maine meets its own energy needs, but how Maine views energy projects that would be located in Maine to produce energy for export. In some cases, siting power export projects in Maine may result in both an economic and environmental benefit to the State, especially if they displace less desirable resources elsewhere whose environmental impacts affect Maine anyway. In today's energy market, neither electricity nor its related pollution respects state or national boundaries, and electricity has become a fluidly-traded commodity bought and sold through power pools and short-term "spot" markets. In other cases, export projects may impose an unacceptable impact on Maine's environment. Current law views energy export projects in the same way as any other type of industrial development; all must meet or exceed Maine's existing environmental and siting standards.

Issues related to siting and local impacts also represent an area of significant controversy with respect to long-term energy planning. The Commission believes that the development of all energy facilities should include early and comprehensive public participation. The issue is likely to become more important throughout the 1990's, since it is becoming increasingly difficult to site and construct new energy projects that may be necessary to meet Maine's energy needs and

maintain the integrity of our energy delivery systems. Citizens appear to exhibit increasing concern over their perceived lack of any significant role in the planning process and strong concerns over the quality of the environment.

In recent years, local opposition to a number of projects has vastly increased the difficulty that electric utilities currently face in siting new power transmission lines, even though the lines may be necessary to meet growing demand or to maintain system reliability. Similarly, there is some concern that local opposition may delay or prevent the construction of a new natural gas pipeline into the State, or the development of wind energy projects in Maine, even though these projects may be important aspect of the State's broader energy goals. The primary issue is how to balance the legitimate needs of citizens who are affected by such projects with the State's ongoing responsibility to meet the needs of its citizens in the most responsible overall manner.

The Commission makes no recommendation in this area, but recognizes that resolving these issues are likely to represent a continuing challenge for the 1990's.

APPENDIX A

IMPLEMENTING LEGISLATION

JUL 30 '91

BY GOVERNOR

50

RESOLVES

STATE OF MAINE

IN THE YEAR OF OUR LORD
NINETEEN HUNDRED AND NINETY-ONE

S.P. 292 - L.D. 774

Resolve, to Establish the Commission on Comprehensive Energy Planning

Emergency preamble. Whereas, Acts and resolves of the Legislature do not become effective until 90 days after adjournment unless enacted as emergencies; and

Whereas, the State is faced with immediate and growing energy needs; and

Whereas, this resolve establishes a state commission to study comprehensive energy planning for the State; and

Whereas, the study must be initiated before the 90-day period expires in order that the study can be completed and a report submitted in time for submission to the next legislative session; and

Whereas, in the judgment of the Legislature, these facts create an emergency within the meaning of the Constitution of Maine and require the following legislation as immediately necessary for the preservation of the public peace, health and safety; now, therefore, be it

Sec. 1. Commission established. Resolved: That the Commission on Comprehensive Energy Planning is established; and be it further

Sec. 2. Commission membership. Resolved: That the commission consists of the following 16 members: 3 Senators, appointed by the President of the Senate; 3 members of the House of Representatives, appointed by the Speaker of the House of Representatives; 4 other legislative members appointed jointly by the President of the Senate and the Speaker of the House of Representatives; the Director of the State Planning Office, or

the director's designated representative; the Chair of the Public Utilities Commission, or the chair's designated representative; the Public Advocate, or the Public Advocate's designated representative; the Commissioner of Transportation, or the commissioner's designated representative; the Commissioner of Conservation, or the commissioner's designated representative; and the Commissioner of Environmental Protection or the commissioner's designated representative. At least 3 of the 10 legislative members must be members of the minority party. The commission shall, by a vote of 2/3 of all members, elect a chair, who must be a legislative member; and be it further

Sec. 3. Appointments; meetings. Resolved: That all appointments must be made no later than 30 days following the effective date of this resolve. The Executive Director of the Legislative Council must be notified by all appointing authorities once the selections have been made. The Chair of the Legislative Council shall call the first meeting of the commission no later than 30 days after the appointment of members; and be it further

Sec. 4. Duties. Resolved: That the commission shall develop a comprehensive energy plan for the State. The plan must include:

1. An assessment of the future demand for energy in the State under a variety of scenarios regarding energy prices and anticipated conservation and cogeneration measures;

2. A study of the various options available to the State to meet growing needs for energy and energy transmission, including, but not limited to, least-cost energy planning, conservation, energy efficiency, cogeneration, small power production, purchases from Canada and utility-sponsored generation. This study should examine predicted cost, reliability, environmental impact within the State and environmental costs, otherwise known as externalities, for each option;

3. An analysis of the State's energy situation in the context of regional power arrangements and agreements; and

4. Recommendations to the Governor and to the Legislature based on the findings of the commission including a recommendation for instituting a process whereby the State may update and evaluate in an ongoing manner its comprehensive energy planning; and be it further

Sec. 5. Process. Resolved: That, in conducting the study, the commission may:

1. Hold several public hearings, at least 3 of which must be held outside the State House complex in locations geographically distributed throughout the State;

2. Create subcommittees or advisory groups as the committee considers appropriate;

3. Request assistance from any individual, agency, organization or other entity as the committee considers appropriate; and

4. Adopt by 2/3 vote of all members, procedures for conducting the commission's business; and be it further

Sec. 6. Staff assistance. Resolved: That the State Planning Office shall staff the commission. The commission may request additional staff assistance from state agencies as the commission considers appropriate. The commission shall request assistance with the preparation of any recommended legislation from the Legislative Council; and be it further

Sec. 7. Reimbursement. Resolved: That the members of the commission who are Legislators are entitled to receive the legislative per diem, as defined in the Maine Revised Statutes, Title 3, section 2, for each day's attendance at commission hearings; and be it further

Sec. 8. Report. Resolved: That the commission shall submit its report, which must be approved by 2/3 of the commission members, together with any necessary implementing legislation, to the Second Regular Session of the 115th Legislature and to the Joint Standing Committee on Utilities no later than November 1, 1991.

Emergency clause. In view of the emergency cited in the preamble, this resolve takes effect when approved.

APPENDIX B

COMMISSION MEMBERSHIP

Commission on Comprehensive Energy Planning

Chapter 50, Resolves of 1991

Membership

Legislative Members

Senator David L. Carpenter
14 Belaire Drive
Springvale, Maine 04083
324-4665

Senator John J. Cleveland (Chair)
183 Davis Avenue
Auburn, Maine 04210
777-1375

Senator Margaret G. Ludwig
3 Rogers Road
Houlton, Maine 04730
532-2715

Senator Bonnie L. Titcomb (Vice Chair)
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655-7647

Senator Harry L. Vose
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Meddybemps, Maine 04657
454-2641

Representative James Reed Coles
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Representative Maria Glen Holt
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443-3588

Representative Carol A. Kontos
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Representative Michael H. Michaud
111 Main Street
East Millinocket, Maine 04430
746-9069

Representative Hugh A. Morrison
18 Plaisted Street
Bangor, Maine 04401
942-4137

Executive Branch Members	*Agency Designees*
C. Edwin Meadows, Commissioner Department of Conservation State House Station 22 Augusta, Maine 04333 289-2211	David Mercier Resource Administrator LURC 289-2631
Kenneth Gordon, Chair Public Utilities Commission State House Station 18 Augusta, Maine 04333 289-3831	Tom Austin Director, Financial Analysis
Dana Connors, Commissioner Department of Transportation State House Station 16 Augusta, Maine 04333 289-2551	Jane Lincoln Deputy Commissioner
Stephen G. Ward Public Advocate State House Station 112 Augusta, Maine 04333 289-2445	Bill Perkins Counsel
Dean Marriot, Commissioner Department of Enivronmental Protection State House Station 17 Augusta, Maine 04333 289-2811	Dennis Keschl Director Bureau of Air Quality Control 289-2437
Richard Silkman, Director State Planning Office State House Station 38 Augusta, Maine 04333 289-3261	John Flumerfelt Director, Energy Policy and Planning 624-6012

APPENDIX C

MINUTES OF PUBLIC HEARINGS

COMMISSION ON COMPREHENSIVE ENERGY PLANNING

Chapter 50, Resolve of 1991

MINUTES of Public Hearings

October 3, 1991

The Commission on Comprehensive Energy Planning held its first public forum on October 3, 1991 in Room 113 of the State Office Building. The meeting was attended by Sen. John Cleveland, Sen. Bonnie Titcomb, Sen. David Carpenter, Sen. Harry Vose, Rep. Maria Holt, Rep. Reed Coles, Rep. Hugh Morrison, Rep. Carol Kontos, Steve Ward, Public Advocate, Ken Gordon, Chairman, Public Utilities Commission, David Mercier, Dept. of Conservation, Dennis Keschl, Department of Environmental Protection, Jane Lincoln, Department of Transporation, and John Flumerfelt, State Planning Office. Sen. Margaret Ludwig and Rep. Michael Michaud were not present for the meeting.

The morning session was devoted to two presentations: one by John Flumerfelt and the other by Commissioner Gordon and Tom Austin of the Public Utilities Commission (PUC). Mr. Flumerfelt delivered a presentation on Maine's current energy picture. A copy of the slides used during the presentation were distributed to the Commission.

PUC Commissioner Ken Gordon and Tom Austin, the PUC's Director of Financial Analysis, explained the PUC role in implementing energy policy in Maine. The presentation provided an overview of various factors the PUC has to consider in issuing certificates and determining rates, and focussed on the development of the least-cost planning process in Maine and the importance of developing an ongoing planning process, rather than any specific plan, to meet the State's future electric and gas energy needs.

The afternoon session began with the testimony of Dr. Edward Rendall of Blue Hill. Dr. Rendall emphasized the need to stress conservation and renewable energy, such as hydro and solar, in the State's energy policy. Dr. Rendall opposed the idea of nuclear power and burning fossil fuel to meet the future energy needs of people in Maine. A copy of his remarks were distributed and made part of the Commission's record.

Mr. Stephen Brooke of Farmingdale presented testimony in opposition to hydropower and the proposed expansion of the Edwards Dam on the Kennebec River. He cited the "enormous cost" to the environment of blocking the Kennebec River with this dam.

A panel of 6 energy "experts" were then invited to provide their comments to the Commission. Copies of the panelists' written remarks were distributed to the Commission and made part of the official record. The following provides a brief summary of their oral statements.

Mr. Curley of Northern Utilities Natural Gas spoke in favor of obtaining increased natural gas supplies into Maine. Mr. Curley urged the Commission to encourage the use of natural gas due to its inherent economic and environmental benefits.

Mr. Arthur Adelberg of CMP provided three specific recommendations for the Commission to consider. He urged that the Energy Plan: ensure consistent policy by addressing all energy sources, whether regulated or unregulated; exploit energy surpluses by authorizing specially priced or developmental

rates for new or expanding businesses; and review and examine current policy and fine-tune it before new energy initiatives are considered.

Mr. David Bristol of Hydra-Co Enterprises focussed on the benefits of independent power production in Maine's energy mix. He stated that non-utility power producers have invested over $1 billion in renewable energy projects in Maine and that they insulate electric utility ratepayers from the risks associated with such projects.

Ms. Beth Nagusky of the Natural Resources Council of Maine stressed that Maine is at a "point of crisis" with respect to overall energy issues. She urged the Commission to maintain a broad range view of energy policy that focusses on transportation energy use as well as issues affecting utility projects. She stated that ground-level ozone and global warming are Maine's two most pressing environmental concerns.

Mr. Richard Esteves of SESCO emphasized the role of conservation in meeting increasing energy demand because it is environmentally desirable and economically beneficial to local economies. He stressed that conservation is cost-effective irrespective of the need for new power, but that the utilities' current "monopoly control" over the procurement of conservation services presents a major market barrier to companies such as his.

Mr. Glenn Poole of the Industrial Energy Consumer Group (IECG) outlined 6 principles and policies the Commission should consider when making its recommendations. He stated that primary principles of Maine's energy policy should be to: 1) emphasize flexibility; 2) encourage competition; 3) establish pricing mechanisms that encourage efficient consumption decisions; 4) conserve existing resources; 5) allow free markets in energy to prosper; and 6) maintain an energy policy that is consistent.

After the panel discussion was over, the Chair invited further comments from the audience.

Ms. Pamela Person of East Orland spoke in opposition to the proposed coal plant at Bucksport and stressed the need for an energy plan that would restrict the development of unwanted energy projects in Maine. She suggested a 25 member task force made up of industry, consumer, environmental, health, utilities and fuel suppliers to conduct a complete conservation campaign, study new energy technologies, and externalities laws in other states. Ms. Person's written statement was distributed to the Commission and made part of the official record.

Dr. Richard Komp, of the Maine Solar Energy Association, discussed the use of solar power as an alternative and cleaner source of energy. Dr. Comp pointed out that solar devices are currently subject to Maine sales tax while heating oil and other fuels are not.

Mr. Robert Dunning, of Bridgton, identified four goals the Commission should keep in mind while making its recommendations. He stated that energy policy should: result in low customer bills; ensure stable supplies of energy; ensure the availability of a variety of choices to the customers; and should be environmentally benign.

The meeting adjourned at approximately 5:30 p.m.

October 15-16, 1991

The Commission on Comprehensive Energy Planning held regional public forums in Houlton and Bangor on October 15 and 16, respectively. The October 15 meeting was held at the Unitarian Church

in Houlton. The meeting was attended by Sen. Bonnie Titcomb, Sen. Margaret Ludwig, Rep. Maria Glen Holt, Rep. Hugh Morrison, Rep. James R. Coles, Rep. Carol Kontos, Steve Ward, Public Advocate, Jane Lincoln, DOT, Dennis Keschl, DEP, David Mercier, DOC, and John Flumertelt, SPO. Sen. Cleveland, Sen. Carpenter, Sen. Vose, and Rep. Michaud were unable to attend the meeting.

Both meetings were chaired by Sen. Titcomb in Sen. Cleveland's absence. Each meeting focussed on hearing comments on energy policy from members of the public. Written comments were received as noted below.

Oral testimony was provided by the following individuals in Houlton: Mr. Lewis Wirtsa, Mrs. Marilyn Roper, Mr. Lewis Snell, Mr. Torr Smith, Mr. Lee Harmon, Mr. Dennis Daniels, Mr. Paul Underwood, Mr. David Deitrick, Mr. William Ruliffson, and Mr. Mel Hovey. Mr. Hovey presented prepared remarks on behalf of Maine Public Service.

Many participants at the Houlton forum emphasized the importance of energy conservation and the use of alternative sources of energy in meeting the energy needs of consumers -- as well as the value of energy education. Other common themes are summarized below.

-- Several participants suggested that the State should provide low-interest loans to consumers to help fund investments in energy efficiency and alternative forms of energy, such as solar.

-- It was also suggested that Maine up-grade its current energy efficiency standards for buildings and appliances, and that such standards be made mandatory.

-- Solar energy was a common theme of the forum. Several participants suggested that solar energy and other renewables, such as wind and tidal, should be encouraged through tax policy and State-sponsored R&D and demonstration projects.

-- Two people criticized the development of the biomass energy industry in Maine and suggested that it represents an inappropriate use of Maine's forest resource (although Mr. Mike Robinson, of Sherman Lumber, suggested during the Commission's field trip to his cogeneration facility that biomass energy development was having a positive effect on Maine's forest).

-- Support was also expressed for State efforts designed to increase transportation energy efficiency through investments in public transportation and initiatives to increase the efficiency of Maine's vehicle fleet.

-- Several participants expressed anti-nuclear sentiment, although Mr. Hovey from Maine Public Service spoke in favor of nuclear energy.

-- Opposition was expressed toward President Bush's National Energy Strategy and specifically toward oil exploration in the Alaska National Wildlife Refuge.

-- Many of those present expressed a willingness to pay higher prices for energy in return for environmental or social benefits. One person, however, a self-described "average consumer," indicated that his personal energy decisions were based on what was most cost-effective, rather than perceived social or environmental benefits.

Mr. Hovey read from prepared remarks and submitted a written statement for the record. He suggested that the State currently has no clear energy policy and that clear guidelines are required for issues such as hydro relicensing, the utilities' role in promoting conservation, and what types of energy resources should be used to meet Maine's future energy needs. In his view hydro and nuclear energy are the

most desirable since they pose the least environmental risk and can help the State reduce its dependence on oil. He opposes using utility rates to subsidize the energy needs of low-income citizens and suggested instead that this should be done by the State in the form of energy subsidies funded by tax dollars. Mr. Hovey also expressed support for efforts designed to internalize environmental costs associated with energy production and use, but stressed that all types of energy, not just that which is regulated, must be included in any such program.

The October 16 forum was held at Jeff's Catering in Bangor. The meeting was attended by Sen. Bonnie Titcomb, Rep. Maria Glen Holt, Rep. Hugh Morrison, Rep. Michael Michaud, Steve Ward, Jane Lincoln, Dennis Keschl, David Mercier, and John Flumerfelt, SPO. Sen. John Cleveland, Sen. David Carpenter, Sen. Harry Vose, Sen. Margaret Ludwig, Rep. Carol Kontos, and Rep. James R. Coles were not present for the meeting.

Dr. Steve Ballard, Director of the University of Maine's Margaret Chase Smith Center for Public Policy, made a presentation on the activities of the Center and its role in helping to promote a non-confrontational policy forum for energy and other regulatory issues. A written copy of the presentation was submitted for the record. Dr. Ballard noted that developing energy policy requires a multi-disciplinary effort since such issues are germane to the jurisdictions of a variety of State agencies and cut across a broad spectrum of political constituencies. He indicated that any new energy policy will need to look at all options, engage in creative problem-solving, recognize continuing opportunities for improved energy efficiency, support integrated energy planning, look at both short and long-term planning, address energy emergency preparedness, and address R&D needs. Dr. Ballard said that a State energy policy should also be framed with an understanding of its national context and that it should recognize the economic impacts of energy policy decisions.

Professor Dick Hill from the University of Maine also addressed the Commission and provided written comments for the record. His main points were that oil prices and world oil supply are the underlying factors driving current energy use trends, and that the U.S. will continue to rely more heavily on electricity as a percentage of total energy use in the future. He noted that, while alternative sources of energy should be pursued, many such alternatives pose their own problems. He specifically noted the toxicity of the chemicals used in solar photo-voltaic panels. Professor Hill also suggested that energy policy address modern land use policies that encourage communities to "spread out," leaving consumers ever more dependent on cars. He indicated that nuclear energy continues to be one of the best source of energy to meet the demand.

Mr. Jesse Rose, Mr. Tom Gocze and Mr. Jared Crawford spoke in favor of solar energy. Mr. Gocze also suggested that Maine needs stronger energy-related building standards.

Mr. William Butler spoke on behalf of Friends of Maine Woods in opposition to biomass-fired energy plants. He claimed that the demand placed on the forest by these plants is having a negative impact on the Maine woods.

Rep. Catharine Lebowitz of Bangor spoke in favor of hydro and nuclear power, and also stated that the forest should not be used for producing energy. She also said that Maine should not buy energy from Canada, and that she did not think that solar power is feasible. She supported improved energy efficiency standards and energy education, and urged that the State do more to encourage small hydro projects.

Mr. Robert Briggs, President of Bangor Hydro-Electric Company, presented prepared remarks and provided a written statement for the record. He stated that Maine has lost its competitive electric rate advantage relative to New England, largely due to the costs of non-utility power purchases and utility-sponsored conservation programs. He asserted that PUC policies force utilities to promote a social

agenda that is not in the best economic interests of utility ratepayers (specifically, "lifeline" electric rates for low-income consumers and non cost-effective DSM programs), and that allowing increased sales of electricity would help reduce rates. Mr. Briggs suggested that State energy policy should continue to promote cost-effective investments in conservation and energy efficiency with respect to all forms of energy, but in a manner that does not discriminate against any one type of energy. He also stated that Maine should encourage the use of electricity where it would result in economic and environmental benefits, but that the State should avoid using utility regulation to implement social policies.

Mr. Avery Caldwell stressed that the State should perform a comprehensive energy forecast and emphasized the need for better marketing of conservation programs.

Mr. Harvey Lorber suggested that a citizens' group be formed that would conduct surveys to determine the energy needs of the people of Maine and develop an energy proposal for the Commission. He also emphasized the need for energy-efficient housing for low-income citizens.

Mr. Steve Linnell, an employee of Bangor Hydro-Electric speaking on his own behalf, said that energy policy should be driven by market forces, and that the costs of energy conservation should not be funded through utility rates, but should be subsidized through taxes. He stated that current policies encourage consumers to choose oil over electricity due to the rate impacts of utility-sponsored conservation programs.

In addition to the public forums, the Commission visited two energy facilities in northern Maine: the waste-wood powered Wheelabrator-Sherman cogeneration facility and the Bangor Hydro-electric hydro facility located at West Enfield. Several members of the Commission also visited the home of Marilyn and Harry Roper in Houlton to view their residential solar electric system.

November 6, 1991

The Commission on Comprehensive Energy Planning held its 4th meeting to receive public comments on November 6, 1991 at Michel's Restaurant in Portland. The meeting was attended by Sen. John Cleveland, Sen. Bonnie Titcomb, Sen. David Carpenter, Rep. Maria Glen Holt, Rep. Hugh Morrison, Rep. James Reed Coles, Rep. Carol Kontos, Steve Ward, Public Advocate, Gideon Pichet, DOT, Dennis Keschl, DEP, David Mercier, DOC, and John Flumerfelt, SPO. Sen. Margaret Ludwig, Sen. Harry Vose, and Rep. Michael Michaud were not present for the meeting.

The Commission held two sessions, from 3:00 P.M. to 5:30 P.M., and 7:00 P.M. to 10:30 P.M. The Commission Chairperson Sen. John Cleveland opened the meeting and invited members of the public to present written and oral comments on energy related issues.

Direct comments were provided by those listed below. In addition, the following individuals and groups mailed or handed in their comments: The Propane Association of Maine, the Maine Highway Users Conference, the Maine Petroleum Association, Angelo Kaltsos, Coordinator, No Thank-Q Hydro-Quebec, and the Green Party of Hancock County.

As in previous hearings, many participants emphasized the need for energy conservation and the use of alternative sources of energy to meet the energy needs of the citizens of Maine. However, many others raised issues concerning the role of biomass energy, the role of the market forces in determining the types of energy sources and conservation programs best suited for Maine, the need for better energy planning on the part of the State, and the issue of energy production on a commercial basis for export purposes. The following is a summary of the comments by the participants.

Jane Hartwell of Alternative Energy, Inc., explained the role of wood biomass in the energy mix of Maine and the environmental and economic advantages of wood-fired power plants. She focused on the viability of commercial scale energy production using Maine's forest resource. Ms. Hartwell provided a video tape describing wood-fired power production.

David Hall of Bath focused on three issues in his remarks: space heating, transportation, and electricity. He advocated the need for energy efficient buildings through retrofitting, and enhanced standards for new building construction which could be financed through a fuel tax. He emphasized the need for public transportation, particularly a train service between Portland and Boston, and recommended that the Maine Turnpike Authority should provide financing to refurbish the train tracks from Wells to the New Hampshire border. He suggested that alternative fuel vehicles should be encouraged in Maine. Mr. Hall recommended that electricity production through small scale power generators should be encouraged. This would help reduce imports of energy from outside the state and decrease Maine's dependence on imported oil. Mr. Hall recommended against the use of nuclear power.

Elizabeth King from Woolwich focused on energy conservation and a more efficient use of energy resources for which technology is currently available. She also emphasized the need to meet the increase in energy demand through conservation.

Clinton Townsend from Skowhegan proposed that the State should: establish a state policy for the improvement of energy efficiency and conservation in Maine; compare the current plans with the previous plans to find out if the goals are being achieved; establish an energy office to undertake energy planning on a continuing basis; start a sustained education outreach program to educate public on energy issues; plan for alternative sources of funding to finance programs currently funded through the oil overcharge monies; lobby Congress and the federal administration to obtain funds for low-income energy assistance and for weatherization; assist Maine businesses and private homes to conserve energy in cooperation with the Public Utilities Commission (PUC); adopt least-cost planning that includes environmental and human health costs; make state buildings energy efficient; upgrade Maine's energy efficiency standards for major appliances and establish higher efficiency standards for new buildings; and plan and promote public transportation.

Deborah Leighton of the Center for Vision & Policy recommended that the new energy policy should consider environmental safety, renewability of energy resources, and affordability of energy to all. It should also encourage new energy technology, energy efficiency and conservation, and the development of alternative sources of energy.

Tim Zorach of the Maine Audubon Society proposed the new energy plan should: promote efficiency to meet the growing demand for energy; require the utilities to implement conservation programs before new power generation is allowed; promote renewable resources of energy before fossil fuel; minimize environmental impacts of energy production; and ensure affordability for all energy use sectors. Mr. Zorach recommended a gas guzzler tax to encourage fuel-efficient vehicles and stressed the need for public transportation in Maine.

Peter Chamberlain of AIRCO expressed concerns regarding higher energy prices in Maine in the last few years and discussed the issue of the competitiveness of energy prices in Maine vis-a-vis other states. Mr. Chamberlain expressed the need for reduced electric rates for large electric users such as AIRCO and suggested that non-utility power contracts be a matter of regulatory approval and public record.

Norman Anderson and Paul Best of the Maine Lung Association advocated the need for a coordinated energy and transportation policy. Particular emphasis was given to the air pollution caused by the transportation sector and the air quality standards needed to protect public health.

Harley Lee of Endless Energy Corporation made a presentation with a slide show on the viability of wind energy as demonstrated in California and other places. Mr. Lee emphasized the prospects of wind energy becoming competitive with the traditional sources of energy and advocated that the State should encourage wind energy development in Maine.

Elizabeth Swain, a Commissioner with Land Use Regulation Commission, advocated that the energy policy should not be made on a case by case basis. She felt that state regulatory bodies such as LURC, BEP and PUC are making decisions in a piecemeal fashion, and stressed that a comprehensive energy policy is needed to guide such regulatory agencies in their decision-making. Ms. Swain expressed the concept of "repowering" New England by encouraging the replacement of dirtier old power with renewable sources of energy which are environmentally clean. She recommended reliance on biomass and natural gas, and the development of hydro power and wind energy as better alternatives to fossil-fuel energy. In closing, Commissioner Swain recommended that energy produced through clean sources can and should be exported to boost Maine's economy and help reduce electric rates for the consumers in the state.

Chris Hyde of the Maine Energy Coalition explained the goals and objectives of the Coalition as follows: reduce Maine's dependence on hydrocarbon energy and imported oil; reduce pollution; conserve energy while maintaining the living standard of the people of Maine; help develop new energy technologies; and restore American pre-eminence in energy technology.

Chris Hall of the Maine Chamber of Commerce and Industry emphasized the need for affordable energy as the most important factor which should be considered in the energy plan, although he stressed that an energy policy should not just be one that only encourages the lowest prices. He advocated a market driven approach to select sources of energy instead of government regulations. Mr. Hall proposed that to make effective use of the energy surplus in the State, special "economic development rates" should be allowed for new and expanding businesses to spur economic development. Mr. Hall advocated the continued use of hydro power as a clean and relatively cheap energy source for Maine.

Bob Moldaver of the Maine Nuclear Referendum Committee advocated energy efficiency and conservation as a way to meet the growing demand for energy. Mr. Moldaver noted that the nuclear energy is not a good option because of the problems involved with the disposal of nuclear waste and other safety issues. He stressed that the Commission should consider in the energy plan the "true costs" of energy being currently supplied in the State. Mr. Moldaver presented for the record two copies of a book titled Energy, Jobs and the Economy.

Bert Hansen of BIW, stressed that energy conservation, public transportation and affordable energy for common consumers as well as the industry are good goals for the energy plan. He felt that cheaper electric rates for industry will provide incentives for them to conserve energy.
John Devine, an energy engineer, focused on the need for reliable, affordable and stable energy supplies for business and industry as important elements for maintaining quality of life in Maine. He advocated the need for a regional approach to handle energy issues. He suggested that PUC's policies regarding energy utility-sponsored conservation programs have resulted in higher electric rates for consumers, particularly the middle class. Mr. Devine suggested that an overhaul of PUC policies is needed to correct this situation. He stressed that renewable resources such as hydro power should be employed to provide cleaner energy.

Mr. Robert Beane, a retired firefighter from Portland, stressed the need for cleaner sources of energy such as solar power. He opposed the use of nuclear power and biomass in Maine.

Dorothy Albert of the Maine Sierra Club focussed on issues related to energy conservation and long-term planning for the future energy needs of the State, and also supported solar and wind alternatives.

Pamela Prodan from Wilton advocated the need for efficient use of existing energy resources, development of renewable energy, and the inclusion of the total costs of producing energy. She discussed the strategy of sustainable development as a prudent way of meeting the current needs of people without jeopardizing the resources needed for future generations. Ms. Prodan stressed the need for regulations because the current economic environment is not based on the principle of sustainability.

Dave Johnson from Phippsburg stressed the need to change peoples' attitudes about energy conservation. Mr. Johnson noted that most people can save both energy and money by making more informed decisions at the time of building a home. He stressed the need to make energy conservation socially acceptable through educational programs. Mr. Johnson suggested that cooperation and resources should be sought from the banking industry to make resources available for energy conservation.

Erik Olson from Portland commented on the use of alternative sources of energy and the dangers of the State's dependence on oil. He mentioned the need for better consumer information on various sources of energy.

Rep. Conrad Heeschen, commented on previous legislative efforts to address different energy related issues. He noted that the current transportation policy based on low-density development is a drain on the energy resources. More than one mode of transportation should be available to people. He suggested that the Commission should revisit the issue of externalities. Rep. Heeschen favored the use of alternative sources of energy such as cogeneration, solar, wind and micro-cogeneration. He stressed the need for resurrecting the Energy Office to coordinate the planning and implementation of energy programs, and urged the adoption of higher building energy efficiency standards in Maine, possibly based on climate zones. He also stressed that energy planning must be an ongoing process.

Peter Merrill of the Maine Oil Dealers Association (MODA) discussed safety issues related to natural gas, opposed the application of environmental externalities, and urged that Maine work toward maintaining competition in energy markets. He also indicated support for energy conservation and proposed that tax incentives for efficiency investments be restored.

March 24, 1992

The Commission on Comprehensive Energy Planning held its 5th and last public hearing to receive public comments on the Draft Report issued on March 24, 1992. The meeting was held on April 7, 1992 in room 113 of the State Office Building in Augusta. The meeting was attended by Sen. John Cleveland, Rep Carol Kontos, Rep. Hugh Morrison, Jane Lincoln, DOT, Steve Ward, Public Advocate, Ken Gordon, Commissioner PUC, Dennis Keschl, DEP, and John Flumerfelt, SPO.

The Commission held two sessions, from 3:00 P.M. to 5:00 P.M., and 7:00 P.M. to 9:00 P.M. The Commission Chairperson Sen. John Cleveland opened the meeting and invited members of the public to present written and oral comments on the Draft Report.

Direct comments were provided by those listed below. In addition, the following individuals and groups mailed in their comments: M. David Lauter, M.D. from New York, Eugene A. Guilford Jr., President, Maine Oil Dealers Association, Josephine G. Whetstone, David Garrity, Norm Anderson, Director, American Lung Association of Maine, Lee McKin Buffinton, J. Peter Monro, Prof. Richard Hill, Bill

Sneed, Wil Laffe, Frederick J. Munster Jr., Maine Chamber of Commerce and Industry, American Wind Energy Association, Alternative Energy, Inc., Maine Audubon Society, Morris Hancock, Angelo J. Kaltsos, Coordinator, No Thank Q Hydro Quebec, Sandra M. Dickson, Harley Lee, President, Endless Energy Corporation, The Eva Hoyt Zippel School, Deborah Leighton of the Center for Vision and Policy, Maine Public Service Company, Eastern Regional Council/Council of State Governments (ERC/CSG).

Major issues:

A significant number of those who commented praised the balance and breadth of the draft report. The Natural Resources Council provided the most critical testimony and suggested that the report failed to fulfill the Commission's legislative mandate. Other parties, as noted below, offered a variety of general comments and specific suggestions. Several parties requested clarification on specific issues. Common themes of the presentations are summarized below.

1- A large number of participants and those who mailed in their comments urged that a State Energy Office be reinstated to undertake ongoing research on various issues relating to energy and to assist the Legislature in developing new guidelines for long-term energy planning.

2- Many praised the commitment of the Commission to provide better energy education in K-12 students and urged the Commission to broaden the scope of such education. However, NRCM emphasized the need for providing additional information to students about those sources of energy which are more dangerous to the environment than others.

3- Most participants supported the idea of increased availability of natural gas. Some participants advocated that compliance with building codes should be strengthened. It was also recommended that the real estate industry be required to provide information regarding energy consumption to home buyers.

4- A large number of participants and those who provided their comments by mail recommended more emphasis on alternative sources of energy such as solar and wind power.
5- The utility industry representatives supported the Draft Report in general. However, one objection by the utility industry was the emphasis the Report placed on the continuation of the current conservation policy adopted by the State. The utility representatives felt that such conservation programs are partly responsible for the increase in the rates and the utilities should be allowed to buy energy from the cheapest sources available in order to bring the rates down. They pointed out that conservation has a cost and it should be clearly stated so that the policy makers as well as the general public can understand it.

6- The issue of externalities was raised by many participants as well as those who mailed in their comments. Most comments regarding externalities dealt with the issue of including all real costs as part of the decision-making process.

7- Finally, several participants recommended that either this Commission should be made a permanent body or an advisory body be constituted to undertake planning and development of new energy policies for the State.

The following is a summary of the written comments provided to the Commission in the meeting as well as comments received by the State Planning Office on the Draft Report on the Comprehensive Energy Planning.

The "Coalition for Sensible Energy" presented 17 policy recommendations which are summarized as follows: Reinstate the State Energy Office and establish a permanent 30 member Energy and

Environmental Taskforce, reduce the use of coal and oil by 50% by 2030 and carbon dioxide emissions by 25% by 2005, actively seek natural gas for Maine, meet 20% of Maine's energy needs through wind and solar energy by 2010, reduce energy intensity by 50% in 40 years through conservation and efficiency, include externality costs in the energy decision-making process, develop policies to reduce solid waste through recycling, work with regional, national and international bodies to reduce global warming and ozone depletion, ensure the viability of Maine's natural resources, develop policies to reduce hazards in energy production, use and disposal, develop policies to improve air and water quality, encourage energy policies that create more jobs for Mainers and retain the current jobs, and, encourage job training for new energy related technologies and industry. Members of the Coalition for Sensible Energy who provided oral and written comments included Pam Person, Dr. Ned Rendall, M.D., Dr. Phil Person, Dr. Frank Eggert, Robert Phipps, Greg Whitehead. Written comments of Victor Grob were handed in although he did not make an oral presentation.

Dan Thayer, an engineer from Auburn recommended that ASHRAE 90.1 building and design standards which are currently a part of the Code should be vigorously implemented. New legislation is needed for better compliance with these rules by the building industry. Mr. Thayer noted that a market-driven approach is needed to accomplish the goal of energy conservation and recommended a carbon tax to address the issue of externalities. He recommended that the utilities should be required to buy energy management services from private vendors if these services are cheaper.

Arthur Adelberg from CMP recommended various changes to the Draft Report which are summarized below: Energy efficiency should be the cornerstone of the energy policy in Maine but affordable rates should go hand in hand with such a policy, the existing State policies are driving the rates up, the current State policy called "least cost planning" penalizes customers who use energy efficiently and encourages customers to use other fuels which may be more environmentally harmful, and, the State energy policy should encourage energy efficiency in ways that do not make electricity unaffordable.

Cheryl Harrington recommended that more information and data are needed in order to determine the level of biomass production Maine's forests will sustain, to develop State policy regarding export of energy produced in Maine, and to consider whether coal plants should be built in Maine. She recommended that the State Energy Office be reinstated in order to conduct thorough research on various issues related to energy export, end uses of energy and costs, State sponsored conservation programs, increased use of natural gas, etc. Ms. Harrington noted that more work needs to be done on the issue of externalities. She commented that the policy decisions of the late 1980's which led to recent increases in electricity rates were prudent. Although these decisions resulted in higher rates, the State should, according to Ms. Harrington, witness stable energy rates in the future. Ms. Harrington recommended that the economic development rates should be approached carefully because the public perception about lower rates for the industry may not be very positive.

Jack Biscoe gave a slide presentation on the impact of the Exxon Valdez oil spill in Alaska and impressed upon the Commission to consider carefully the consequences of such an oil spill in Maine. Mr. Biscoe recommended that Maine should cut its oil consumption by 50% in 40 years.

Beth Nagusky of the Natural Resources Council of Maine provided recommendations as follows: Restore those sections of the Draft Report suggested earlier by Sen. Titcomb, Rep. Holt and Rep. Kontos that included specific actions to achieve a cleaner and lower cost energy mix, create a sub-group charged with drafting relevant energy related legislation, reestablish the State Energy Office to be housed in the Department of Environmental Protection. She recommended that the Energy Plan should aim at reducing total energy consumption by 50% in 40 years, oil use by 50% in 40 years, carbon dioxide emissions by 25% by 2005, and 50% in 40 years. Ms. Nagusky recommended that the true cost of energy should be reflected in its price, that the Commission should clarify the phrase "objective

and unbiased" energy information to be provided to students in K-12, and, that the Commission should not treat all energy sources equally since some energy sources are more polluting and harmful than the others.

Robert Briggs, President, Bangor Hydro-Electric Company, recommended that the Commission should clarify the principle of "leveling the playing field" by stating that the amount a utility should pay for demand-side alternatives should be limited to an amount equal to the difference between the utility's current average rates and its avoided costs. Mr. Briggs recommended that the utilities should be allowed to buy power from sources that have lowest rates thus lowering the rates customers have to pay. He supported increased natural gas availability in the State, but recommended that gas not be pursued at the expense of increased utilization of Maine's electric capacity. Finally, Mr. Briggs recommended that the Report, in its current form, leaves an impression that disproportionally more resources are spent to obtain electricity as compared to its benefits. This impression should be corrected.

Dianne McAnn Thomas, Patricia Warren, and Ernest Kozun Jr. of the Maine Energy Education Project (MEEP) appreciated the Commission for its recognition of energy education for school children. They noted that much more needs to be done in making students aware of the various issues involved in the energy area. They recommended that energy education should be expanded to school teachers as well and that more funding should be provided for these programs.

Avery Caldwell recommended that the banks and the real estate industry should be required to provide detailed information regarding home energy consumption to prospective home buyers so that they can make informed decisions when buying homes. He emphasized the need for a energy rating system for all buildings. Finally, Mr. Caldwell said that the Commission should make recommendations regarding siting of new projects, transmission lines and other energy projects.

Representative Conrad Heeschen recommended that the Energy Office should be reinstated. He stated that sustainability of resources is a major and crucial issue and should be one of the main goals of the Plan. He said that alternative power technologies such as solar and wind should be taught in schools and colleges and an infrastructure should be built so that services are readily available for installation and repair of such alternative energy equipment. Finally, Rep. Heeschen recommended that the aim should be to make the whole transportation system energy efficient and not just some components of it.

The following is a summary of comments of the individuals and organizations who responded by mail.

David Lauter, M.D., recommended that the Report should set goals to reduce total energy use by 50% in 40 years, to reduce oil use by 50% over 40 years, to reduce CO2 emissions by 25% over 15 years and 50% by the year 2030. Dr. Lauter also recommended that the State Energy Office be reinstated.

The Maine Oil Dealers Association (MODA) objected strongly to the Commission's support for an increase in the availability of natural gas without conducting any analysis regarding the reliability of gas supply, the risks involved and the pollution caused by the use of natural gas. MODA recommended that all energy sources should be treated equally and no recommendation be made as to which one is better than the others.

Josephine G. Whetstone indicated her concerns about the cost of energy to consumers especially those who have installed energy saving devices but still end up paying more due to rate hikes. She recommended that the State Energy Office should be reinstated.

David J. Garrity recommended that: The least-cost policy should include all costs such as defence costs to ensure free flow of oil from the Middle East, all environmental costs should be included in the kind of energy the State would like the people in Maine to use, it should be encouraged as a state policy to use electricity generated through alternative sources such as hydro, wind, solar and thermal power, the PUC should review more rigorously the costly proposals by the utility companies to purchase energy in order to avoid rate hikes for the customers, and, provide incentives for electric thermal storage heat.

Norman Anderson of the American Lung Association of Maine recommended that while striving to ensure a balance between the goals of achieving public health protection, environmental protection, and the maintenance of reliable and low-cost energy, the Energy Plan should set priorities regarding which of these goals will take precedence over others. Regarding energy efficiency in building design, he recommended that the Plan should consider in its educational and regulatory strategies the need for adequate ventilation.

Lee McKim Buffinton recommended that conserving energy and reducing fossil fuel emissions should be central to the Energy Plan. This would lead to better health and enhanced environmental and economic benefits for Maine.

J. Peter Monro recommended that bicycle and pedestrian trails should be included as an element of the new transportation policy to reduce dependence on oil and to encourage alternative means of transportation.

Prof. Richard Hill recommended that economic incentives should be provided for cluster housing and stand-alone housing should be discouraged. He also recommend that the people should be made aware of the fact that solar and wind power will play only a limited role due to their limited productivity. Regarding biomass, Prof. Hill thought that it is a choice between the use of nuclear energy and the resulting nuclear waste and storage problems, or of biomass energy resulting in the depletion of Maine's forests.

Bill Sneed recommended that: The real cost of energy should be included in the price of energy, energy conservation should be the centerpiece of the new Energy Plan, environmental sustainability should drive any new policy for economic growth and development and the use of current and new energy resources, and, renewable energy sources should be given priority over non-renewable resources. To implement the new Energy Plan, Mr. Sneed recommended that the Energy Commission should be made permanent and expanded to include members representing other interest groups in the energy business and rate-payers groups. His other recommendations included energy efficiency in all sectors of the economy, stricter enforcement of the ASHRAE-90.1 standards, gas guzzler tax and feebate to encourage energy efficient vehicles, tax exemption for solar equipment, greater availability of natural gas in the State, and the inclusion of externalities into the cost of energy consumed in Maine.

Wil Laffe noted that currently, less expensive Canadian made wood stoves are being used in Maine which do not meet EPA regulations. He recommended that there should be a tax credit towards the purchase of any EPA compliant wood stoves. This, according to Mr. Laffe, will reduce pollution, make the U.S. manufacturers of such stoves more competitive, and reduce Maine's dependence on foreign energy sources.

Frederick J. Munster Jr. recommended interest-free loans by the State for the purchase of alternative energy systems that would help the growth of alternative sources of energy such as wind power and reduce the depletion of Maine forest.

The Maine Chamber of Commerce and Industry (MCCI) made the following recommendations: A clarification is needed regarding the meaning of sustainability as used in the Draft Report, the term sustainability should be interpreted as equivalent to efficiency and not as some form of governmental regulation resulting in decreased economic productivity, potential funding sources for energy efficiency should be the energy bonds first and energy taxes or general fund revenues as secondary source; energy efficiency can best be achieved through the private sector, the issue of energy cost is crucial to the entire Maine business community, an advisory group should be formed to consider environmental and energy issues, and, in light of the Federal Clean Air Act amendments of 1990, any further emission regulations by the State may not be useful.

The American Wind Energy Association made the following recommendations: All energy sources should not be treated equally since the energy market is already distorted by its inability to reflect external environmental, security, and resource depletion costs, the Plan should require the State buildings to install small wind turbines, electric vehicles should be encouraged to reduce air pollution, energy education programs should emphasize renewable sources of energy, Maine should strive to reduce its dependence on oil in the next decade beyond the national level of the current 43 percent, the cost of externalities should be considered in the energy decision-making process and provide tax exemptions to low income people to reduce the regressive nature of the externality costs, incentives should be provided for businesses to develop and install alternative energy sources, the State should conduct a wind energy resource and site assessment program for prospective project developers, the State should support the federal multi-technology Renewable Energy Tax Equity Act to encourage renewable energy resources, the State should support federal regulation that would promote open transmission access to all electricity producers, and, the issue of global warming should be given greater emphasis in the Plan.

Alternative Energy, Inc., recommended that the language on Page 6 of the Report should be changed to clarify that forest is not being cut to feed biomass plants, only waste wood is being used for energy production, and that the language on Pages 8 and 9 gives an impression that energy rates went up in Maine due to the contracts by the utilities with the independent power producers. The fact, according to the Alternative Energy, Inc., is that independent power producers are able to construct power generating facilities at much lower costs than utility generators. Additionally, the wheeling costs to the independent power producers are rendering their operations uneconomical and may force them to relocate to areas where there is already a concentration of industrial polluters. This situation should be corrected if the State wants independent power producers to remain in areas which need such plants to provide jobs and a stable tax base. Finally, the Alternative Energy, Inc., recommended that the Commission should recommend that the Department of Environmental Protection streamline its process of issuing permits for new power plants and reduce the time it takes to issue licenses.

Tim Zorach of the Maine Audubon Society made the following recommendations: Strengthen the proposals to reduce petroleum consumption, the Report should discuss in the open issues such nuclear power and coal plants in Maine, the Plan's goals should be more specific, for instance, to reduce petroleum consumption by 50% in 40 years, natural gas should be considered a transitional energy sources and not as a "clean" fuel as mentioned in the Report, and, energy efficiency and conservation should be emphasized as central to the long-term energy plan for the State.

Morris C. Hancock, recommended that the exceptions in the current law should be eliminated for homes being built and require all new homes built in Maine to achieve either the prescriptive or performance-based standards and the enforcement of the current laws should be strengthened so that all buildings, particularly commercial buildings can be brought under compliance. The Commission should encourage research on issues like "embodied energy" to document how much energy is being consumed in building a structure and the amount required to demolish and replace it. Currently, no

documentation exists. Mr. Hancock recommended that CAFE standards should be strengthened and that the architectural community should be given representation on any future commission or committee on energy planning.

Angelo J. Kaltsos, Coordinator, No Thank Q Hydro Quebec, made the following recommendations: Educational material should be made available to Maine citizens distributed in utility bills, schools and published by local media newspapers, the public sector should be consulted before a decision is made on issues such as new power projects; Hydro Quebec should be removed from the list of possible sources of energy to be used in Maine.

Sandra M. Dickson asserted that solar energy deserves more emphasis than it received in the Draft Report. She emphasized the need for better information on the new photovoltaic technology to correct the impression that it is not competitive. Ms. Dickson recommended that the Commission work to implement the recommendations included in the Plan.

Harley Lee, President, Endless Energy Corporation, commented that the benefit list of the renewable energy sources on Page 42 should include two more characteristics, lowest long-term costs and greater reliability. Regarding the discussion on energy costs on Page 50, Mr. Lee commented that since there are so many clean energy resources available, externalities legislation may not necessarily increase energy prices.

The Eva Hoyt Zippel School recommended that there should be more emphasis on wind power than the Report indicates and more emphasis should be placed on energy conservation education, particularly at the elementary school level.

Deborah Leighton of the Center for Vision and Policy recommended that specific goals be set to conserve energy and reduce pollution by reducing total energy use by 50% in 40 years, cutting oil consumption 50% in 40 years, Cutting carbon dioxide emissions 25% by the year 2005. Other recommendations included installation of solar and wind energy devices in State buildings and providing more focus on these renewable energy resources, reestablishment of the State Energy Office, establishment of an advisory group to implement the Energy Plan.

Maine Public Service Company recommended that while the utilities should continue to provide cost-effective energy conservation services as the current law requires, these should not result in cross-subsidization between groups of ratepayers. Additionally, on pages 44, 46, and 51, it should define more clearly the relationship between conservation programs and a utility's rates. Conservation programs should be designed to achieve the lowest possible rates.

The **Eastern Regional Council/Council of State Governments (ERC/CSG)** made the following recommendations: When discussing Maine's future energy demand, a breakout of possible scenarios across all energy sectors should be considered, policies should be developed to encourage the market penetration of alternative sources of energy, due to artificially low prices of petroleum, the growth of alternative sources of energy has been stunted. This situation can be corrected in positive, activist fashion by the State without jeopardizing the role of the market in determining the demand and price of the various energy sources. It was recommended that the Commission address the issues of encouraging alternative sources of energy, conservation efforts by the State, energy educational programs,etc., more directly and recognize the fact that a policy can be a powerful proactive strategic tool with potential to help shape Maine's future.

APPENDIX D

INDEX OF PUBLIC RECORD

COMMISSION ON COMPREHENSIVE ENERGY PLANNING

INDEX OF PUBLIC RECORD

1- 1991 National Energy Strategy, Federal Department of Energy.

2- No Thank You Hydro Quebec, a pamphlet.

3- Energy From the Sun, The Scientific American, Sep. 1991.

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23- Energy Plan, Oregon State, 1990.

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26- Names of individuals and organizations who provided written comments:

- Arthur Adelberg of the Central Maine Power, Augusta, Maine.
- Dorothy Albert of the Maine Sierra Club.
- Norm Anderson of the Maine Lung Association.
- Dr. Steve Ballard, Director, the Margaret Chase Smith Center, University of Maine.
- Robert Beane of Portland, Maine.
- Paul Best of the Maine Lung Association.
- Jack Bisco of Turner, Maine.
- Robert Briggs, President, the Bangor Hydro-Electric Company.
- David Bristol of the Hydra-Co Enterprises.
- Lee McKim Buffinton of Thomaston, Maine.
- Avery Caldwell of Hampden, Maine.
- Peter Chamberlain of AIRCO.
- Dwight Curley of the Granite State Gas Transmission, Inc.
- John Devine of Portland, Maine.
- Sandra M. Dickson of Port Clyde, Maine.
- Dr. Frank Eggert of the Coalition for Sensible Energy.
- Richard Esteves of SESCO, Lisbon Falls, Maine.
- David J. Garrity of Portland, Maine.
- Victor Grob of the Coalition for Sensible Energy.
- Chris Hall of the Maine Chamber of Commerce and Industry.
- David Hall of Bath, Maine.
- Morris C. Hancock, A.I.A. of Freeport, Maine.
- Bert Hansen, Manager, the Bath Iron Works, Bath, Maine.
- Cheryl Harrington from Winthrop, Maine.
- Jane Hartwell of the Alternative Energy, Inc.
- Rep. Conrad Heeschen.
- Prof. Richard Hill of the University of Maine at Orono.

- G. M. Hovey, President, the Maine Public Service Company.
- Chris Hyde of the Maine Energy Coalition.
- Dave Johnson of Phippsburg, Maine.
- Angelo Kaltsos of No Thank-Q Hydro Quebec.
- M. David Lauter, M.D. from York, Maine.
- Elizabeth King of Woolwick, Maine.
- Dr. Richard Komp of Addison, Maine.
- Ernest Kozun Jr. of the Maine Energy Education Program.
- Wil Laffe of Van Buren, Maine.
- Harley Lee of the Endless Energy Corporation.
- Deborah Leighton of the Center for Vision & Policy.
- Bob Moldaver of the Maine Nuclear Referendum Committee.
- J. Peter Monro of Portland, Maine.
- Frederick J. Munster Jr. of Presque Isle, Maine.
- Beth Nagusky of the Natural Resources Council of Maine.
- Charlie Newton, Director, PENQUIS.
- Erik Olson of Portland, Maine.
- Pamela Person of East Orland, Maine.
- Dr. Phillips H. Person of East Orland, Maine.
- Robert Phipps of the Coalition for Sensible Energy.
- Glenn Poole of the Industrial Energy Consumer Group.
- Pamela Prodan of Wilton, Maine.
- Dr. Edward Rendall of Blue Hill, Maine.
- Bill Sneed of Prospect, Maine.
- Elizabeth Swain, Commission LURC.
- Dan Thayer of Auburn, Maine.
- Dianne McAnn Thomas of the Maine Energy Education Program.
- Clinton Townsend of Skowhegan, Maine.
- Patricia Warren of the Maine Energy Education Program.
- Josephine G. Whetstone of Gorham, Maine.
- Gregory Whitehead of the Coalition for Sensible Energy.
- Lewis Wirta of North Amity, Maine.
- Tim Zorach of the Maine Audubon Society.
- The American Wind Energy Association.
- The Council of State Government, Estern Regional Conference.
- The Eva Hoyt Zippel School, Presque Isle, Maine.
- The Green Party of Hancock County, Maine.
- The Modern Energy Company.
- The Maine Highway Users Conference.
- The Maine Oil Dealers Association.
- The Maine Petroleum Association.
- The Maine Public Utilities Commission.
- Northeast States for Coordinated Air Use Management.
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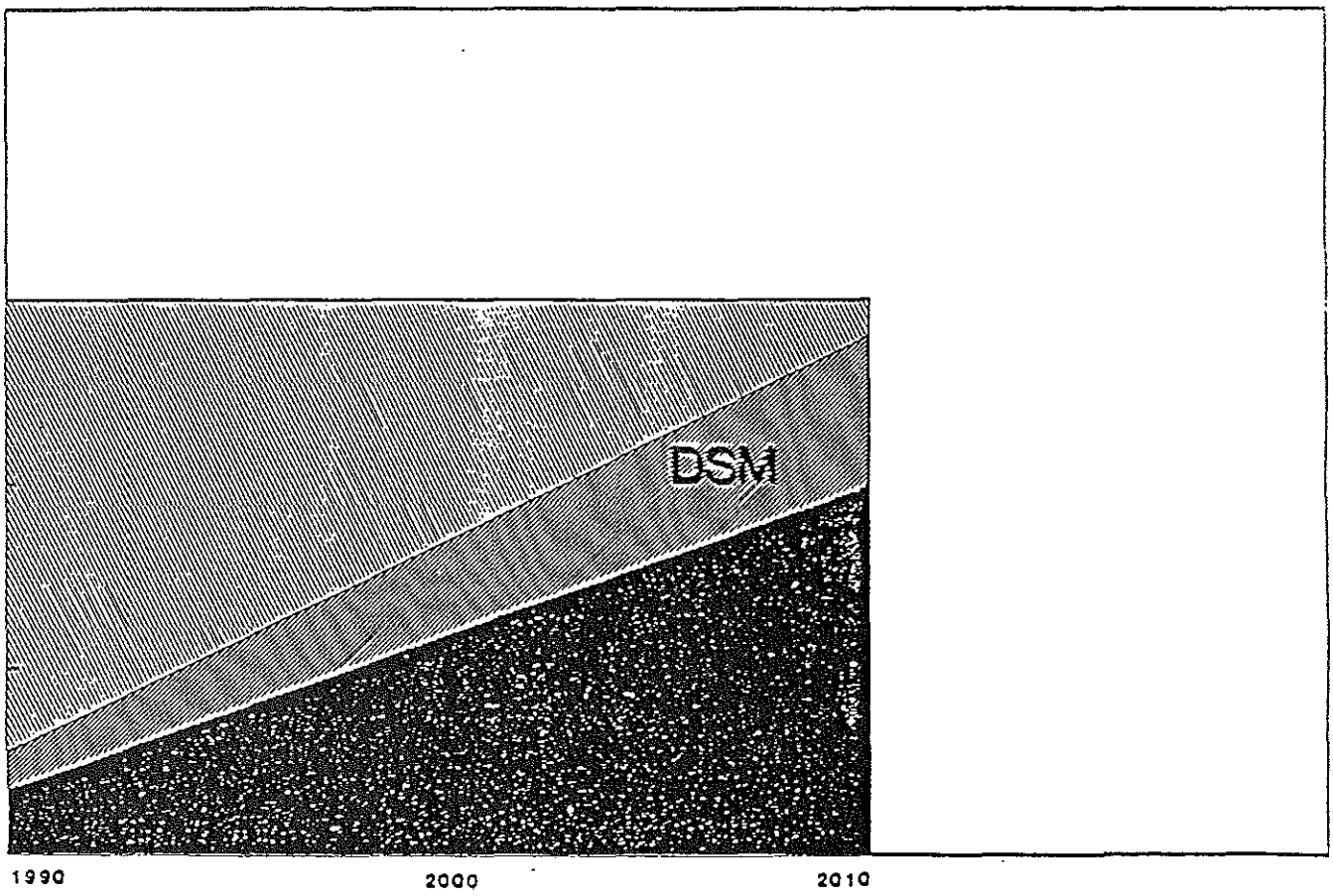
APPENDIX E

OVERVIEW OF CMP CONSERVATION PROGRAMS

Attachment I

DEMAND-SIDE MANAGEMENT QUARTERLY REPORT

Quarter 4, 1991



Central Maine Power Company
Planning & Budgets / Energy Management Program Evaluation

Summary of Programs.

T&C	Program	Cumulative Annual Energy Impacts (KWH / yr)	Cumulative Annual Demand Impacts (KW–yr)	Total Program B/C Ratio	Total Program CCE *
19.4	Residential Energy Conservation Loan Program	751,272	102	na*	na*
19.7	Pilot Energy Efficient Street Lighting Conversion Program	7,129,643	360	na*	na*
19.8	Pilot Lighting Efficiency Program	15,182,204	2,896	na*	na*
20	Residential Energy Audit Program	n/a	n/a	n/a	n/a
21	Residential Bundle–Up Program	42,162,256	6,690	1.44	0.04
21	Commercial Bundle–Up Program	2,364,480	375	0.88	0.07
22	Energy Efficient New Home Design Program	6,347,370	859	0.21	0.27
22	Revised Energy Efficient New Home Design Program	n/a	n/a	n/a	n/a
23	Residential Load Cycling Program	n/a	8,118	n/a	n/a
24	Residential Time–of–Use Load Cycling Program	n/a	3,670	0.76	n/a
25	Commercial Energy Audit Program	13,595,809	2,301	n/a	n/a
25	Loan Program	1,466,742	246	0.47	0.12
25	Motor Rebate Retrofit Program	1,630,452	274	1.90	0.03
25	Lighting Rebate Retrofit Program	64,656,952	10,862	1.21	0.05
25	Custom Rebate Retrofit Program	15,964,959	3,163	1.92	0.03
26	Efficiency Buy–Back Program	31,464,908	10,956	2.11	n/a
27	Res. Weatherization & Insulation Services	13,418,606	1,816	0.76	0.08
27	Res. Weatherization & Insulation Services – Low Income	4,431,280	600	0.51	0.11
28	Power Partners Program	91,751,908	24,026	1.41	n/a
29	Commercial Design Assistance Program	1,129,079	221	0.73	n/a
30	Commercial New Construction Motor Rebate Program	30,365	5	0.44	0.13
30	Lighting Rebate Program	10,783,789	1,812	1.56	0.04
30	Custom Rebate Program	3,405,255	572	2.21	0.03
32	Residential Lighting Efficiency Program	7,621,738	1,454	1.91	0.03

Notes:

Benefit/Cost ratio is based on 91–A avoided costs which may not reflect the avoided costs in effect when a program was implemented.

* CCE is the per unit cost of conserved energy in terms of $/kWh and is comparable to the 20 year levelized cost that is routinely reported as part of the Company's avoided cost filings.

na* indicates that the program is no longer active.

APPENDIX F

OVERVIEW OF ENERGY RATED HOMES PROGRAMS

NREL/TP-261-4677

A NATIONAL PROGRAM FOR ENERGY-EFFICIENT MORTGAGES AND HOME ENERGY RATING SYSTEMS: A BLUEPRINT FOR ACTION

REVIEW DRAFT

Final Report of the National Collaborative on
Home Energy Rating Systems and Mortgage Incentives
for Energy Efficiency

Prepared by the

National Renewable Energy Laboratory
Washington, D. C.

March 1992

Executive Summary

Cost-effective energy efficiency technologies* exist today to reduce dramatically the $100 billion we spend each year on energy for our nation's housing. However, adoption of these technologies has been far slower than would be economically best for our nation and for individuals. One reason is that builders and home buyers have a strong tendency to minimize the "up-front" cost of a residential property, even at the expense of future savings. Mortgage loan practices reinforce this tendency. They fail to consider the lower *total* cost of owning an energy-efficient home with energy expenses are added to mortgage and tax payments.

One of the goals of the National Energy Strategy, recently developed at the direction of President Bush, is to counteract this tendency by developing reliable methods for rating the energy performance of residences and by encouraging mortgage-lending practices that fully reflect the value of lower energy operating costs. In response to that call for action, the U.S. Department of Energy, in cooperation with the U.S. Department of Housing and Urban Development, convened the National Collaborative on Home Energy Rating Systems and Mortgage Incentives for Energy Efficiency. The National Collaborative comprised members representing 25 organizations in the housing, mortgage finance, and energy supply industries, along with state and federal government, federally chartered financial institutions, and public interest organizations. Four technical advisory committees supported their work.

The mission of the National Collaborative was to reach a consensus on a voluntary national program that will link credible home energy rating systems with mortgage incentives for energy-efficient housing. *A Blueprint for Action* reports on the National Collaborative's findings and recommendations for creating such a program.

Widespread availability of energy-efficient mortgages (EEMs), teamed with accurate home energy rating systems (HERS), would make it easier and more affordable for Americans to live in energy-efficient homes. In fact, the Joint Center for Housing Studies has estimated that 250,000 more U.S. families could become first-time homeowners each year with EEMs. And the benefits to the environment of increasing the energy efficiency of the nation's housing stock would be significant.

In theory, a national EEM program would make available home mortgages that take into account the energy cost savings of the home. Home buyers could apply for EEMs when purchasing an energy-efficient home or when they are buying an existing home and planning to make immediate energy improvements to it. EEMs would have more favorable terms and qualifying conditions than conventional

*"Energy efficiency" is intended to include both energy efficiency measures (such as insulation and low-emissivity windows) and renewable energy technologies (such as passive solar design and solar domestic hot water systems), the use of which reduces a home's consumption of utility-supplied energy.

loans. Supporting the EEMs, a reliable HERS allows both the lenders and the home buyers to be confident of the predicted energy savings.

EEMs and HERS are not new. However, EEMs have not been widely used because most buyers and many lenders are not aware of them. Also, lenders are not completely confident of the various EEM programs. Extra paperwork, lack of uniformity among EEM programs, and uncertainty about promised energy cost savings make lenders reluctant to use EEMs. In addition, lenders usually do not have access to a credible HERS program to determine energy cost data.

The members of the National Collaborative examined these issues and worked hard to hammer out a strategy to deliver an effective EEM program linked to voluntary HERS. There was broad consensus on the actions that can be taken immediately to set the stage for the program:

- Develop common standards for EEMs among the five federal agencies and federally chartered financial institutions: the Federal National Mortgage Association (Fannie Mae), the Federal Home Loan Mortgage Corporation (Freddie Mac), the Federal Housing Administration (FHA), the Department of Veterans Affairs (DVA), and the Farmers Home Administration (FmHA)
- Review the procedures of government programs and government-chartered institutions to remove any unnecessary barriers to implementing EEMs and simplifying the loan process
- Develop training and promotional programs to educate lenders, builders, real-estate professionals, appraisers, and consumers about EEMs
- Collect and analyze data from existing EEM programs on use patterns, default rates, and other factors.

When considering the design and implementation of HERS, the National Collaborative members concluded that the following steps should be taken:

- Develop a reliable, accurate, nationally uniform HERS program that could be used on a voluntary basis
- Implement HERS through state and local programs
- Train appraisers, real-estate personnel, energy raters, and others to use the system
- Institute quality control mechanisms for HERS.

The National Collaborative members agreed on several desirable characteristics of a national EEM program, including:

- All housing will be financed in the program
- The underwriting process will adequately recognize the reduced operating costs of energy-efficient housing
- Mortgage financing of both energy-efficient construction and improvements will be permitted
- Lenders will be indemnified against any added risk of borrower default
- Lenders will be able to use HERS to provide a reliable technical basis for allowing underwriting of mortgage loans by providing energy cost savings information to lenders.

However, National Collaborative members were not able to reach consensus on some specific provisions of a national EEM program, such as how energy-efficiency improvements or construction costs should be reflected in the mortgage or how to incorporate energy cost savings into the procedures used to qualify people for EEMs. On these points, members agreed to disagree. A number of nonlending members advanced a concept for EEM characteristics; mortgage-lending members explained their concerns with the concept. Both sides of these issues are discussed in *A Blueprint for Action.*

The National Collaborative, through a consensus-building process, has constructed concepts that can link home financing to a successful national program of home energy rating systems. Collaborative members have progressed in understanding each other's needs and concerns that otherwise may have been barriers to creating a national program. Most important, the process has generated a momentum that can mold a successful program to help more people own energy-efficient homes.

Much remains to be done to fully develop, promote, and implement a national program of energy-efficient mortgages linked to voluntary home energy rating systems. Many of the report's assumptions and goals need to be carefully tested to provide relevant data that will allow the program to have its maximum impact. These data will provide the basis for completing the unfinished business outlined in this report. But the need for data does not hinder action. Member organizations will review and comment on this Review Draft, which will also be made available for public comment. Implementation strategies will be further developed and tested, both for energy-efficient mortgages and for home energy rating systems. *A Blueprint for Action* will be revised to reflect the comments of member organizations and the public.

Chapter One: Introduction

Americans share the belief that their housing should be affordable, comfortable, and energy efficient. But, research has shown that the level of investment in energy efficiency in housing is less than that which is economically justified. Two major barriers limit investment in home energy efficiency. First, energy efficiency represents increased front-end cost, either as a home is first built or as an existing home is later improved. It is a long-term investment that must be financed. Second, there are insufficient market data to fully understand the value of energy efficiency in housing.

In recent years, growing attention has been given to two concepts that can help overcome these barriers—home energy rating systems, or HERS, and energy-efficient mortgages, or EEMs. HERS provide objective, standardized information on the energy performance of homes, analogous to miles-per-gallon ratings on automobiles or EnergyGuide labels on appliances. And EEMs provide a financing mechanism for energy efficiency. They allow a buyer of an energy-efficient home to qualify for a higher mortgage, using the future savings in energy costs to afford higher mortgage payments. EEMs may also be used to finance energy-saving improvements to existing homes, as part of the primary mortgage, at the time of purchase or refinance.

Expanded use of HERS could stimulate increased use of energy-efficiency and renewable energy technologies[1] by making energy efficiency a more qualified, visible, and recognized attribute as homes are designed, built, bought, and improved. It would facilitate informed decision making. At the same time, expanded EEM activity will encourage home builders and owners to invest in energy-saving features without worrying that they are making their properties less affordable. HERS and EEMs have the potential to be closely linked. Energy cost estimates generated by a reliable HERS can be valuable information for those underwriting and insuring EEMs. Increased use of HERS for this purpose could help to speed the institutionalization of HERS and EEMs in the housing market.

Recognizing the potential for HERS and EEMs to stimulate home energy efficiency, the U.S. Department of Energy (DOE), in cooperation with the U.S. Department of Housing and Urban Development (HUD), initiated the National Collaborative on Home Energy Rating Systems and Mortgage Incentives for Energy Efficiency. The National Collaborative was created to prepare *A Blueprint for Action*, which is intended to extend the benefits of HERS and EEMs throughout the United States.

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[1]"Energy efficiency," as used throughout this document, is intended to include both energy-efficiency measures (such as insulation and low-emissivity windows) and renewable energy technologies (such as passive solar design and solar domestic hot water systems), the use of which reduces a home's consumption of utility-supplied energy.

I. Background

HERS and EEMs are not new. Numerous HERS[2] and energy-efficiency certification programs[3] have been started in the United States. For a variety of reasons, many have ceased to exist. Others have persevered and continue to operate with varying degrees of market penetration. They are sponsored by a number of different types of organizations with varying goals and program designs. Some examples follow.

- The Energy Rated Homes of America organization has programs in Alaska, Arkansas, Iowa, Rhode Island, Vermont, Virginia, and West Texas.
- Several states are beginning HERS programs, including Arizona, California, Colorado, Mississippi, Missouri, Nebraska, New York, and South Carolina.
- The cities of Fort Collins, Colo., and Austin, Tex., have rating programs.
- The "Good Cents" and "Super Good Cents" certification programs are supported by almost 300 utilities, especially in the South and the Pacific Northwest.

Energy-efficient mortgages have been available for more than 10 years. In the early 1980s, the five federal mortgage agencies and federally chartered financial institutions announced their willingness to buy, guarantee, or insure EEMs—Fannie Mae, Freddie Mac, FHA, DVA, and FmHA.[4] Appendix A gives a brief description of the existing EEMs programs. In a number of locales, HERS or energy certification programs have been approved as a means to access EEMs. In other areas, EEMs are sometimes used without a HERS basis.

However, despite the availability of both HERS and EEMs, the programs have been underutilized. Few buyers and lenders are aware of the EEM option. For lenders, it often is seen as representing additional paperwork. There is a lack of uniformity in the five different national EEM programs. Primary and secondary lenders are unsure of the reliability of the promised energy savings. There are limited data on the relationship between energy performance and housing values. And because homeowners are unaware of EEMs and do not inquire about them, this is perceived as a lack of market interest.

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[2]HERS measure and rate on a scale the relative energy efficiency of any house, regardless of age, efficiency, or fuel use. The rating is based on the thermal performance of the building envelope and the heating, ventilating, and air conditioning (HVAC) system and is obtained by an on-site inspection and calculations. HERS calculations include estimates of annual energy performance and costs and recommendations for cost-effective energy-efficiency improvements.

[3]A pass/fail home energy-efficiency rating system, or "certification program," is typically operated by utilities, home builders' organizations, or not-for-profit organizations. Energy- efficiency standards for these programs are developed using local building characteristics, construction practices, and climatic conditions. They usually include thermal envelope efficiency criteria and space conditioning efficiency criteria. Certification programs generally rely on a specified inspection/verification process to ensure rating consistency. Houses either pass or fail the inspection for energy efficiency.

[4]Federal National Mortgage Association, Federal Home Loan Mortgage Corporation, Federal Housing Administration, Department of Veterans Affairs, Farmers Home Administration.

As a result, the potential national benefits of HERS and EEMs are not being realized. The benefits could include:

- An increase in the market penetration of energy-efficient new homes and energy improvements of existing homes
- A significant decrease in the estimated energy use by participating new and existing homes
- An increase in the number of families that could qualify as first-time homeowners by 250,000 each year[5]
- A significant reduction in environmental pollution.

Because of these potential benefits, HERS and EEMs have received the growing attention of the Administration and of Congress. The National Energy Strategy, issued in February 1991, states:

> To encourage the more efficient use of mortgage financing for energy efficiency, the Departments of Energy and of Housing and Urban Development will increase financial and technical support to develop and encourage the voluntary acceptance of efficiency ratings and their use in home financing. After at least 5 years of support for voluntary adoption, it will be required that information on energy efficiency and information on the available mortgage financing options be provided to home buyers prior to sale.[6]

Congress endorsed the use of energy-efficient mortgages in the National Affordable Housing Act of 1990, which directs HUD to develop a uniform plan to make housing more affordable through mortgage financing incentives for energy efficiency. HUD intends to draw on the recommendations of the National Collaborative in meeting that Congressional directive.

II. The National Collaborative

The National Collaborative's members represent 25 organizations and interests which, working together, can make HERS and EEMs a national reality. The members represent states, mortgage lenders, builders, remodelers, public and environmental interests, utilities, and existing HERS programs. For a list of National Collaborative members, see Appendix B.

The National Collaborative was supported by four Technical Advisory Committees (TACs) in the subject areas of EEMs, HERS, Implementation, and Awareness. The Collaborative Consensus Committee (CCC) defined issues that it wanted the TACs to address.[7] All of the technical issue papers prepared by

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[5]Joint Center for Housing Studies 1986.

[6]U.S. Department of Energy 1991/1992, page 11.

[7]Appendix C lists the issues assigned to the four TACs by the Collaborative Consensus Committee (CCC). The TACs were responsible for providing technical recommendations to the CCC; the CCC was responsible for the final technical decisions and policy formulations as they are reflected in *A Blueprint for Action*. In this document, the term "National Collaborative" (or "Collaborative") is used to stand for the CCC.

these TACs, as well as special papers written by members of the CCC and others as part of the Collaborative process, are available in a separate volume, *Going National with HERS and EEMs: Issues and Impacts, The Collected Papers of the National Collaborative.*[8]

The first meeting of the National Collaborative was held March 26, 1991. Since then, Collaborative members have taken part in an intensive series of 10 meetings to prepare *A Blueprint for Action*, plus numerous TAC and special subcommittee meetings and caucuses.[9] The National Collaborative included participants with sharply different perspectives on some issues. Every statement included in *A Blueprint for Action* required the concurrence of every individual participant in the Collaborative. Yet in only one area—the EEM program—members "agreed to disagree" on some of the provisions of a national program. But even here, there was a broad consensus on many actions that can be taken immediately while the parties work together to clarify some of the features of the national effort.

III. A Blueprint for Action

A Blueprint for Action is a compilation of the findings and recommendations of the National Collaborative regarding steps to be undertaken to establish a national EEMs/HERS program. With regard to EEM recommendations, a few areas of specific disagreement are clearly labeled as such.

The proposed "national program" consists of two main aspects: (1) revisions to current EEM programs with a goal of making them more user friendly, uniform, and substantive—and hence more effective; and (2) a national certification system to ensure the technical credibility of HERS programs to be used in conjunction with EEMs. A number of guidelines that local and state HERS programs would have to meet to attain certification as part of a voluntary national program are outlined. HERS programs not wishing to be part of the national EEM/HERS system would not be required to meet any of these guidelines.

This document consists of chapters on linking HERS and EEMs, characteristics of EEMs, characteristics of HERS, and implementation. The recommendations of the Collaborative regarding the linked EEMs/HERS program are described in Chapter 2. Chapter 3 characterizes an EEM program. It also presents characteristics of an EEM program presented by a number of nonlending members of the Collaborative, followed by the mortgage-lending representatives' response. Chapter 4 presents the consensus agreements on the characteristics that HERS programs would have to meet to be part of a national EEMs/HERS program. The document concludes with chapters on implementation strategies for

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[8]This report (NREL/TP-261-4706) is available through the National Renewable Energy Laboratory, 1617 Cole Blvd., Golden, CO 80401.

[9]Appendix D shows the meeting schedule.

linking EEMs and HERS, and the Collaborative's conclusions. Other supporting materials are included as appendixes.

A Blueprint for Action represents the final product of the first phase of discussions of the National Collaborative on these topics. Much further work is called for throughout the document, reflecting the view of the Collaborative that many specifics of a national program remain to be defined.

APPENDIX G

INVENTORY OF ENERGY-RELATED AIR EMISSIONS

Inventory of Maine's Energy-Related Air Emissions

The following tables and pie charts present an overview of emissions of seven categories of energy-related air pollutants as produced by specific fuel type and energy use sector. The methodology is based on a set of "emission factors" that can be used to estimate emissions based on units of energy consumed. The analysis was developed by the State Planning Office in conjunction with the Department of Environmental Protection, Bureau of Air Quality Control.

The emission factors are designed to estimate the levels of emissions of seven types of air pollutants produced by energy used within Maine: sulfur oxides (SOX), nitrogen oxides (NOX), volatile organic compounds (VOCs), carbon monoxide (CO), carbon dioxide (CO_2), methane, and respirable particulates (particulate matter under 10 microns in size, abbreviated as PM10).

Among these pollutants, SOX and NOX emissions are chemical precursors of acid rain. NOX, VOC and CO emissions are responsible for the buildup of tropospheric ozone (smog and ozone that occurs near ground level). PM10 emissions represent a human health hazard due to their potential toxicity and the ease with which they are inhaled. CO_2 and methane are considered "greenhouse" gasses that may be responsible for global warming.

The first table provides the emission factors used in the analysis. The factors are based on Maine-specific energy use characteristics and are represented in pounds of emissions per million Btus (MBtus) of energy consumed. The second table provides estimates of total Maine energy-related air emissions by fuel and by sector. The pie charts that follow show, for each category of pollutant, the percentages of emissions by fuel, and the second shows emissions by end-use sector. Comparing the two is a useful guide in understanding where Maine's energy-related air emissions come from. The graphs are based on 1989 energy consumption data. Utility sector includes cogen and IPP emissions.

The graphs indicate that:

- The majority of Maine's SOX emissions are caused by residual oil consumption, with the industrial sector accounting for 60 percent, and the utility sector accounting for 18 percent.
- Maine's NOX emissions are due primarily to gasoline consumption (42 percent) and transportation uses generally (54 percent);
- A majority of VOC and CO emissions are also produced by gasoline, although a significant share comes from residential wood use;
- Most of Maine's (combustion-related) methane emissions are also due to residential wood use;
- CO_2 emissions are spread fairly evenly across all fuels and sectors, although wood is the single largest contributor (However, wood is, arguably, greenhouse "neutral" since it is a renewable resource); and
- Wood use also accounts for most of Maine's energy-related PM10 emissions, with residential use comprising 55 percent, and industrial use 39 percent.

04-Mar-92

EMISSION FACTORS EXPRESSED AS POUNDS PER MILLION BTU

ENERGY RESOURCE	SOx	NOx	VOC	CO	Methane	CO2	PM10
MOBILE EMISSIONS							
Gasoline vehicles		0.6765	0.6796	6.0165	0.02787	154.8	
Diesel vehicles	0.3605	0.6286	0.0581	0.2427	0.00229	163.6	0.0099
RESIDUAL OIL							
Utility	0.9207	0.3971	0.0050	0.0327	0.00187	169.5	0.0066
Industrial	2.0724	0.3667	0.0019	0.0333	0.00667	169.5	0.1411
Commercial	1.9138	0.3667	0.0075	0.0333	0.00317	169.5	0.0941
DISTILLATE/KEROSENE							
Utility	0.2692	0.1730	0.0014	0.0361	0.00037	163.6	0.0072
Industrial	0.3624	0.1442	0.0014	0.0361	0.00037	163.6	0.0072
Commercial	0.3624	0.1442	0.0025	0.0361	0.00156	163.6	0.0078
Residential	0.3634	0.1298	0.0051	0.0361	0.01283	163.6	0.0099
WOOD							
Utility -- fluidized bed*	0.0081	0.1692	0.0012	0.0864	0.0288	369.5	0.0084
Utility -- non-fluidized*	0.0081	0.2220	0.1000	0.2625	0.0288	369.5	0.0084
Industrial (typical existing)	0.0081	0.2231	0.1231	0.3413	0.0288	369.5	0.3423
Residential -- catalytic	0.0284	0.1418	1.2057	5.5319	1.8440	290.3	0.9220
Residential -- non-catalytic	0.0284	0.1986	1.9858	19.149	4.5390	280.4	2.1277
COAL							
Industrial	1.4008	0.5755	0.0286	0.2449	0.0012	219.0	0.4045
Commercial	1.6250	0.5833	0.0292	0.2083	0.0013	231.8	0.5000
Residential	0.7800	0.5600	0.0280	0.2400	0.0012	206.7	0.4824
"Clean" Coal (Proposed AES)**	0.0380	0.0700	0.0043	0.1900	0.0012	231.8	0.0150
NATURAL GAS							
Industrial	0.00059	0.1367	0.0027	0.0342	0.0029	119.9	0.0029
Commercial	0.00059	0.0977	0.0052	0.0195	0.0026	119.9	0.0029
Residential	0.00059	0.0977	0.0052	0.0195	0.0026	119.9	0.0026
PROPANE							
Industrial	0	0.1355	0.0027	0.0339	0.0030	152.3	0.0028
Commercial/Residential	0	0.0962	0.0051	0.0197	0.0026	152.3	0.0028
MUNICIPAL SOLID WASTE	0.0065	0.5882	0.0041	0.2955	0.0006	216.1	0.0728

* Data based on DEP emissions stack tests -- "utility" refers to non-utility (cogen and IPP) projects

** Data supplied by AES based on license application with DEP

TOTAL MAINE ENERGY-RELATED AIR EMISSIONS BY FUEL AND BY SECTOR

BY FUEL (in tons)

Energy Resource	Energy Use Trillion Btus	SOx	NOx	VOCs	CO	Methane	CO2	PM10	Total Tons
Propane (LPG)	5.80	0.0	310.4	13.0	68.4	7.9	441,801.0	8.2	442,209
Natural Gas	3.70	1.1	208.0	7.9	46.4	5.1	221,757.6	5.3	222,031
Municipal Solid Waste	3.46	11.3	1,017.6	7.2	511.2	1.1	373,925.2	126.0	375,600
Coal	6.80	4,714.5	1,956.0	97.2	824.6	4.2	745,325.0	1,406.1	754,327
Residual	78.90	63,137.9	14,945.3	138.2	1,304.5	177.9	6,687,397.9	3,316.6	6,770,418
Distillate/Kerosene	51.70	9,371.6	3,477.5	107.5	931.9	235.3	4,229,782.6	236.3	4,244,143
LPG/Natural Gas	9.50	1.1	518.4	20.8	114.8	13.0	663,558.7	13.6	664,240
Wood	68.26	425.3	7,099.6	13,136.4	73,268.0	19,277.8	12,011,152.0	11,577.7	12,135,937
Coal/MSW	10.26	4,725.8	2,973.6	104.3	1,335.8	5.3	1,119,250.2	1,532.1	1,129,927
Gasoline	78.50	0.0	26,552.7	35,105.2	236,146.7	1,094.1	6,074,962.7	0.0	6,373,861
Diesel	25.38	4,574.7	7,977.4	737.6	3,079.7	29.1	2,076,438.7	125.6	2,092,963
Total	322.50	82,236.4	63,544.6	49,349.9	316,181.5	20,832.4	32,862,542.8	16,801.8	33,411,489

BY SECTOR (in tons)

Sector	SOx	NOx	VOCs	CO	Methane	CO2	PM10	Total Tons
Transportation	4,574.7	34,530.1	35,842.7	239,226.4	1,123.2	8,151,401.4	125.6	8,466,824
Industrial	49,009.5	11,698.0	1,005.2	4,026.7	353.3	7,569,683.9	6,644.7	7,642,421
Utility	14,757.9	11,692.9	2,057.4	6,206.6	599.2	10,360,042.9	396.3	10,395,753
Commercial	7,154.6	1,899.6	43.6	327.4	19.2	1,436,764.6	390.5	1,446,600
Residential	6,739.7	3,723.9	10,400.9	66,394.4	18,737.5	5,344,649.9	9,244.6	5,459,891
Total	82,236.4	63,544.6	49,349.9	316,181.5	20,832.4	32,862,542.8	16,801.8	33,411,489

Notes

Includes 8,429.6 tons of VOC emissions from stationary (non-mobile) gasoline sources. Source: DEP.
Energy use data from State Planning Office energy database -- based on 1989 consumption
Utility sector includes 39.42 Tbtu of wood energy used to produce power by non-utility generators

Sulfur Oxides

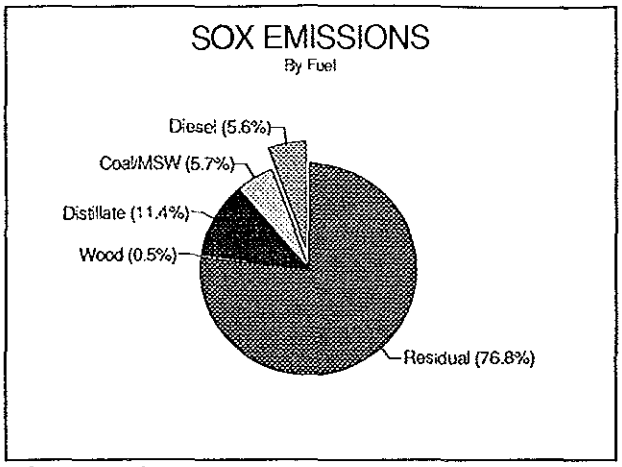


Figure 1

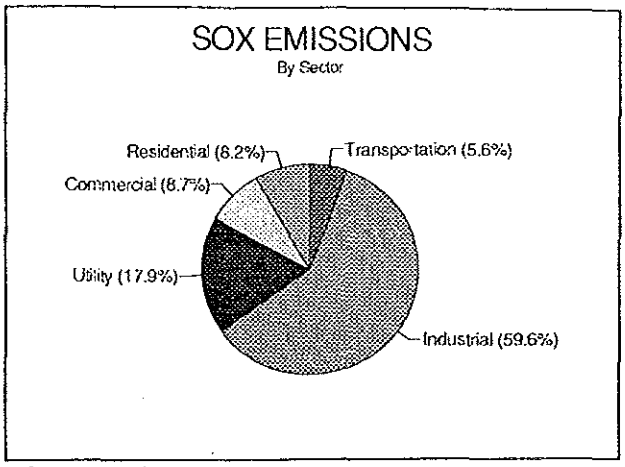


Figure 2

Nitrogen Oxides

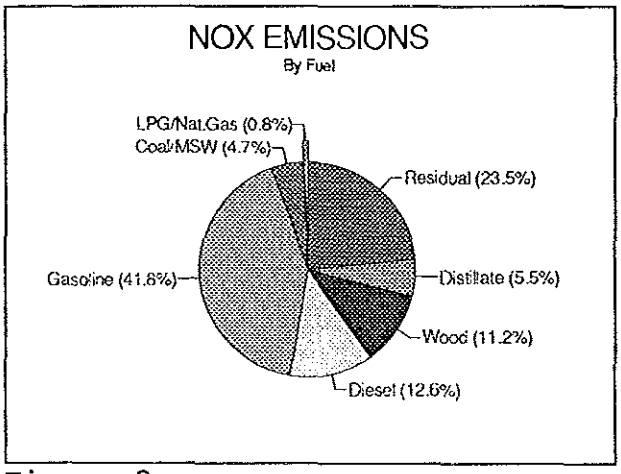


Figure 3

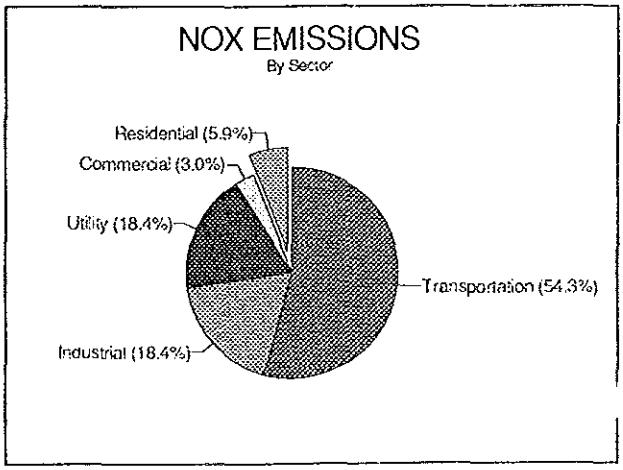


Figure 4

Volatile Organic Compounds

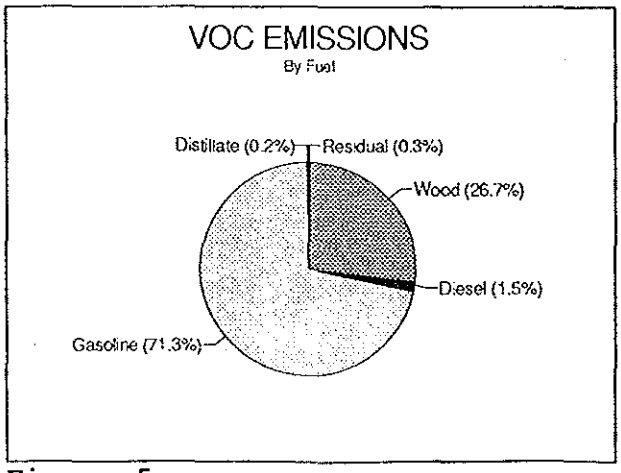


Figure 5

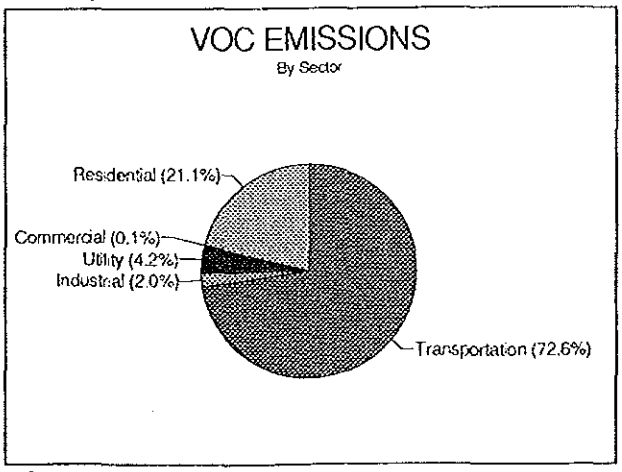
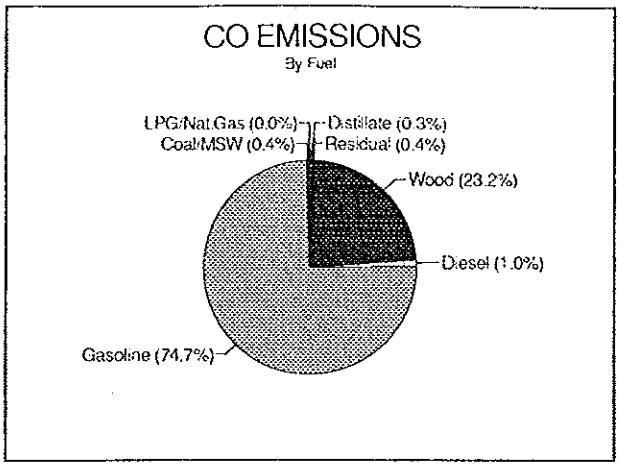


Figure 6

Carbon Monoxide



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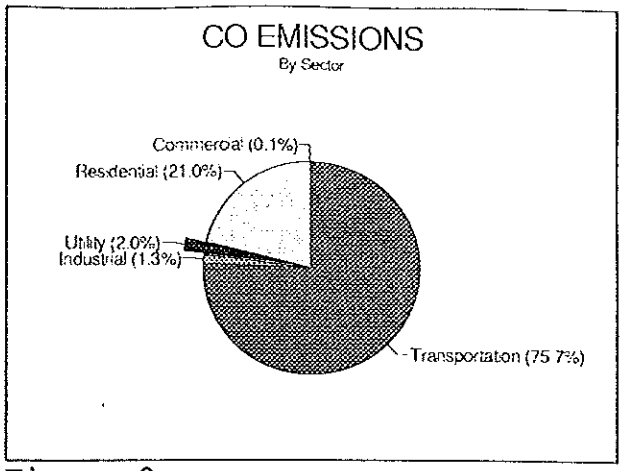


Figure 8

Methane

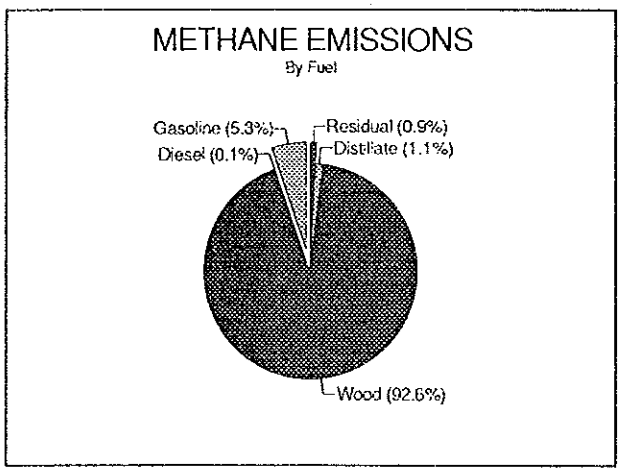


Figure 9

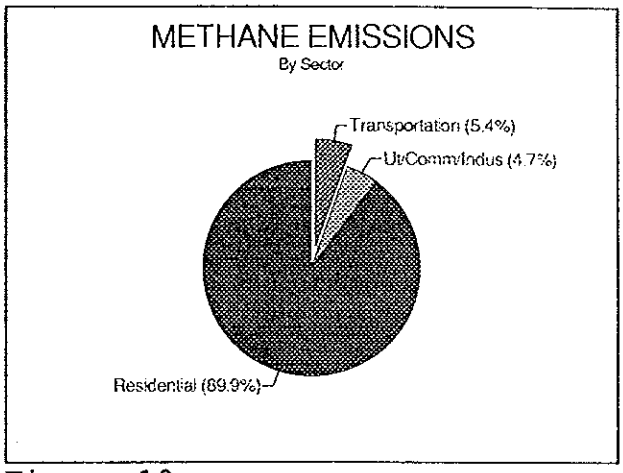


Figure 10

Carbon Dioxide

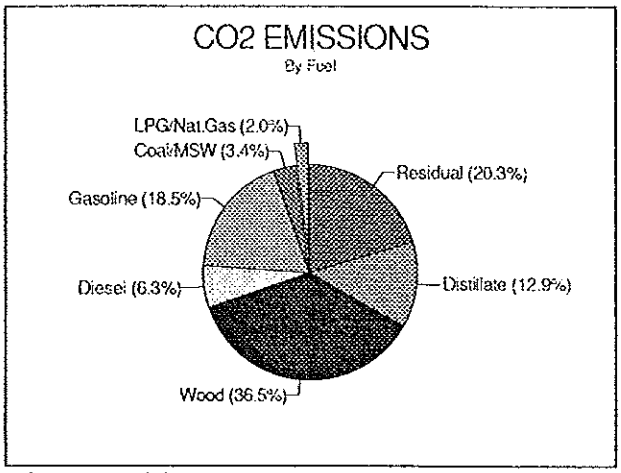


Figure 11

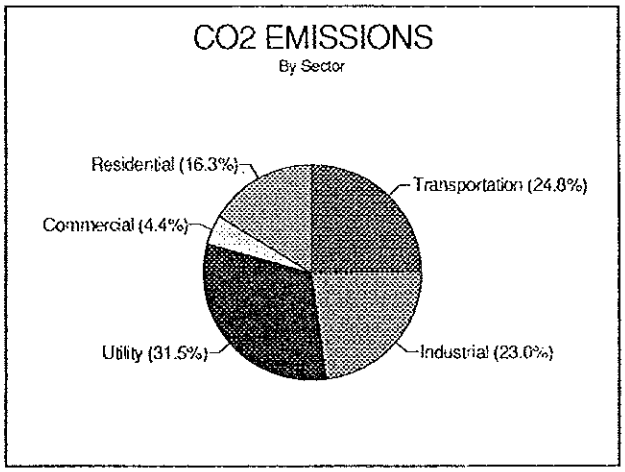
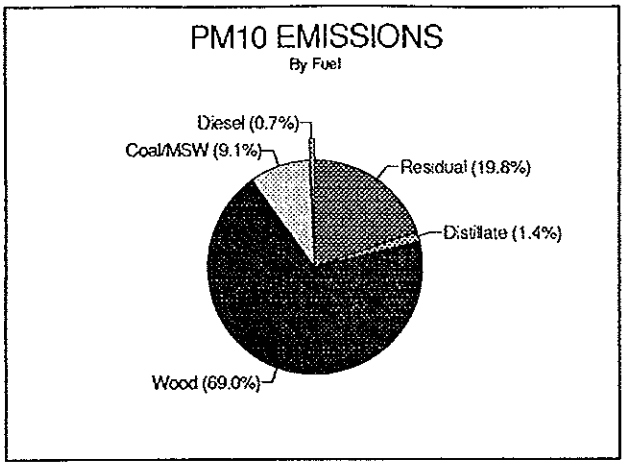


Figure 12

Respirable Particulates



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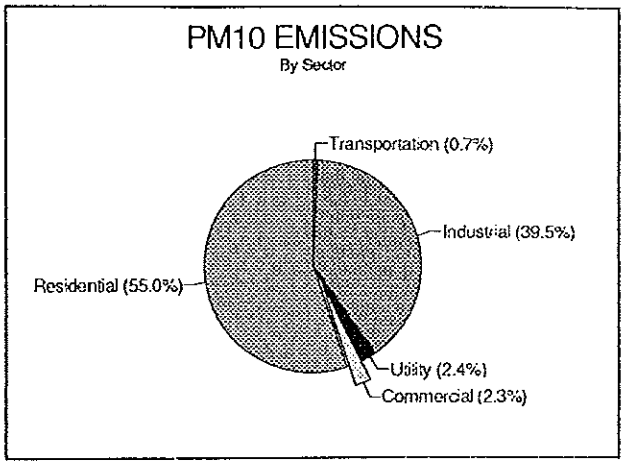


Figure 14

Sulfur Oxides

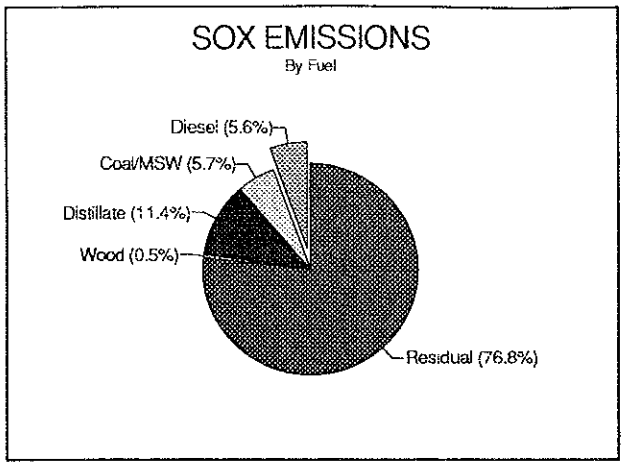


Figure 1

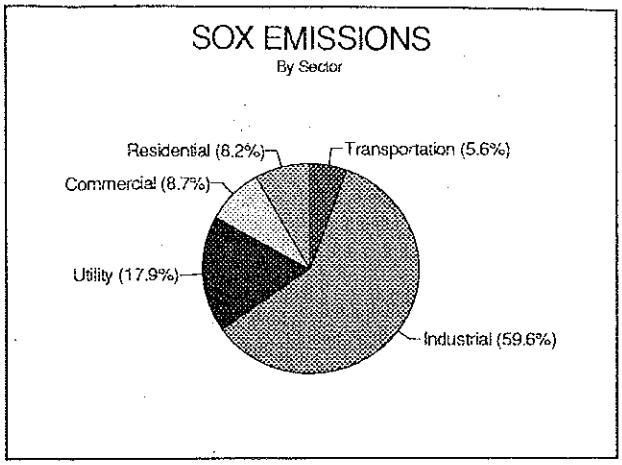
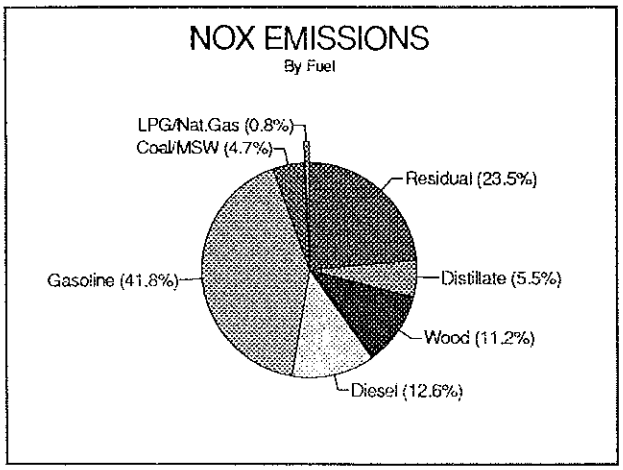


Figure 2

Nitrogen Oxides



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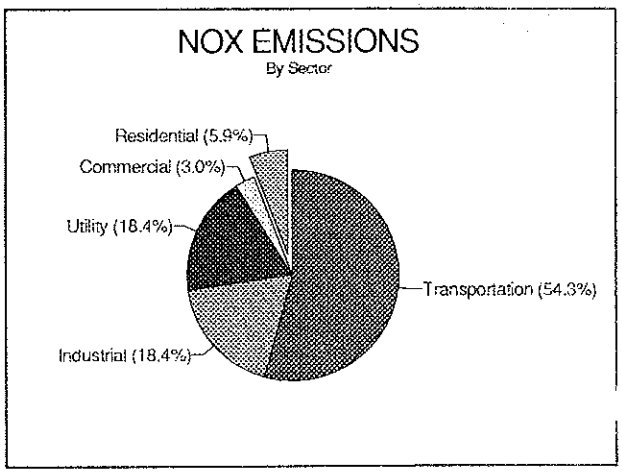


Figure 4

Volatile Organic Compounds

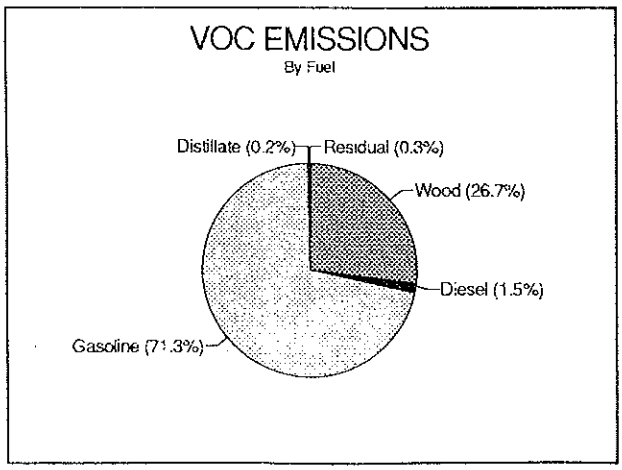


Figure 5

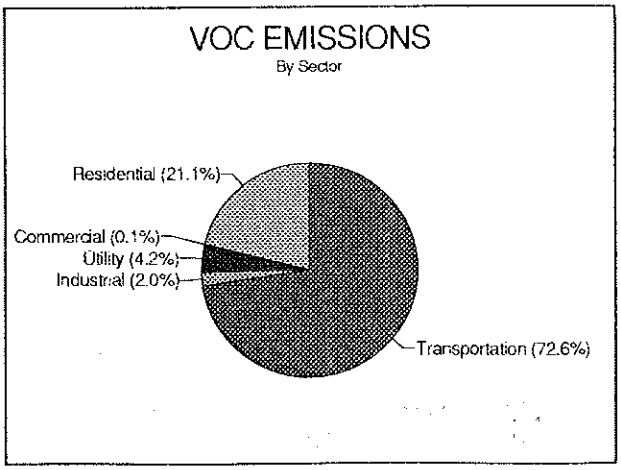


Figure 6

Carbon Monoxide

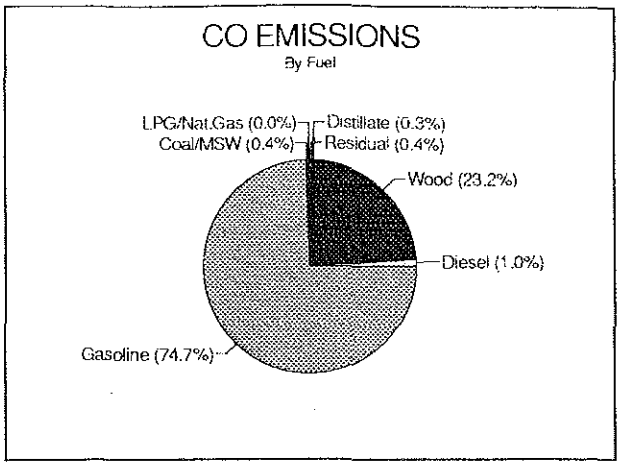


Figure 7

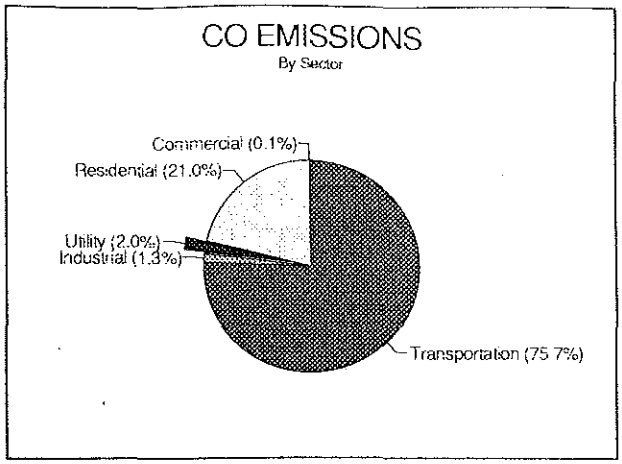


Figure 8

Methane

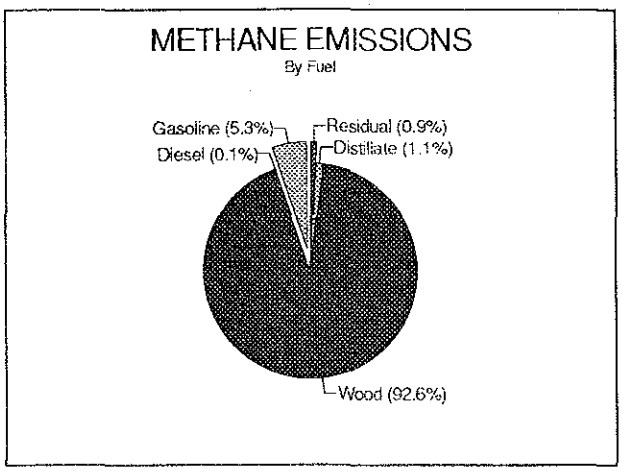


Figure 9

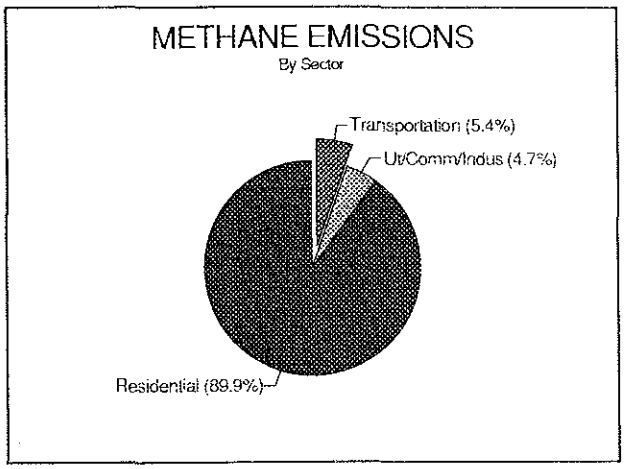
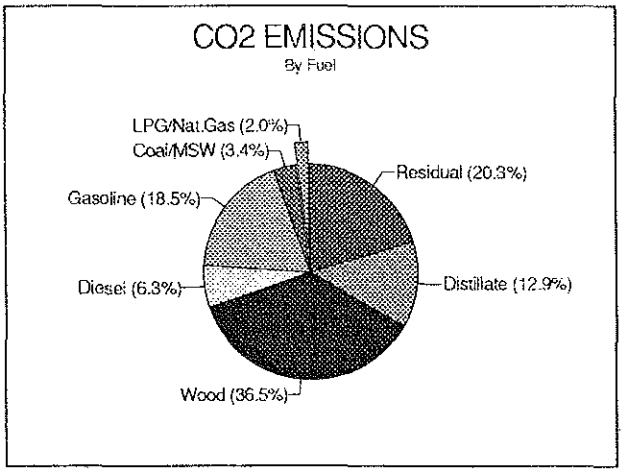


Figure 10

Carbon Dioxide



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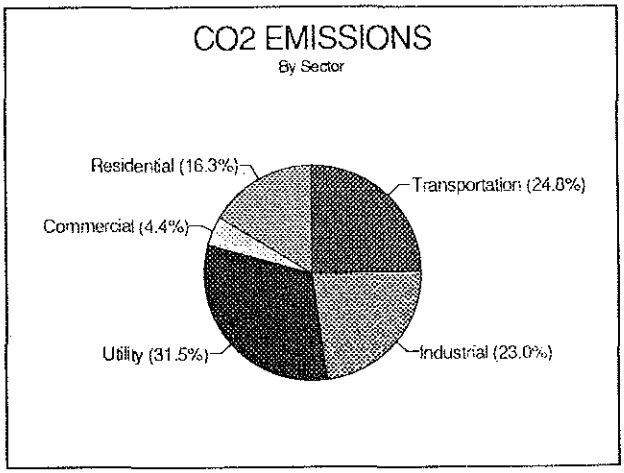

Figure 12

User's Guide to Tables

Tables 1 through 9 provide energy use and price trends on a calendar year basis from 1960 through 1989. Energy consumption estimates are broken out by the following economic sectors: Residential (Table 1), Commercial (Table 3), Industrial (Table 4), Transportation (Table 5), and Electric Generation (Table 7). Tables 2 and 6 provide historical energy price data.

Gallons (etc.) Versus Btus

The energy consumption tables provide estimates of energy use in both natural units and Tbtus, which stands for trillion btus. (A btu, or British Thermal Unit, is the amount of energy required to raise the temperature of one gallon of water by one degree F.) The term "natural units" represents energy as measured in its popular form of use or sale, such as gallons of oil or gasoline, kilowatt-hours of electricity, cords or tons of wood, etc. Converting natural units to btus, in this case trillion btus, establishes a common form of measurement so that various energy types can be compared on an equal basis. For example, 700,000 cords of wood were burned in 1989 in the residential sector, versus 238.66 million gallons of heating oil. By itself, this is not helpful in comparing the relative share of oil and wood within the sector. On a btu basis, however, wood use equalled 14.7 Tbtus while oil use equalled 33.1 Tbtus. Maine households, therefore, used just over twice as much energy, in the form of oil, as they did wood in 1989 (Table 1).

The "natural units" columns provide information such as how many gallons of oil were consumed, how many kilowatt-hours were used, etc. The data in the "Tbtu" columns can be used to analyze issues such as the role of a specific fuel in Maine's energy mix, to aggregate energy consumption by sector, etc. Data in either format can be used to track energy use trends of one specific fuel over time, such as total wood use during the period 1970 to 1989. Table 8 represents total Maine energy use in natural units, and Table 9 represents total Maine energy use in btu format. Table 11 provides the btu conversion factors used in this report.

"Primary" Versus "End-Use" Energy

Unfortunately, there is no one easy way to measure energy use, due to the role of electricity in our energy mix. Electricity is not an energy resource, per se, but is a secondary form of energy, in the sense that it is a product that is manufactured through the conversion of an energy resource (e.g., coal, hydro, nuclear, oil, etc.). Including electricity in energy consumption totals would result in double counting, since one would be measuring both the btu value of the electricity used and the btus of energy used to generate the electricity.

This problem is most easily addressed by dividing energy use into two broad categories: primary and end-use energy. The term "primary" energy refers to all energy other than electricity itself. Primary energy represents our basic energy resources. The term "end-use" energy refers to all energy except energy used to generate electricity.

Another way to avoid the double counting problem is to assign to electricity the btu value of the primary energy used in its generation, and then exclude energy consumed within the utility (electric generation) sector from the energy mix. While a kilowatt-hour of electricity, used in an end-use application (such as a lightbulb), provides 3,412 btus of energy, it generally requires over 10,000 btus of primary energy to generate that kilowatt-hour. In other words, it commonly takes about 3 btus of primary energy to produce 1 btu of electricity. This represents a typical level of powerplant conversion efficiency. Assigning the higher btu conversion factor to electricity, therefore, captures the energy used in its production, but tends to distort how energy is really used in the Maine economy.

"Real" Versus "Nominal" Prices

Tables 2 and 6 provide historical energy prices for the residential, commercial, industrial and transportation sectors. All prices are given in both nominal and real dollars. Nominal prices are the actual prices consumers paid in any specific year. Real prices are nominal prices that have been adjusted for the effects of inflation. Real prices, therefore, represent prices in "constant" dollars, in this case using the value of a dollar in 1982 as a standard. For example, gasoline in Maine cost $ .29 per gallon in 1960 (in 1960 dollars), and $1.13 in 1989 (in 1989 dollars). But, when adjusted for the effects of inflation, the 1960 price (in 1982 dollars) was equal to $ .94/gal, compared with a 1989 price of $ .89/gal. Thus, in constant dollars, gasoline actually cost 5 cents less in 1989 than it did in 1960 (Table 6).

Additional Economic and Transportation Data

Table 10 provides additional Maine-specific data on population, number of households, total registered vehicles, vehicle miles travelled (VMT), Gross State Product and Total Personal Income, and the price deflators used to compute nominal to real dollars in the price tables. This data can be used in conjunction with the consumption and price tables to analyze issues such as energy use per household, how prices affect consumption, the energy "efficiency" of the Maine economy, gasoline use relative to VMT, etc.

Maine's Electric Power Mix

Table 12, an "Inventory of Electric Power Capacity and Generation: 1990," provides a detailed listing of where and how the electricity consumed in Maine (in 1990) was generated. The multi-page table begins with a summary sheet that breaks down Maine's electric power mix by fuel, the type of entity that produces the power, and by the name of the utility system that ultimately sells the power.

Note that this table focusses only on the electricity consumed within Maine, some of which is generated by Canadian or other New England sources, while Table 7 looks at the energy consumed within Maine to generate electricity, and ignores any imports or exports of electricity. This distinction is necessary since electric power is such a dynamic commodity -- some of the electricity produced within Maine (such as part of Maine Yankee's production) is sold to consumers beyond Maine's borders, while the electricity used within Maine may be produced within Maine or elsewhere. Table 7, therefore, represents that portion of Maine's overall energy mix that is related to the production of electric power, irrespective of where that power may be ultimately consumed. Table 12 represents Maine's electric power mix -- i.e., how the electric energy used within Maine is produced, by fuel type, location, and type of producer (utility or non-utility).

"Utility" Versus "Non-Utility" Electric Generation

As of 1990, over 30 percent of Maine's electric energy was produced by non-utility power producers. Much of this power is produced by Maine's pulp and paper industries (this is commonly referred to as "cogeneration"), while an additional amount is produced by stand-alone independent power producers. For the purposes of this report, energy consumption within the "industrial sector" (which has historically included energy related to cogeneration and independent power) was adjusted to reflect more accurately the energy used specifically for traditional industrial operations, versus the energy used to generate electricity for sale through the utility grid.

The industrial consumption estimates in Table 4, therefore, exclude energy used by industrial and stand-alone powerplants used to generate electricity for sale to utilities. This energy is instead included under the category "electricity generation" to more accurately reflect Maine's current energy mix. Continuing to include this energy in the industrial category would significantly overstate the amount of energy used within Maine's industrial sector for truly "industrial" purposes, and would understate the amount of energy actually used to generate electricity for sale to consumers through the utility grid.

Thus, Table 7 represents an expanded definition of "utility sector," and includes all energy consumed within Maine that is used to generate electric power for general societal use (irrespective of whether that power is consumed within state or exported). However, energy used to generate electric power for self-consumption within industrial facilities continues to be reflected within the industrial sector estimates, since it is being used for traditional industrial operations.

"Capacity" Versus "Energy"

Table 12 identifies the entities responsible for providing Maine with electric power by two distinct measures -- capacity and energy. Capacity refers to the rated capability of a

powerplant (or utility system) to meet a certain level of instantaneous demand, and is measured in watts (in this case, megawatts, equal to 1,000,000 watts and abbreviated as MW). Energy refers to the actual production of a plant (or an amount of electricity consumed) over a given period, and is measured in watt-hours (in this case, megawatt-hours, or MWH).

The energy versus capacity distinction is particularly important with respect to oil. While oil-fired powerplants represent the single largest fuel type in Maine's electric mix on a capacity basis (at over 33 percent), these plants were used to provide only 13 percent of the actual electrical energy used in Maine in 1990. This is largely because oil is one of the most expensive resources in the mix, and is only used when necessary, while the use of less expensive resources, such as nuclear and hydro, is maximized.

Self-Generation and "Grid-Connected" Power

Note also that Table 12 deals only with electric power consumed within Maine that is sold through the utility grid. Maine industries consume a significant degree of additional electricity that is produced and consumed by those industries on-site. In addition to the totals listed in Table 12, the State Planning Office estimates that Maine consumes annually approximately 1 million MWHs of self-generated hydropower, and a significant amount of wood-fired power (for which no real data is currently available).

Sources:

The data is derived primarily from prior State Energy Resource Plans and federal sources, particularly the State Energy Data Report (SEDS) published annually by the U.S. Department of Energy/Energy Information Administration. Adjustments were made to the SEDS data where obvious inaccuracies or inconsistencies were identified. Energy price data are derived partly from primary Maine sources and partly from the DOE/EIA State Energy Price and Expenditure Report (SEPER). The electric utility data in Table 12 is based on utility reports to the Federal Energy Regulatory Commission (specifically, FERC Form 1's), utility annual reports, and State Planning Office research.

Primary Maine sources were used whenever possible to corroborate accuracy or fill in gaps. Recent year transportation fuel data is from the Maine Department of Transportation, and is based on fuel tax revenues. Recent year data on industrial wood and residual oil use is from the Maine Department of Environmental Protection, and is based on survey data. Residential wood use data and industrial hydro data is based on surveys performed by the Office of Energy Resources and updated by the State Planning Office.

TABLE 1 – RESIDENTIAL ENERGY CONSUMPTION ESTIMATES

Year	Coal		Natural Gas		Heating Oil		Kerosene		Propane		Wood		Electricity		Total Energy
	TBTU	Thous. Tons	TBTU	Million Cubic Ft.	TBTU	Million Gallons	TBTU	Million Gallons	TBTU	Million Gallons	TBTU	Thous. Cords	TBTU	Million KWH	TBTU
1960	2.35	94.00			27.54	198.54	11.85	87.17	1.37	15.00	5.78	275.00	3.39	993.32	52.28
1961	2.19	87.47			32.58	234.91	14.82	108.99	1.51	16.54	5.88	280.00	3.57	1,046.91	60.55
1962	1.90	75.99			34.38	247.88	13.02	95.76	1.71	18.73	5.99	285.00	3.74	1,096.81	60.74
1963	1.71	68.51			37.17	267.97	13.93	102.40	1.93	21.09	6.09	290.00	3.86	1,130.71	64.68
1964	1.39	55.76			33.45	241.21	10.38	76.29	2.10	22.97	6.20	295.00	4.00	1,172.24	57.52
1965	1.42	56.85			35.76	257.83	9.59	70.48	1.53	16.70	6.30	300.00	4.18	1,223.99	58.77
1966	1.26	50.38	0.35	338.33	33.13	238.91	8.54	62.82	1.61	17.57	6.41	305.00	4.41	1,293.59	55.71
1967	0.95	37.80	0.41	397.39	39.40	284.12	9.92	72.96	1.52	16.57	6.51	310.00	4.59	1,346.66	63.30
1968	0.74	29.44	0.37	358.74	40.94	295.18	11.91	87.56	1.60	17.50	6.62	315.00	4.96	1,455.01	67.13
1969	0.63	25.30	0.51	493.40	43.43	313.15	11.88	87.39	1.59	17.39	6.72	320.00	5.35	1,569.27	70.12
1970	0.56	22.24	0.53	518.85	45.88	330.83	9.35	68.76	1.45	15.81	6.83	325.00	5.88	1,722.81	70.47
1971	0.53	21.01	0.57	552.45	46.13	332.60	9.45	69.47	1.42	15.47	6.93	330.00	6.44	1,887.73	71.45
1972	0.42	16.70	0.61	596.92	49.06	353.73	9.40	69.15	1.66	18.13	7.04	335.00	7.26	2,128.98	75.45
1973	0.40	16.00	0.61	595.34	47.58	343.07	6.88	50.60	1.70	18.63	7.14	340.00	7.72	2,263.40	72.04
1974	0.36	14.42	0.62	609.17	46.24	333.39	5.82	42.80	1.87	20.40	7.35	350.00	8.22	2,408.29	70.48
1975	0.29	11.64	0.74	725.00	44.54	321.12	5.29	38.87	2.24	24.51	7.46	355.00	8.49	2,487.19	69.04
1976	0.25	9.88	0.81	794.00	52.82	380.82	6.89	50.66	2.80	30.59	8.72	415.00	9.45	2,770.60	81.73
1977	0.28	11.03	0.77	748.00	57.94	417.78	5.40	39.68	2.94	32.15	9.98	475.00	9.76	2,859.41	87.05
1978	0.20	7.95	0.78	765.00	52.77	380.51	3.93	28.87	2.60	28.43	10.50	500.00	10.22	2,996.00	81.01
1979	0.16	6.23	0.73	708.98	42.43	305.91	3.07	22.55	3.41	37.28	12.50	595.00	10.29	3,016.00	72.57
1980	0.28	11.19	0.57	555.00	37.12	267.64	2.30	16.88	1.45	15.87	13.76	655.00	10.23	2,998.00	65.70
1981	0.51	20.52	0.59	573.56	30.42	219.31	1.32	9.71	1.26	13.74	20.89	995.00	10.35	3,033.06	65.34
1982	0.62	24.70	0.60	585.57	28.78	207.54	1.54	11.34	1.46	15.95	21.32	1,015.00	10.86	3,181.64	65.17
1983	0.48	19.16	0.56	542.06	18.88	136.13	1.51	11.11	1.73	18.96	22.88	1,089.47	10.98	3,217.65	57.02
1984	0.57	22.71	0.56	544.22	19.36	139.61	1.55	11.36	0.88	9.60	20.72	986.84	11.49	3,368.65	55.13
1985	0.51	20.34	0.54	530.64	28.43	205.02	2.34	17.19	1.29	14.13	21.55	1,026.32	11.67	3,419.27	66.34
1986	0.63	25.19	0.56	545.71	33.10	238.67	1.80	13.20	1.92	21.03	19.01	905.26	12.21	3,577.64	69.23
1987	0.53	21.22	0.55	536.25	31.82	229.42	2.05	15.05	2.87	31.41	18.90	900.00	12.71	3,725.59	69.43
1988	0.40	15.84	0.58	569.66	34.77	250.72	2.05	15.11	3.43	37.50	15.92	757.89	13.32	3,903.62	70.47
1989	0.30	12.00	0.60	585.94	33.10	238.66	2.20	16.18	3.60	39.34	14.70	700.00	13.68	4,009.00	68.18

Data for all energy resources, except wood, is from the 1989 "State Energy Data Report" published by the U.S. Department of Energy.

Wood data for 1960-1970 is from the 1982 Maine Energy Resources Plan. 1970-1983 data is from the 1987 Maine Energy Resources Plan.

1984-1989 wood data is from the "Residential Energy Use in Maine" report released by the Office of Energy Resources (OER), July, 1989.

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TABLE 3 – COMMERCIAL ENERGY CONSUMPTION ESTIMATES

Year	Coal		Natural Gas		Heating Oil		Kerosene		Propane		Residual		Electricity		Total Energy
	TBTU	Thous. Tons	TBTU	Million Cubic Feet	TBTU	Million Gallons	TBTU	Million Gallons	TBTU	Million Gallons	TBTU	Million Gallons	TBTU	Million KWH	TBTU
1960	2.71	112.89			5.80	41.84	0.57	4.19	0.24	2.65	0.91	6.09	1.85	542.32	12.08
1961	2.54	105.89			6.87	49.50	0.71	5.24	0.27	2.92	0.85	5.64	2.03	595.61	12.08
1962	2.22	92.29			7.24	52.23	0.63	4.60	0.30	3.31	0.46	3.09	2.22	650.63	13.26
1963	1.97	81.89			7.83	56.47	0.67	4.92	0.34	3.72	0.47	3.17	2.37	695.84	13.07
1964	1.44	59.93			7.05	50.83	0.50	3.67	0.37	4.05	1.10	7.36	2.59	759.56	13.66
1965	1.61	67.20			7.53	54.33	0.46	3.39	0.27	2.95	0.46	3.04	2.80	819.39	13.05
1966	1.47	61.24	0.18	171.17	6.98	50.34	0.41	3.02	0.28	3.10	0.76	5.09	2.73	801.48	13.13
1967	1.01	41.94	0.26	255.25	8.30	59.87	0.48	3.51	0.27	2.92	0.75	5.02	2.52	737.93	12.82
1968	0.67	28.06	0.22	218.06	8.63	62.20	0.57	4.21	0.28	3.09	0.89	5.91	2.68	784.81	13.59
1969	0.56	23.53	0.31	305.48	9.15	65.98	0.57	4.20	0.28	3.07	1.38	9.21	2.98	873.71	13.94
1970	0.44	18.46	0.42	413.10	9.67	69.71	0.45	3.30	0.26	2.79	1.84	12.25	3.33	975.40	15.24
1971	0.41	17.16	0.47	462.52	9.72	70.08	0.45	3.34	0.25	2.73	4.14	27.60	3.60	1,053.81	16.41
1972	0.34	14.36	0.48	472.40	10.34	74.54	0.45	3.32	0.29	3.20	4.13	27.52	4.00	1,172.90	19.04
1973	0.33	13.80	0.44	426.52	10.03	72.29	0.33	2.43	0.30	3.29	3.83	25.54	4.29	1,256.63	20.04
1974	0.31	12.94	0.45	441.33	9.74	70.25	0.28	2.06	0.33	3.60	3.22	21.44	4.23	1,239.61	19.54
1975	0.25	10.22	0.52	506.00	9.38	67.67	0.25	1.87	0.40	4.33	2.10	13.98	5.35	1,567.67	18.56
1976	0.18	7.35	0.51	495.00	11.13	80.24	0.33	2.43	0.49	5.40	3.35	22.37	5.79	1,698.39	18.24
1977	0.22	9.27	0.51	500.00	12.21	88.03	0.26	1.91	0.52	5.67	3.47	23.15	5.97	1,750.43	21.79
1978	0.13	5.37	0.60	584.00	11.12	80.18	0.19	1.39	0.46	5.02	2.86	19.05	6.20	1,817.00	23.17
1979	0.10	4.20	0.66	642.58	8.94	64.46	0.15	1.08	0.60	6.58	2.49	16.62	5.87	1,721.00	21.55
1980	0.30	12.50	0.88	864.00	10.72	77.30	0.40	2.92	0.26	2.80	4.29	28.57	5.86	1,717.00	18.81
1981	0.38	15.90	1.07	1,044.02	10.14	73.12	0.26	1.88	0.22	2.42	2.27	15.11	6.10	1,787.24	22.70
1982	0.69	28.65	1.22	1,193.16	8.25	59.51	0.12	0.92	0.26	2.81	4.03	26.86	6.25	1,831.30	20.43
1983	0.54	22.53	1.15	1,126.20	8.16	58.83	0.38	2.82	0.31	3.35	4.67	31.10	6.54	1,916.82	20.82
1984	0.66	27.43	1.16	1,132.78	8.37	60.33	0.25	1.80	0.15	1.69	4.53	30.17	7.77	2,275.96	21.75
1985	0.66	27.58	1.18	1,151.24	5.64	40.69	0.25	1.86	0.23	2.49	4.54	30.29	7.98	2,337.97	22.88
1986	0.92	38.18	1.25	1,222.30	9.10	65.59	0.07	0.54	0.34	3.71	5.81	38.71	8.50	2,490.01	20.49
1987	0.70	29.24	1.30	1,269.53	8.64	62.31	0.13	0.99	0.51	5.54	3.12	20.78	9.01	2,641.52	25.98
1988	0.55	23.00	1.50	1,465.28	10.42	75.10	0.42	3.07	0.61	6.62	4.62	30.78	9.36	2,744.16	23.41
1989	0.39	16.19	1.70	1,660.16	9.40	68.12	0.30	2.21	0.60	6.56	5.30	35.33	9.60	2,826.00	27.47

TABLE 4 – INDUSTRIAL ENERGY CONSUMPTION ESTIMATES

Year	Coal		Natural Gas		Heating Oil		Kerosene		Propane		Residual		Wood		Hydro-Electric		Electricity		Total Energy
	Thous. Tons	TBTU	Million Cubic Ft.	TBTU	Million Gallons	TBTU	Million Gallons	TBTU	Million Gallons	TBTU	Million Gallons	TBTU	Thous. Tons	TBTU	KWH Mill.	TBTU	Million KWH	TBTU	TBTU
1960	588.63	14.42			16.90	2.34	4.30	0.58	1.67	0.15	110.61	16.59	140.63	1.46	946.40	9.75	1,246.32	4.25	49.56
1961	592.58	14.52			17.35	2.41	4.68	0.64	1.76	0.16	100.86	15.13	150.00	1.56	882.65	9.09	1,294.58	4.42	47.92
1962	550.11	13.48			19.57	2.71	4.97	0.68	1.80	0.16	56.54	8.48	159.38	1.66	836.33	8.61	1,373.97	4.69	40.47
1963	355.17	8.70			20.19	2.80	5.68	0.77	2.73	0.25	55.60	8.34	168.75	1.76	950.73	9.79	1,403.10	4.79	37.20
1964	210.04	5.15			20.99	2.91	9.73	1.32	3.13	0.29	128.89	19.33	178.13	1.85	833.98	8.59	1,492.62	5.09	44.54
1965	198.18	4.86			20.98	2.91	11.67	1.59	4.38	0.40	53.22	7.98	187.50	1.95	707.38	7.29	1,714.68	5.85	32.82
1966	186.82	4.58			24.20	3.36	7.26	0.99	5.60	0.51	89.23	13.39	219.37	2.28	751.35	7.74	1,840.93	6.28	39.12
1967	146.90	3.60	101.10	0.10	27.95	3.88	22.08	3.00	5.91	0.54	103.40	15.51	251.25	2.61	857.29	8.83	1,919.55	6.55	44.63
1968	127.78	3.13	223.08	0.23	32.47	4.50	3.33	0.45	4.81	0.44	105.22	15.78	281.25	2.93	911.95	9.39	2,219.59	7.57	44.43
1969	123.60	3.03	313.52	0.32	34.75	4.82	2.38	0.32	7.48	0.68	161.63	24.24	309.37	3.22	858.02	8.84	2,362.87	8.06	53.54
1970	46.63	1.14	351.83	0.36	33.81	4.69	2.27	0.31	7.50	0.69	214.93	32.24	337.50	3.51	957.90	9.87	2,369.90	8.09	60.89
1971	54.68	1.34	425.95	0.44	34.85	4.83	2.32	0.32	7.83	0.72	484.68	72.70	412.50	4.29	825.96	8.51	2,375.88	8.11	101.25
1972	25.49	0.62	448.68	0.46	33.93	4.71	2.40	0.33	10.15	0.93	485.88	72.88	468.75	4.88	893.48	9.20	2,524.77	8.61	102.62
1973	27.41	0.67	596.33	0.61	33.73	4.68	1.75	0.24	9.96	0.91	449.89	67.48	515.63	5.36	964.50	9.93	2,612.19	8.91	98.80
1974	51.67	1.27	545.98	0.56	30.73	4.26	1.67	0.23	8.15	0.75	376.40	56.46	628.13	6.53	881.51	9.08	2,766.90	9.44	88.57
1975	31.05	0.76	699.00	0.72	28.66	3.98	2.48	0.34	10.16	0.93	311.79	46.77	712.50	7.41	840.11	8.65	2,477.47	8.45	78.00
1976	25.14	0.62	745.00	0.76	32.27	4.48	2.81	0.38	10.43	0.95	394.07	59.11	761.25	7.92	1,020.08	10.51	2,652.23	9.05	93.78
1977	4.00	0.10	751.00	0.77	34.21	4.74	2.86	0.39	10.36	0.95	409.53	61.43	785.63	8.17	1,062.06	10.94	2,961.43	10.10	97.59
1978	15.69	0.38	766.00	0.78	29.37	4.07	2.64	0.36	10.29	0.94	333.01	49.95	810.00	8.42	946.05	9.74	3,164.00	10.80	85.46
1979	21.00	0.51	759.77	0.78	31.72	4.40	1.50	0.20	24.68	2.26	292.92	43.94	832.50	8.66	1,019.68	10.50	3,335.00	11.38	82.63
1980	97.96	2.40	747.00	0.76	31.98	4.44	1.21	0.16	16.04	1.47	169.62	25.44	1,305.00	13.57	982.10	10.12	3,470.00	11.84	70.20
1981	90.49	2.22	705.69	0.72	31.30	4.34	0.50	0.07	12.10	1.11	220.45	33.07	1,500.00	15.60	988.24	10.18	3,419.15	11.67	78.97
1982	227.12	5.56	840.82	0.86	38.44	5.33	0.92	0.12	13.83	1.27	193.33	29.00	1,853.10	19.27	988.34	10.18	3,713.68	12.67	84.27
1983	196.73	4.82	755.47	0.77	26.71	3.70	0.81	0.11	10.37	0.95	176.28	26.44	1,402.06	14.58	994.58	10.24	4,302.14	14.68	76.30
1984	150.03	3.68	787.10	0.81	27.39	3.80	0.47	0.06	9.58	0.88	170.98	25.65	1,540.79	16.02	975.95	10.05	3,978.09	13.57	74.52
1985	158.02	3.87	865.20	0.89	19.14	2.65	0.64	0.09	7.78	0.71	179.29	26.89	1,498.06	15.58	977.47	10.07	4,067.05	13.88	74.63
1986	312.57	7.66	712.84	0.73	23.32	3.23	0.39	0.05	14.76	1.35	183.40	27.51	1,603.08	16.67	970.09	9.99	4,135.34	14.11	81.31
1987	226.58	5.55	865.31	0.89	38.55	5.35	0.92	0.13	11.32	1.04	241.09	36.16	1,899.37	19.75	1,021.11	10.52	4,351.06	14.85	94.22
1988	240.61	5.89	1,165.40	1.19	51.89	7.20	1.07	0.15	19.81	1.81	221.21	33.18	1,366.58	14.21	963.34	9.92	4,616.05	15.75	89.31
1989	246.96	6.05	1,367.19	1.40	45.43	6.30	0.74	0.10	17.49	1.60	280.00	42.00	1,359.93	14.14	1,103.05	11.36	4,601.41	15.70	98.66

Wood data derived from prior energy resource plans and DEP "Annual Fuel Usage Report". Wood data excludes estimated industrial sector consumption used to generate electricity for sale to utilities.

KWH for hydro represents electric generation (output). Tbtu's represent estimated value of energy input.

Residual oil consumption data for 1987-1989 from National Emissions Data System as reported by Maine DEP

TABLE 5 – TRANSPORTATION ENERGY CONSUMPTION ESTIMATES

Year	Aviation Fuel		Jet Fuel		Diesel Fuel		Motor Gasoline		Total Energy
	TBTU	Million Gallons	TBTU	Million Gallons	TBTU	Million Gallons	TBTU	Million Gallons	TBTU
1960	0.24	2.04	2.72	20.13	7.29	52.553	44.01	352.086	51.54
1961	0.23	1.91	2.78	20.57	6.17	44.479	44.55	356.405	50.95
1962	0.36	2.97	3.01	22.29	5.62	40.557	44.99	359.913	50.97
1963	0.25	2.05	3.08	22.81	6.69	48.238	45.70	365.580	52.63
1964	0.47	3.92	3.13	23.19	7.33	52.881	46.21	369.661	54.01
1965	0.36	2.99	2.59	19.15	6.98	50.350	47.97	383.737	55.31
1966	0.63	5.29	2.70	20.00	7.55	54.448	49.48	395.847	57.67
1967	0.43	3.60	3.00	22.19	5.61	40.466	50.50	404.031	56.55
1968	0.32	2.63	3.76	27.89	7.29	52.549	53.42	427.367	61.02
1969	0.14	1.20	5.22	38.65	8.33	60.077	54.86	438.861	63.33
1970	0.37	3.06	5.89	43.66	8.07	58.167	57.91	463.309	66.35
1971	0.35	2.91	6.57	48.67	8.73	62.944	60.40	483.227	69.48
1972	0.36	3.03	6.41	47.48	9.60	69.220	63.58	508.671	73.55
1973	0.35	2.90	7.48	55.42	9.66	69.683	65.64	525.108	75.65
1974	0.32	2.66	5.81	43.03	9.22	66.510	65.07	520.579	74.62
1975	0.28	2.37	5.26	38.94	8.88	64.016	66.43	531.412	75.59
1976	0.32	2.65	10.58	78.39	10.58	76.301	69.81	558.511	80.71
1977	0.33	2.77	12.69	94.00	11.19	80.661	70.85	566.833	82.37
1978	0.32	2.68	12.86	95.25	11.50	82.925	71.79	574.306	83.61
1979	0.36	3.02	12.17	90.17	10.63	76.670	65.35	522.770	76.34
1980	0.41	3.44	10.24	75.84	9.28	66.920	61.82	494.534	71.51
1981	0.24	2.00	8.43	62.42	8.74	63.018	60.77	486.187	69.75
1982	0.19	1.56	8.68	64.28	10.69	77.054	62.02	496.182	72.90
1983	0.23	1.90	8.18	60.62	11.72	84.473	63.50	508.013	75.45
1984	0.22	1.83	8.27	61.23	16.63	119.900	66.35	530.800	83.20
1985	0.21	1.74	8.93	66.16	17.89	129.000	68.50	548.000	86.60
1986	0.29	2.42	8.80	65.19	19.83	143.000	72.75	582.000	92.87
1987	0.27	2.24	9.89	73.29	22.05	159.000	75.88	607.000	98.20
1988	0.33	2.78	11.88	88.02	24.69	178.000	82.25	658.000	107.27
1989	0.30	2.50	12.40	91.85	25.38	183.000	78.50	628.000	104.18

Data for all energy resources from the 1989 DOE "State Energy Data Report" and the Maine DOT.

Table does not include fuels consumed by the transportation sector not used for energy specific purposes (ie. lubricants and road and asphalt oil). Total energy does not include jet fuel

TABLE 6 -- COMMERCIAL, INDUSTRIAL AND TRANSPORTATION ENERGY PRICES (NOMINAL AND REAL)

Real Prices in 1982 dollars

Year	Coal		Natural Gas		Distillate Fuel		Propane		Residual		Commercial Electricity		Industrial Electricity		Gasoline		Diesel	
	$/ton		$/ccf		$/gal		$/gal		$/gal		c/KWH		c/KWH		$/gal		$/gal	
	Nom	Real	Nom	Real	Nom	Real	Nom	Real	Nom	Real	Nom	Real	Nom	Real	Nom	Real	Nom	Real
1960	32.40	104.85			0.13	0.42	0.12	0.39	0.08	0.26	3.20	10.36	1.30	4.21	0.29	0.94	0.26	0.84
1961	32.57	104.39			0.14	0.45	0.11	0.35	0.08	0.27	3.20	10.26	1.30	4.17	0.29	0.93	0.27	0.87
1962	32.90	103.13			0.13	0.41	0.10	0.31	0.08	0.24	3.10	9.72	1.30	4.08	0.29	0.91	0.26	0.82
1963	33.19	102.44			0.13	0.40	0.10	0.31	0.07	0.22	3.00	9.26	1.30	4.01	0.29	0.90	0.26	0.80
1964	33.48	101.76			0.13	0.40	0.11	0.33	0.07	0.21	2.90	8.81	1.30	3.95	0.30	0.91	0.26	0.79
1965	33.90	100.30			0.14	0.41	0.11	0.33	0.07	0.21	2.80	8.28	1.30	3.85	0.31	0.92	0.27	0.80
1966	34.53	98.66	0.21	0.60	0.14	0.40	0.11	0.31	0.07	0.21	2.70	7.71	1.20	3.43	0.31	0.89	0.27	0.77
1967	35.21	98.08	0.19	0.53	0.15	0.42	0.12	0.33	0.07	0.20	2.70	7.52	1.20	3.34	0.33	0.92	0.28	0.78
1968	36.32	96.34	0.17	0.45	0.15	0.40	0.10	0.27	0.08	0.20	2.60	6.90	1.10	2.92	0.34	0.90	0.28	0.74
1969	37.75	94.85	0.17	0.43	0.15	0.38	0.09	0.23	0.07	0.18	2.60	6.53	1.10	2.76	0.36	0.90	0.28	0.70
1970	39.38	93.76	0.18	0.43	0.16	0.38	0.12	0.29	0.08	0.19	2.60	6.19	1.10	2.62	0.38	0.90	0.29	0.69
1971	40.58	91.40	0.19	0.43	0.17	0.38	0.13	0.30	0.12	0.27	2.60	5.86	1.20	2.70	0.39	0.88	0.30	0.68
1972	38.01	81.74	0.21	0.45	0.17	0.37	0.14	0.29	0.10	0.21	2.70	5.81	1.30	2.80	0.38	0.82	0.30	0.65
1973	38.70	78.18	0.20	0.40	0.20	0.40	0.13	0.27	0.15	0.30	2.80	5.66	1.30	2.63	0.40	0.81	0.33	0.67
1974	44.30	82.04	0.24	0.44	0.34	0.63	0.22	0.41	0.31	0.57	3.20	5.93	1.90	3.52	0.54	1.00	0.47	0.87
1975	68.21	115.61	0.26	0.44	0.40	0.68	0.30	0.50	0.31	0.52	3.70	6.27	2.10	3.56	0.57	0.97	0.53	0.90
1976	87.14	138.10	0.28	0.44	0.41	0.65	0.33	0.52	0.29	0.46	3.60	5.71	1.90	3.01	0.59	0.94	0.54	0.86
1977	79.55	118.20	0.34	0.51	0.46	0.68	0.34	0.50	0.32	0.47	4.00	5.94	2.10	3.12	0.63	0.94	0.59	0.88
1978	70.46	97.59	0.38	0.53	0.46	0.64	0.35	0.49	0.30	0.42	4.10	5.68	2.20	3.05	0.64	0.89	0.59	0.82
1979	81.97	104.29	0.39	0.50	0.65	0.83	0.41	0.52	0.44	0.57	4.90	6.23	2.90	3.69	0.92	1.17	0.78	0.99
1980	93.48	109.08	0.47	0.55	0.92	1.07	0.55	0.65	0.62	0.72	6.20	7.23	4.20	4.90	1.24	1.45	1.05	1.23
1981	72.00	76.60	0.58	0.62	1.13	1.20	0.59	0.62	0.77	0.82	6.90	7.34	4.80	5.11	1.37	1.46	1.31	1.39
1982	78.00	78.00	0.70	0.70	1.11	1.11	0.66	0.66	0.69	0.69	7.20	7.20	4.70	4.70	1.28	1.28	1.25	1.25
1983	85.00	81.81	0.84	0.81	0.96	0.92	0.71	0.68	0.65	0.63	6.50	6.26	4.50	4.33	1.26	1.21	1.22	1.17
1984	85.00	78.92	0.81	0.75	0.97	0.90	0.69	0.64	0.71	0.66	7.30	6.78	5.00	4.64	1.24	1.15	1.28	1.19
1985	80.00	72.14	0.76	0.69	0.90	0.81	0.94	0.85	0.63	0.57	7.80	7.03	5.20	4.69	1.25	1.13	1.26	1.14
1986	80.00	70.30	0.71	0.62	0.64	0.56	1.03	0.91	0.35	0.31	7.80	6.85	4.90	4.31	1.01	0.89	1.04	0.91
1987	80.00	68.14	0.67	0.57	0.63	0.54	1.02	0.87	0.39	0.33	7.10	6.05	4.70	4.00	1.02	0.87	1.07	0.91
1988	82.00	67.60	0.59	0.48	0.61	0.50	1.00	0.82	0.33	0.27	7.30	6.02	5.20	4.29	1.05	0.86	1.06	0.87
1989	84.00	66.51	0.54	0.43	0.72	0.57	N/A	N/A	0.40	0.32	7.34	5.81	5.22	4.13	1.13	0.89	1.12	0.89

Data between 1970-1986 is from the 1987 Maine Energy Resources Plan. Between 1960-1970, the data is from the 1982 Maine Energy Resources Plan.

Propane data is from the "State Price and Expenditure Report, 1988." This includes data through 1988.

Diesel and gasoline prices for 1987-1989 were updated from the State Planning Office's weekly surveys.

Electricity prices were updated with data from CMP's,BHE's, and MPS's annual reports.

All other categories were updated with estimates based on information published the "SEPER,1988" report.

TABLE 7 – ENERGY CONSUMPTION FOR ELECTRICITY GENERATION

Year	Distillate		Residual		Nuclear		Hydro-Electric		Wood		Total Energy
	TBTU	Million Gallons	TBTU	Million Gallons	TBTU	Million KWH	TBTU	Million KWH	TBTU	Thous. Tons	TBTU
1960	0.220	1.583	11.613	77.421			22.460	2,180.587			34.293
1961	0.283	2.042	14.976	99.837			20.606	2,000.619			35.865
1962	0.325	2.342	17.175	114.499			20.397	1,980.286			37.896
1963	0.300	2.164	15.873	105.820			22.601	2,194.260			38.774
1964	0.381	2.747	20.146	134.308			19.768	1,919.194			40.295
1965	0.520	3.748	27.493	183.288			16.652	1,616.677			44.665
1966	0.515	3.715	27.246	181.640			20.591	1,999.107			48.352
1967	0.554	3.992	29.284	195.228			21.278	2,065.838			51.116
1968	0.594	4.286	31.436	209.576			21.550	2,092.230			53.581
1969	0.562	4.053	29.724	198.162			24.854	2,412.993			55.140
1970	0.555	4.005	29.987	199.912			25.489	2,474.682			56.032
1971	1.266	9.131	30.746	204.976			30.183	2,930.409			62.196
1972	1.504	10.842	34.170	227.798	0.586	54.220	37.875	3,677.200			74.134
1973	0.825	5.945	30.643	204.289	36.540	3,383.307	51.310	4,981.561			119.318
1974	0.515	3.710	25.103	167.355	39.893	3,693.778	46.779	4,541.671			112.290
1975	0.243	1.751	17.680	117.870	49.586	4,591.256	34.010	3,301.963			101.519
1976	0.225	1.624	11.667	77.777	65.496	6,064.463	45.896	4,455.893			123.284
1977	0.156	1.122	8.207	54.712	55.386	5,128.319	56.843	5,518.755			120.591
1978	0.159	1.146	10.950	72.999	58.582	5,424.280	41.805	4,058.729			111.496
1979	0.219	1.579	14.021	93.476	48.928	4,530.396	51.717	5,021.021			114.885
1980	0.354	2.553	22.757	151.713	48.040	4,448.178	54.044	5,247.011			125.196
1981	0.231	1.663	23.415	156.099	57.488	5,322.935	51.119	4,962.977			132.252
1982	0.326	2.351	19.753	131.688	50.097	4,638.588	51.442	4,994.366	6.70	644.40	128.320
1983	0.360	2.595	21.716	144.775	62.488	5,785.918	74.051	7,189.437	13.21	1,269.81	171.821
1984	0.250	1.800	22.356	149.043	55.552	5,143.666	79.409	7,709.629	13.71	1,318.59	171.280
1985	0.166	1.194	21.579	143.858	57.897	5,360.852	24.866	2,414.147	14.26	1,370.69	118.762
1986	0.193	1.394	27.406	182.708	67.405	6,241.178	47.281	4,590.379	17.35	1,668.65	159.639
1987	0.201	1.449	27.139	180.925	43.566	4,033.918	57.681	5,600.082	29.62	2,848.22	158.208
1988	0.295	2.128	30.525	203.499	53.900	4,990.722	57.653	5,597.382	35.64	3,426.57	178.009
1989	0.300	2.163	31.600	210.667	74.400	6,888.889	64.831	6,294.265	39.42	3,790.60	210.553

Wood represents estimated consumption by the industrial sector cogeneration and stand-alone powerplants to produce electricity for sale to utilities.

Data represents total consumption in Maine and includes (excludes) energy used to produce electricity for export (import).

KWH for hydro-electric and nuclear power represents electricity generation. All other natural unit and all TBTU data represents estimated energy input.

Hydro-electric data for the years 1987-1989 from the State Planning Office.

TABLE 8 -- MAINE ENERGY CONSUMPTION BY MAJOR FUEL TYPE: NATURAL UNITS

Year	Coal	Natural Gas	Heating Oil	Kerosene	Propane	Residual	Diesel	Gasoline	Total Oil	Wood	Nuclear	Hydro-Electric	Total Electricity Consumed
	Thous. Tons	Million Cubic Feet	Million Gallons	Million Gallons	Million Gallons	Million Gallons	Million Gallons	Million Gallons	Million Barrels	Thous. Tons	Million KWH	Million KWH	Million KWH
1960	796.84		258.86	95.65	19.32	194.12	52.55	354.12	23.21	550.20		3,126.99	2,781.96
1961	787.01		303.80	118.90	21.22	206.33	44.48	358.31	25.07	567.02		2,883.27	2,937.10
1962	719.32		322.02	105.32	23.84	174.13	40.56	362.89	24.49	583.84		2,816.61	3,121.41
1963	506.40		346.79	113.00	27.55	164.59	48.24	367.63	25.42	600.66		3,144.99	3,229.65
1964	326.42		315.77	89.69	30.15	270.56	52.88	373.58	26.97	617.49		2,753.17	3,424.42
1965	322.92		336.89	85.53	24.03	239.55	50.35	386.72	26.74	634.31		2,324.06	3,758.05
1966	299.06	509.50	317.17	73.10	26.26	275.97	54.45	401.13	27.34	673.63		2,750.46	3,936.00
1967	227.10	753.74	375.93	98.54	25.40	303.64	40.47	407.63	29.80	712.95		2,923.13	4,004.14
1968	185.64	799.89	394.14	95.10	25.40	320.71	52.55	430.00	31.38	750.40		3,004.18	4,459.41
1969	172.74	1,112.41	417.93	93.96	27.95	369.00	60.08	440.06	33.55	785.97		3,271.01	4,805.85
1970	87.61	1,283.78	438.36	74.34	26.10	427.10	58.17	466.37	35.49	821.54		3,432.58	5,068.11
1971	93.09	1,440.91	446.67	75.13	26.02	717.26	62.94	486.14	43.19	903.99		3,756.36	5,317.42
1972	56.75	1,518.00	473.04	74.88	31.48	741.20	69.22	511.70	45.27	967.69	54.22	4,570.68	5,826.65
1973	57.41	1,618.19	455.03	54.78	31.88	679.72	69.68	528.01	43.31	1,022.01	3,383.31	5,946.06	6,132.22
1974	79.20	1,596.47	438.08	46.53	32.16	565.20	66.51	523.24	39.80	1,149.40	3,693.78	5,423.18	6,414.80
1975	53.05	1,930.00	419.21	43.21	39.00	443.64	64.02	533.78	36.73	1,241.22	4,591.26	4,142.07	6,532.33
1976	42.49	2,034.00	494.97	55.90	46.42	494.22	76.30	561.16	41.17	1,379.34	6,064.46	5,475.97	7,121.22
1977	24.43	1,999.00	541.15	44.45	48.19	487.39	80.66	569.61	42.18	1,493.07	5,128.32	6,580.81	7,571.27
1978	29.10	2,115.00	491.20	32.89	43.74	425.06	82.93	576.99	39.35	1,554.68	5,424.28	5,004.78	7,977.00
1979	31.51	2,111.33	403.67	25.14	68.53	403.01	76.67	525.79	35.78	1,718.67	4,530.40	6,040.70	8,072.00
1980	121.79	2,166.00	379.48	21.01	34.72	349.90	66.92	497.97	32.14	2,280.53	4,448.18	6,229.11	8,185.00
1981	127.16	2,323.27	325.38	12.09	28.26	391.65	63.02	488.19	31.16	2,981.91	5,322.94	5,951.22	8,239.45
1982	280.77	2,619.56	307.84	13.18	32.59	351.88	77.05	497.75	30.48	4,009.20	4,638.59	5,982.71	8,726.62
1983	238.66	2,423.72	224.27	14.74	32.67	352.15	84.47	509.91	29.01	4,294.50	5,785.92	8,184.02	9,436.61
1984	200.46	2,464.10	229.13	13.63	20.86	350.19	119.90	532.63	30.15	4,329.14	5,143.67	8,685.58	9,622.70
1985	206.19	2,547.07	266.04	19.69	24.41	353.44	129.00	549.74	31.96	4,397.31	5,360.85	3,391.61	9,824.29
1986	376.25	2,480.84	328.97	14.14	39.51	404.82	143.00	584.42	36.07	4,619.99	6,241.18	5,560.47	10,202.98
1987	277.30	2,671.09	331.73	16.96	48.27	442.79	159.00	609.24	38.29	6,088.01	4,033.92	6,621.19	10,718.18
1988	279.64	3,200.35	379.85	19.24	63.93	455.49	178.00	660.78	41.84	5,921.93	4,990.72	6,560.72	11,263.83
1989	275.30	3,613.28	354.37	19.12	63.39	526.00	183.00	630.50	37.73	6,193.08	6,888.89	7,397.31	11,436.41

KWH for hydro-electric and nuclear power represents electricity generation (output). See Tbtu data for estimated energy input.

Gasoline includes aviation fuel; total oil excludes jet fuel.

TABLE 9 -- MAINE ENERGY CONSUMPTION BY MAJOR FUEL TYPE: TRILLION BTU'S

Year	Heating Oil	Kerosene	Propane	Residual	Diesel	Gasoline	Total Oil	Coal	Natural Gas	Wood	Nuclear	Hydro-Electric	Total Energy
1960	35.90	13.01	1.77	29.12	7.29	44.26	131.34	19.48		7.24		32.21	190.27
1961	42.13	16.17	1.95	30.95	6.17	44.78	142.15	19.25		7.44		29.70	198.53
1962	44.66	14.32	2.18	26.12	5.62	45.35	138.26	17.59		7.64		29.01	192.51
1963	48.10	15.37	2.53	24.69	6.69	45.94	143.32	12.38		7.85		32.39	195.93
1964	43.79	12.20	2.77	40.58	7.33	46.68	153.35	7.98		8.05		28.36	197.74
1965	46.72	11.63	2.20	35.93	6.98	48.33	151.80	7.89		8.25		23.94	191.88
1966	43.99	9.94	2.41	41.39	7.55	50.12	155.40	7.31	0.52	8.69		28.33	200.25
1967	52.14	13.40	2.33	45.55	5.61	50.94	169.97	5.55	0.77	9.12		30.11	215.52
1968	54.66	12.93	2.33	48.11	7.29	53.74	179.06	4.54	0.82	9.54		30.94	224.90
1969	57.96	12.78	2.57	55.35	8.33	55.00	191.99	4.23	1.14	9.94		33.69	240.99
1970	60.80	10.11	2.40	64.07	8.07	58.28	203.72	2.14	1.31	10.34		35.36	252.87
1971	61.95	10.22	2.39	107.59	8.73	60.75	251.63	2.28	1.48	11.22		38.69	305.29
1972	65.61	10.18	2.89	111.18	9.60	63.95	263.41	1.39	1.55	11.91	0.59	47.08	325.93
1973	63.11	7.45	2.94	101.96	9.66	65.99	251.10	1.40	1.66	12.50	36.54	61.24	364.45
1974	60.76	6.33	2.96	84.78	9.22	65.39	229.44	1.94	1.63	13.88	39.89	55.86	342.65
1975	58.14	5.88	3.58	66.55	8.88	66.71	209.73	1.30	1.98	14.87	49.59	42.66	320.12
1976	68.65	7.60	4.26	74.13	10.58	70.13	235.36	1.04	2.08	16.63	65.50	56.40	377.01
1977	75.05	6.04	4.43	73.11	11.19	71.19	241.01	0.60	2.05	18.15	55.39	67.78	384.96
1978	68.12	4.47	4.03	63.76	11.50	72.11	224.00	0.71	2.17	18.92	58.58	51.55	355.93
1979	55.98	3.42	6.30	60.45	10.63	65.71	202.49	0.77	2.16	21.15	48.93	62.22	337.73
1980	52.63	2.86	3.21	52.49	9.28	62.23	182.69	2.98	2.32	27.33	48.04	64.16	327.52
1981	45.13	1.64	2.60	58.75	8.74	61.01	177.87	3.11	2.38	36.50	57.49	61.30	338.65
1982	42.70	1.79	3.03	52.78	10.69	62.21	173.19	6.87	2.76	47.29	50.10	61.62	341.83
1983	31.10	2.01	3.04	52.82	11.72	63.73	164.42	5.84	2.49	50.67	62.49	84.30	370.20
1984	31.78	1.85	1.97	52.53	16.63	66.57	171.32	4.90	2.53	50.46	55.55	89.46	374.23
1985	36.90	2.68	2.28	53.02	17.89	68.71	181.47	5.04	2.62	51.39	57.90	34.93	333.35
1986	45.63	1.92	3.68	60.72	19.83	73.04	204.82	9.20	2.55	53.04	67.40	57.27	394.29
1987	46.01	2.31	4.46	66.44	22.05	76.14	217.41	6.78	2.75	68.27	43.57	68.20	406.98
1988	52.68	2.62	5.93	68.32	24.69	82.58	236.82	6.84	3.28	65.76	53.90	67.58	434.19
1989	49.10	2.60	5.80	78.90	25.38	78.80	240.58	6.74	3.70	68.27	74.40	76.19	469.88

Tbtu data for nuclear and hydro represents estimated value of energy input.
Gasoline includes aviation fuel; total oil excludes jet fuel

TABLE 10 -- ADDITIONAL DATA

Year	Population	Households	Registered Vehicles	Vehicle Miles Travelled	Real Gross State Product (1982 = 100)	Real Total Personal Income (1982 = 100)	Price Deflators (1982 Dollars)
60	969,000	280,355					30.9
61	995,000	282,630					31.2
62	994,000	284,905					31.9
63	993,000	287,180			$7,309,000,000	$6,214,518,519	32.4
64	993,000	289,455			$7,718,000,000	$6,608,829,787	32.9
65	997,000	291,730			$8,111,000,000	$6,972,991,124	33.8
66	999,000	294,005			$8,315,000,000	$7,206,588,571	35
67	1,004,000	296,280			$8,367,000,000	$7,389,746,518	35.9
68	994,000	298,555			$8,480,000,000	$7,531,623,342	37.7
69	992,000	300,830			$8,769,000,000	$7,800,022,613	39.8
70	994,000	303,104			$8,844,000,000	$8,081,361,905	42
71	1,015,000	311,884			$8,958,000,000	$8,186,209,459	44.4
72	1,034,000	320,664			$9,449,000,000	$8,545,698,925	46.5
73	1,046,000	329,444			$9,949,000,000	$9,074,688,889	49.5
74	1,059,000	338,224			$9,976,000,000	$9,252,198,148	54
75	1,072,000	347,000			$9,672,000,000	$9,028,803,390	59.3
76	1,088,000	356,000			$10,555,000,000	$9,704,916,006	63.1
77	1,104,000	363,000			$10,916,000,000	$9,961,199,108	67.3
78	1,114,000	371,000	1,485,078	7,972,000,000	$11,434,000,000	$10,251,993,075	72.2
79	1,123,000	383,000	1,506,079	7,112,000,000	$11,765,000,000	$10,524,477,099	78.6
80	1,125,000	395,000	1,520,080	7,465,000,000	$11,731,000,000	$10,812,072,345	85.7
81	1,133,000	406,000	1,539,081	7,587,000,000	$12,013,000,000	$10,880,047,872	94
82	1,137,000	409,000	1,546,082	7,649,000,000	$12,099,000,000	$10,901,708,000	100
83	1,145,000	413,000	1,558,083	7,929,000,000	$12,813,000,000	$11,338,648,701	103.9
84	1,157,000	424,000	1,581,084	9,345,000,000	$13,652,000,000	$11,991,819,870	107.7
85	1,164,000	431,000	1,595,085	9,277,000,000	$14,238,000,000	$12,494,036,069	110.9
86	1,172,000	438,000	1,610,086	10,022,000,000	$15,056,000,000	$13,212,334,798	113.8
87	1,186,000	448,000	1,634,087	10,766,000,000	$15,914,000,000	$14,130,936,968	117.4
88	1,206,000	460,000	1,666,088	11,401,000,000	$16,662,000,000	$14,958,166,529	121.3
89	1,216,964	465,000	1,682,053	11,739,000,000	$18,596,199,525	$15,724,524,941	126.3
90	1,227,928	470,000	1,697,928				

Sources: All data except Registered Vehicles and VMT from State Planning Office. Other data from Maine DOT.

TABLE 11 – BTU CONVERSION FACTORS

Energy Resource	*Unit*	*Heat Content* MMBtu/unit	unit/MMBtu	*KBtu/lb*	*Unit/lb*
Propane	gal	0.0915	10.93	19.7	0.215
Gasoline	gal	0.125	8.00	20.1	0.1608
Kerosene	gal	0.136	7.35	19.76	0.1453
Diesel	gal	0.13869	7.21	19.46	0.1403
Distillate (#2)	gal	0.13869	7.21	19.46	0.1403
Residual (#6)	gal	0.150	6.67	19.0	0.1269
Wood*					
a) industrial	tons	10.4	0.096	5.2	0.0005
	cord	19.5	0.051		
b) residential	tons	14.1	0.071	7.05	0.0005
	cord	21	0.048		
Coal					
a) industrial	tons	24.5	0.041	12.25	0.0005
b) commercial	tons	24	0.042	12	0.0005
c) residential	tons	25	0.040	12.5	0.0005
Municipal Solid Waste	tons	10.16	0.098	5.08	0.0005
Natural Gas	ccf	0.1024	9.766	22.9	0.2236
Electricity	MWH	3.412			
Nuclear Power	MWH	10.8			
Hydro-electric Power	MWH	10.3			

TBTU = 1 trillion BTUs
MMBTU = 1 million BTUs
KBtu = 1 thousand BTUs
42 Gallons = 1 bbl (barrel)
ccf = 100 cubic feet
MWH = megawatt hour = 1000 KWH

* These factors reflect an even mix of hard and soft wood consumed in Maine.
It is assumed that the utility and industrial sectors consumed green wood and the residential sector consumed air dry wood.
Green = 40 percent moisture content. Air Dry = 20 percent moisture content.
Heat factors for coal are based on these assumptions: industrial consumption is an even mix between anthracite and bituminous; commercial is bituminous; and residential is anthracite.

Sources:
"1988 State Energy Data Report," "Mark's Standard Handbook for Engineers," EIA's "Coal Data: A Reference," Washington State Energy Office, "National Energy Data System" and the Maine DECD Wood Burning Guide.

Table 12 -- 1991 Maine Electricity Mix

Notes:

1) This table represents the energy resources used to provide the electricity used in Maine in 1991. It shows the electricity produced and purchased by Maine utilities for sale to consumers in Maine. Facilities that serve multiple parties, such as Maine Yankee, are listed several times according purchasing utility.

2) These data do not show electricity that is produced in Maine for export, such approximately half of Maine Yankee, and a portion of the output from Wyman Unit #4 and certain cogeneration facilities. Maine utilities operate in a dynamic regional market: Some of the power produced in Maine is committed to utilities elsewhere while some of the power used in Maine is produced elsewhere.

3) These data only show energy that is bought and sold through the utility grid. In addition, Maine industries produce and use approximately 1 million MWH's of hydropower and a significant amount of additional biomass-fired electricity that is used on site and is not connected to the grid. In this context, the absolute share of hydro and biomass is significantly higher than indicated in the summary at the end of the table.

4) The "Biomass/Multi" category represents multi-fuel cogeneration units as listed. These plants use a variety of biomass materials (wood, waste-wood, mill residues, mill sludge, etc.) and other fuels, such as coal, oil, and tires. The "MSW" category includes some natural gas.

5) Sources include State Planning Office surveys, utility annual reports and FERC Form 1's.

Project/Facility Name	Location	Utility	Owner/Operator	Type	MW's	MWH's
Albert R Lavalley	York	CMP	IND	Biomass	1.25	2,566.1
Babcock-Ultrapower/ W Enfield	Penobscot	BHE	IND	Biomass	16.50	19,329.6
Babcock-Ultrapower/ Jonesboro	Washington	BHE	IND	Biomass	16.50	24,115.4
Beaverwood Joint Venture	Penobscot	BHE	IND	Biomass	11.40	90,465.4
Dirigo Dowels	Somerset	CMP	IND	Biomass	0.30	1,188.0
Downeast Peat	Washington	23 MW Export	IND	Biomass		
Fairfield Energy Venture	Aroostook	MPS	IND	Biomass	0.00	210.3
Fairfield Energy Venture	Aroostook	CMP	IND	Biomass	32.00	241,781.9
Forster Mfg/ Mattawamkeag	Penobscot	BHE	IND	Biomass	1.00	638.7
Forster Mfg/ Strong	Franklin	CMP	IND	Biomass	1.25	3,041.6
Gorbell-Thermo Electron	Somerset	CMP	IND	Biomass	13.80	88,134.9
Greenville/ Swift River	Piscataquis	CMP	IND	Biomass	13.80	76,426.0
Lewiston Steam And Power (LFC)	Androscoggin	CMP	IND	Biomass	11.80	62,524.7
Robbins Lumber	Waldo	CMP	IND	Biomass	1.20	3,586.2
Stratton Energy Associates	Franklin	CMP	IND	Biomass	36.80	296,555.2
Wheelabrator-Sherman	Penobscot	MPS	IND	Biomass	16.50	124,699.0
Boise Cascade	Oxford	CMP	IND	Biomass/Multi	75.00	589,716.1
Champion Cogenerating	Hancock	CMP	IND	Biomass/Multi	32.70	196,025.6
Georgia Pacific/E. Millinocket(GNP)	Washington	BHE	IND	Biomass/Multi	20.00	36,925.4
Scott Paper (S D W/ Somerset)	Somerset	CMP	IND	Biomass/Multi	87.00	583,647.5
Scott Paper/ (S D W/ Westbrook)	Cumberland	CMP	IND	Biomass/Multi	62.50	511,020.1
Scott Paper/ Winslow	Kennebec	CMP	IND	Biomass/Multi	18.80	144,833.5
James River Corp.	Penobscot	BHE	IND	Biomass/Multi		156.0
Biomass Total					470.1	3,097,587.1
Canadian Imports	Canada	BHE	IMP	Can. Import	24.00	121,670.4
Canadian Imports	Canada	COOP	IMP	Can. Import	0.00	42,247.0
Canadian Imports	Canada	MPS	IMP	Can. Import	27.40	225,370.0
Canadian Imports	Canada	CMP	IMP	Can. Import	150.00	321,733.7
Total Canadian Imports					201.4	711,021.1
Ellsworth	Hancock	BHE	BHE	Hydro	9.20	31,244.3
Howland	Penobscot	BHE	BHE	Hydro	1.88	8,236.4
Medway	Penobscot	BHE	BHE	Hydro	3.44	30,410.1
Milford	Penobscot	BHE	BHE	Hydro	6.40	41,936.4
Orono	Penobscot	BHE	BHE	Hydro	2.33	12,453.4

Project/Facility Name	Location	Utility	Owner/Operator	Type	MW's	MWH's
Stillwater	Penobscot	BHE	BHE	Hydro	1.95	12,093.3
Veazie	Penobscot	BHE	BHE	Hydro	8.40	60,678.3
Bangor Hydro-Pacific/ W Enfield	Penobscot	BHE	IND	Hydro	13.00	102,184.5
ESI/ Milo Hydro	Piscataquis	BHE	IND	Hydro	0.66	2,499.6
Green Lake	Hancock	BHE	IND	Hydro	0.40	1,997.3
Maine Energy Partners	Penobscot	BHE	IND	Hydro	0.30	790.2
Pumpkin Hill Hydro	Penobscot	BHE	IND	Hydro	0.85	5,267.7
Sebec	Piscataquis	BHE	IND	Hydro	0.90	3,198.3
Androscoggin 3	Androscoggin	CMP	CMP	Hydro	3.60	25,290.5
Androscoggin Mill Lower	Androscoggin	CMP	CMP	Hydro	0.30	103.6
Androscoggin Mill Upper	Androscoggin	CMP	CMP	Hydro	2.40	997.2
Bar Mills	York	CMP	CMP	Hydro	4.00	24,283.1
Bates Mill Lower	Androscoggin	CMP	CMP	Hydro	0.50	364.2
Bates Mill Upper	Androscoggin	CMP	CMP	Hydro	3.90	5,773.5
Bonny Eagle	York	CMP	CMP	Hydro	7.20	55,896.8
Brunswick	Cumberland	CMP	CMP	Hydro	19.60	105,694.2
Cataract	York	CMP	CMP	Hydro	6.65	31,269.5
Cataract W Channel	York	CMP	CMP	Hydro	1.04	108.7
Continental Mills	Androscoggin	CMP	CMP	Hydro	1.58	2,750.2
Deer Rips	Androscoggin	CMP	CMP	Hydro	7.15	28,332.4
Fort Halifax/ Sebasticook #4	Kennebec	CMP	CMP	Hydro	1.50	8,014.5
Gulf Island	Androscoggin	CMP	CMP	Hydro	22.20	142,659.2
Harris	Somerset	CMP	CMP	Hydro	76.40	238,653.1
Hill Mill	Androscoggin	CMP	CMP	Hydro	2.16	600.0
Hiram	Oxford	CMP	CMP	Hydro	10.50	60,481.5
Messalonskee 2	Kennebec	CMP	CMP	Hydro	2.80	9,337.3
Messalonskee 3	Kennebec	CMP	CMP	Hydro	1.60	5,880.1
Messalonskee 4	Kennebec	CMP	CMP	Hydro	0.80	3,084.7
Messalonskee 5	Kennebec	CMP	CMP	Hydro	1.50	5,427.6
Monty	Androscoggin	CMP	CMP	Hydro	28.44	143,167.5
North Gorham	Cumberland	CMP	CMP	Hydro	2.25	10,707.1
Shawmut	Somerset	CMP	CMP	Hydro	8.65	61,585.9
Skelton	York	CMP	CMP	Hydro	16.80	114,792.6
West Buxton	York	CMP	CMP	Hydro	7.92	40,645.3

APPENDIX I

GLOSSARY OF TERMINOLOGY

COMMISSION ON COMPREHENSIVE ENERGY PLANNING

GLOSSARY

AMBIENT AIR QUALITY: That portion of the atmosphere, external to buildings, to which the general public has access.

ALTERNATIVE TRANSPORTATION FUEL: Fuel that is derived from sources other than gasoline or through a process of reformulation of gasoline. Examples of alternative fuel are methanol, ethanol, Compressed Natural Gas (CNG), Liquid Propane Gas (LPG), electric power, and highly reformulated gasoline.

AVOIDED COSTS: The incremental costs to an electric utility of electric energy or capacity or both which, but for the purchase from the qualifying facility or facilities, such utility would generate itself or purchase from another source.

BARREL: A volumetric unit of measure for crude oil and petroleum products equivalent to 42 U.S. gallons.

BIOMASS: Any organic matter which is available on a renewable basis including forest residues, agricultural crops and wastes, wood and wood waste, animal wastes, livestock operation residue, aquatic plants, and municipal waste. For the purposes of this report, biomass refers to wood and wood waste.

BIOMASS ENERGY: Biomass fuel, energy, or steam derived from the direct combustion of biomass for the generation of electricity, mechanical power, or industrial process heat.

BRITISH THERMAL UNIT (BTU): The amount of heat required to raise the temperature of one pound of water one degree Fahrenheit.

CORPORATE AVERAGE FUEL ECONOMY (CAFE): The Energy Policy and Conservation Act passed by the U.S. Congress in 1975 established energy efficiency standards called CAFE standards which require car manufacturers to meet strict energy efficiency standards. Presently, the range of new cars sold by each manufacturer is required to obtain an average of 27.5 mpg and light trucks 20 mpg.

CLEAN AIR ACT: (42 U.S.C. Section 7401, et seq.) as amended, establishes national ambient air quality emission standards to be implemented by participating states which are designed to reduce air pollution. It was enacted by Congress because of a growing awareness of the serious adverse public health effects resulting from air pollution.

COGENERATION: The technology of producing electric energy in combination with other forms of useful energy (thermal or mechanical) for industrial, commercial, heating, or cooling purposes, through the sequential use of an energy source. In typical electric generation, the heat used to

power generating turbines is vented into the atmosphere or a body of water.

COMMERCIAL SECTOR: Nonmanufacturing business establishments, including hotels, motels, restaurants, wholesale businesses, retail stores, laundries, and other service enterprises; health, social, and educational institutions; and Federal, State, and local governments. Street lights, pumps, bridges, and public services are also included.

CONSTANT DOLLARS: Dollars adjusted to eliminate inflation from their value to reflect the value of one dollar in a base year; e.g., if the price in current dollars has increased 15 percent, but the inflation rate is also 15 percent, the price in constant dollars has not gone up.

DEMAND-SIDE MANAGEMENT: The planning, implementation, and monitoring of electric utility activities designed to influence customer use of electricity in ways that will produce desired changes in the utility load. (as opposed to "supply side")

END-USE ENERGY: Energy used by final consumers; total energy consumption less consumption losses incurred in the generation, transmission and distribution of electricity, less power plant electricity use and unaccounted for electrical system energy losses. It is also the sum of fossil fuel consumption in the residential, commercial, industrial, and transportation sectors plus electric utility sales to these sectors and generation of hydroelectric power by non-electric utilities.

ENVIRONMENTAL EXTERNALITIES: An environmental externality occurs when the activities of one economic entity have a direct impact on another entity, but the affected entity has no say in how that activity is conducted.

FOSSIL FUEL: A solid, liquid, or gaseous fuel material formed in the ground by chemical and physical changes in plant and animal residues under high temperature and pressure.

GROSS STATE PRODUCT (GSP): The total value of goods and services produced by the State's economy, before deduction of depreciation charges and other allowances for capital consumption. It includes the total purchases of goods and services by private consumers and government, gross private domestic capital investment, and net foreign trade.

HEATING DEGREE DAYS: The number of degrees per day the daily average temperature is below 65 degrees F. The daily average temperature is the mean of the maximum and minimum temperature for a 24-hour period.

HYDROELECTRIC POWER: Electricity generated by an electric power plant whose turbines are driven by falling water.

INDEPENDENT POWER PRODUCTION: Wholesale electricity producers that meet the technical Qualifying Facility (QF) standards; industrial generators that do not meet the QF standards; stand-alone power plants owned by entrepreneurs; and utility owned plants which supply power outside their service area.

INDIGENOUS ENERGY RESOURCES: Power resources found in Maine such as hydro power, wood and wood waste products, municipal waste, wind, and solar power.

INDUSTRIAL SECTOR: Manufacturing, construction, mining, agriculture, fishing, and forestry establishments.

INTERRUPTIBLE LOAD: Loads that can be curtailed at the supplier's discretion or in accordance with a contractual agreement.

KILOWATT-HOUR: A unit of energy equivalent to the expenditure of one kilowatt for one hour, equal to 3,412 BTUs

LEAST-COST ENERGY PLANNING: To meet an electric utility's projected demands with the lowest practicable operating and capital costs. This includes conservation as a energy source.

LIFE-CYCLE COST: The total cost of an item over its lifetime; includes initial purchase price, cost of operation and maintenance, and renovations; future costs are usually discounted to reflect present value.

MEGAWATT (MW): One million watts. One thousand kilowatts.

NEW ENGLAND POWER POOL (NEPOOL): NEPOOL was established in the early 1970s' to provide a power pool in which many of the day-to-day operations of power generation are closely integrated with those of the other utilities in New England. This allows for major power transfers from one area to another in case there is a sudden increase in demand for electricity.

PRIMARY ENERGY: Includes all major energy resources (e.g. coal, gas, nuclear, oil, hydro, etc.) but excludes electricity, steam, or other secondary forms of energy.

PROPANE: A normally gaseous, paraffinic hydrocarbon (C3H8). It is extracted from natural gas or refinery gas streams, and includes all products covered by Gas Processors Association Specifications for commercial propane and HD-5 propane and ASTM Specification D1835. Propane is used primarily for residential and commercial heating and cooling, and also as a fuel for transportation. Industrial uses of propane include use as a petrochemical feedstock.

PURPA: Public Utility Regulatory Policies Act of 1978.

QUALIFYING FACILITIES: Cogenerator projects that meet the Federal Energy Regulatory Commission's (FERC) or the Maine Public Utilities Commission's (MPUC) size, fuel source and operational criteria.

RENEWABLE ENERGY RESOURCE: Any energy source which has recently originated in the sun, including direct and indirect solar radiation and intermediate solar energy forms such as wind, ocean thermal gradient, ocean currents and waves, hydropower, photovoltaic energy products of photosynthetic processes, organic wastes, and others.

RENEWABLE ENERGY: Energy from sources that can be or are naturally replenished, such as wind, solar, tidal, biomass, geothermal.

RESIDENTIAL SECTOR: Private household establishments, which consume energy primarily for space heating, water heating, air conditioning, lighting, refrigeration, cooking, and clothes drying.

RESIDUAL FUEL OIL: The heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are boiled off in refinery operations. Included are products known as No. 5 and No. 6 fuel oil, heavy diesel oil, Navy Special Fuel Oil, Bunker C fuel oil, and acid sludge and pitch used as refinery fuels. Residual fuel oil is used for the production of electric power, space heating, vessel bunkering, and various industrial purposes.

SMALL POWER PRODUCTION: Any qualifying facility, which is not primarily owned by a utility, that produces electricity and uses renewable resources as its primary fuel.

WIND ENERGY: The kinetic energy of wind converted at electric utilities into mechanical energy by wind turbines (i.e., blades rotating from a hub) that drive generators to produce electricity for distribution.