New Hampshire Energy Plan

Governor's Office *of* Energy and Community Services

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One of the most important aspects of the energy planning process undertaken by the Governor's Office of Energy & Community Services (ECS) has been the opportunity for dialogue about our state's energy future. To help facilitate discussions and involve policymakers in the planning effort, ECS formed an Executive Committee to oversee the planning process. Members of the public and interested stakeholders participated in discussions in the eight public hearings held throughout the state, and in stakeholder groups on the topic areas covered in the plan.

As a result, we believe that this energy plan is a more comprehensive document, and a more useful tool for both policymakers and the public. We would also like to thank those who participated in the process, and recognize the significant contributions of the many stakeholders who attended meetings and provided helpful comments and suggestions for the development of the New Hampshire Energy Plan.

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1. Executive Summary

1.1 Introduction

As New Hampshire continues to grow, so does our demand for energy. We need reliable, affordable energy to expand and strengthen our economy. We rely on consistent, plentiful energy for our homes, businesses, and our transportation needs. Energy is increasingly considered a critical component of our economic vitality and our environmental quality, both hallmarks of New Hampshire's high quality of life and rich natural environment.

New Hampshire's decision to undertake our first comprehensive state energy plan was motivated in large part by a recognition of energy's central role in fulfilling our priorities of economic growth, environmental quality, and a diverse energy supply. It is now widely recognized that in order to continue building upon our state's strengths, we should consider energy policies and programs that take advantage of new technologies, promote energy efficiency, encourage the development of cleaner, affordable alternative energy sources, utilize our plentiful renewable natural resources, and reduce our dependence on foreign oil.

New Hampshire has already made great progress on many of these important energy goals. Through restructuring of the electric industry, we have lowered electric rates up to 16% for families and businesses in the state. We are investing in state buildings to make them more energy efficient, an effort that will ultimately save taxpayers as much as $4 million a year. In addition, we have launched a comprehensive initiative with our electric utilities to help businesses and homeowners become more energy efficient, which will lower their electric bills and reduce pollution, and our gas utilities are following close behind.

New Hampshire is also continuing to diversify its energy supply in order to prevent energy shortages and reduce our dependence on foreign oil. By the end of 2002, two new natural gas-fired power plants will increase New Hampshire's electricity capacity, and the total resources in the New England power pool, by more than 1,200 megawatts, while producing only a fraction of the air pollution generated by older coal and oil-fired plants. The Governor's Office of Energy and Community Services and the Department of Resources and Economic Development are working together with other stakeholders to study the potential development of bio-oil, a new alternative fuel, made from the leftover scrap wood from our forest products industries. Bio-oil is both a potentially cleaner, affordable way to heat our homes and businesses and power our cars and trucks, and also a potential market for the forest products industry in the North Country.

We have also enacted a first-in-the-nation Clean Power law, which requires New Hampshire's fossil fuel power plants to significantly reduce emissions of four pollutants – nitrogen oxides, sulfur dioxide, carbon dioxide and mercury. These steps will help ensure that New Hampshire citizens and businesses will have the clean, reliable and affordable energy that our state needs to continue to prosper, while maintaining a healthy environment for our families.

Our hope is that this first state energy plan is a resource for New Hampshire policymakers, state agencies, citizens and businesses. It provides a comprehensive look at our state's current and future energy needs and resources, considers how we fit in the New England region, and recommends policies that our state should consider in order to meet our future energy goals. It also represents an important step toward creating a framework to continue energy planning efforts in New Hampshire.

1.1.1 The Need for State Energy Planning

In the era of the restructuring of energy markets, many states are recognizing the value of energy planning. Fundamental changes in the energy marketplace, concerns about energy security, the need for clean and reliable power, and the increasingly regional nature of power markets have led several states to develop energy plans, many of which are updated regularly to ensure access to current information and to allow for the consideration of new policies to adapt to ever-changing energy issues.[1] Several other states have recently started the planning process in response to the current energy environment and energy security concerns.

Prior to the restructuring of New Hampshire's electric industry, individual utilities were responsible for energy planning within their service areas to ensure that they could meet their customers' energy needs in a safe, reliable manner. This was accomplished through "Integrated Resource Plans," developed through proceedings at the Public Utilities Commission, which usually did not include significant outreach to other stakeholders or the general public.

Following restructuring of most of New Hampshire's electricity market, the need for energy planning has actually increased. As a result of the recognition of the need for review and analysis of the state's energy use and future needs, Governor Shaheen and key legislators recognized the need for development of a state energy plan.

Another major impetus for the increase in energy planning around the country was the California energy crisis in 2000 – 2001. Following restructuring of California's electricity market, consumers

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[1] Massachusetts, Vermont, Rhode Island, New York, Illinois, Iowa, Virginia, West Virginia, North Carolina, Pennsylvania, South Carolina, California, Hawaii, Montana, Nevada, Washington and Wisconsin are among the states that have an energy planning process.

experienced large and unanticipated increases in the price of electricity. This event helped policy makers around the country, including here in New Hampshire, to recognize the importance of careful planning for energy supply and demand in our state and in our region.

New Hampshire law provides general guidance for the state's energy policies. RSA 378:37 requires that we ensure the "lowest reasonable cost while providing for the reliability and diversity of energy sources; the protection of the safety and health of the citizens, the physical environment of the state, and the future supplies of nonrenewable resources." However, no single state agency has been charged with energy planning to help policymakers ensure that energy decisions are consistent with the state's energy policy goals.

New Hampshire's electric restructuring statute, RSA 374-F:3, also sets forth several broad public policy goals. These principles call for full and fair competition, benefits for all consumers, protection of low-income consumers, environmental improvement, increased commitment to renewable energy resources, and investments and incentives for energy efficiency.

In addition, after the tragic terrorist attacks on the United States on September 11, 2001, energy security has become a priority for both emergency planners and energy policymakers. Due to the importance of our state and national energy infrastructure to our economy, many consider it a potential target for future terrorist actions. While energy security is not the focus of this Energy Plan, recognizing the impacts of changes in energy production or consumption, and their impact on the state, helps inform the public and policymakers of the importance of energy reliability and security in New Hampshire. The State's efforts in the area of emergency preparedness planning are discussed in Section 1.1.3.

The generation and use of energy, whether for our homes, businesses, transportation, or other applications, has a very significant impact upon our environment. Emissions from energy use impact our health, our natural resources, and our quality of life. The infrastructure for energy use and delivery also impacts our land use decisions about where we live and work. As a result, by considering energy, environmental and economic policies and programs together, we can protect the air, water, and open space in our state, providing a cleaner and healthier environment for all citizens while continuing to have a strong and diverse economy.

Regional organizations are now playing an increasingly important role in energy planning as the electric industry undergoes restructuring. New Hampshire is not an energy island, and actions taken outside of New Hampshire affect energy security, the price and supply of energy, and our environment in New Hampshire. Our electric industry is closely linked to regional, as well as national, electricity markets. While we have been interdependent with the larger New England power pool for several decades, regional and national electricity market issues have become increasingly important in recent years as deregulation of the electric industry has evolved.

Having an energy planning process in place will help us represent the state at the regional and national levels, and allow us to put forth a well-reasoned and cohesive strategy in those venues that influence New Hampshire's energy and environmental future, including:

- Independent System Operator of New England (ISO-New England);
- New England Power Pool (NEPOOL);
- Coalition of Northeastern Governors (CONEG);
- New England Governors' Conference (NEGC);
- National Association of Regulatory Utility Commissioners (NARUC)
- National Council of State Legislators (NCSL);
- National Governor's Association (NGA);
- New England Conference of Public Utility Commissioners (NECPUC); and
- Federal Energy Regulatory Commission (FERC).

In an effort to ensure that New Hampshire is prepared to address the many complex energy issues facing our state in the next decade and beyond, to fulfill our public policy goals, and to facilitate open discussions on how best to address the changing energy landscape, the Legislature in 2001charged ECS with developing a ten-year energy plan for the state.

1.1.2 Goals of the New Hampshire Energy Plan

On June 27, 2001, Governor Shaheen signed House Bill 443 (Chapter 121) into law, charging ECS with preparing a 10-year state energy plan. The law required ECS to develop a comprehensive plan after holding at least four public hearings throughout the state, and soliciting input from state agencies and other interested stakeholders.

This energy planning effort had its origins in a study committee created by House Bill 1318 in the 2000 Session, which convened to consider several energy issues facing the state, including heating oil, kerosene and diesel fuel shortages and price spikes. The study committee recognized the need for a statewide energy planning effort to ensure that policymakers had access to accurate energy information, as well as tools to help them with energy policy decisions. The discussions of the small group of legislators resulted in the introduction of HB443.

The bill sets forth six major topic areas to be covered in the New Hampshire Energy Plan (NHEP): demand projections for electricity and natural gas; adequacy of generation, transmission and distribution for both electricity and natural gas in New Hampshire and regional issues that will impact the State; siting requirements for energy facilities; fuel diversity, including renewable and alternative energy resources; energy efficiency and conservation; and the impacts of regional issues on New Hampshire. In addition, the

NHEP includes issues related to energy security, and provides information on the State's efforts to manage its own energy use.

It is important to recognize that some important energy issues are not covered in this first comprehensive planning effort, despite a recognition that they are key issues that should be considered by the State. The energy issues covered in the legislation are largely those that are under the jurisdiction of the Public Utilities Commission, primarily electricity and natural gas, areas that are also under the purview of the House Science Technology and Energy Committee, which produced the legislation.

One of the important energy issues outside the scope of HB443 is transportation. The Base Case, or business-as-usual forecast, discussed in detail in Chapter 3, projects that our energy use in the transportation sector sees the most growth of any sector over the next decade, and over the next twenty years. The majority of this significant increase in demand for transportation fuels comes from the "residential" sector. Consequently, the cars, SUVs and trucks that we use for our own personal transportation represents the largest increase in overall demand for our state – even more than the growth in industrial and commercial transportation. This finding has energy, economic, and environmental implications for our State, and should be considered in our planning efforts relative to transportation.

A second area not covered in the NHEP is deliverable fuels, such as home heating oil, propane, and kerosene. These fuels are an important part of New Hampshire's fuel mix, especially in the residential sector. However, these important energy sectors were not included in the energy plan legislation. ECS works closely with the home heating industry and with the fuel delivery community, especially with respect to energy emergency planning and the federal low-income fuel assistance programs. These fuels are included in projections relative to overall fuel use in our State despite the fact that they are not included in the legislation. However, it is important to note that while they do play an important role in our energy landscape, we did not model or analyze these fuels and do not make any specific recommendations about their use. Our hope is that future updates of the NHEP can incorporate more of the important issues related to these fuels.

ECS worked with a group of consultants to prepare the NHEP: Systematic Solutions of Ohio, Policy Assessment Corporation of Colorado, and Sylvatica of Maine. The three groups have collaborated to provide energy planning services to several states and regional organizations, including Massachusetts, Vermont, Hawaii, the Canadian government, the New England Governor's Conference, ISO New England, and NEPOOL. These consultants provided the forecasting and analysis required for the Plan using a computer simulation model known as ENERGY2020, which is described in Section 1.2.2 below, and in more detail in Appendix 2. The consulting group also assisted with facilitating stakeholder involvement and testing policy options. Innovative Natural Resource Solutions of New Hampshire assisted with development of the final document.

The NHEP legislation called for four public hearings around the state to solicit public input on the energy plan. To facilitate a higher level of stakeholder and public involvement, ECS held eight public hearings and meetings throughout the state. The public hearings were initiated in Manchester on April 3, 2002. Subsequent meetings were held in Portsmouth, Keene, Belmont, Berlin, Littleton, Colebrook and Lebanon.

In addition to the public hearings called for in the legislation, ECS convened a group of stakeholder meetings in Concord to provide more information about the planning process and the ENERGY2020 model, and to solicit information and suggestions for the energy plan. The groups were organized around the various topics to be covered in the energy plan, including electricity, natural gas, fuel diversity, energy efficiency, siting, and regional issues. The first meeting was held in December 2001, and subsequent meetings were held throughout the spring and summer of 2002. In late August the groups were brought together to consider the outcomes of some policy testing, and to consider the overlapping nature of energy issues across the different groups. Participating stakeholders included energy companies, legislators, state agencies, businesses, environmental organizations, advocates for renewable energy and other interested parties. Stakeholder interest in the planning process was high, and the input of interested parties was critical to the development of an energy plan that accurately reflects the state's current energy picture, its future needs, and its policy priorities.

Stakeholders identified several key issues for consideration in the energy plan:

- Continuing our State's strong presence at the regional and national levels on energy issues such as transmission expansion, standard market design, and regional renewable and efficiency programs;
- Preservation of New Hampshire's diverse energy portfolio, including indigenous resources such as wood;
- Continued investments in energy efficiency at the state level, including ratepayer funded programs;
- Financial or tax incentives to promote energy efficiency and renewable energy opportunities in both the residential and commercial and industrial sectors;
- A commitment from the State to purchase a defined percentage of its energy from renewable sources in order to maintain energy security and reduce dependence on foreign oil; and
- A permanent process for energy planning at the state level, so that the dialogue created during this first comprehensive energy planning effort will continue.

Several stakeholders provided written comments. A complete listing can be found in Appendix 1, and documents are on file at the Governor's Office of Energy and Community Services, and are available at our website, www.nhecs.org. These comments include key issues such as energy security, investing in renewable energy, increasing energy efficiency, ensuring adequate transmission and distribution resources, and maintaining New Hampshire's strong role at the regional level.

1.1.3 Energy Emergency Planning and Preparedness

Although the topic of energy emergency planning is not a focus of this plan, it is clearly an aspect of energy planning that has come to the forefront as a result of the tragic events of September 11, 2001. Even before September 11th, however, New Hampshire had a well developed energy emergency planning effort in place, largely in response to the winter fuel shortages of 2000 and the regional electricity shortages that are now a common event in our region each summer. To ensure that the proper agencies were coordinating their preparations for possible energy emergencies, the Governor's Office of Energy & Community Services undertook the development of the State Energy Emergency Response Plan, or SEERP, in 2001.

The purpose of the SEERP is to provide timely and coordinated notification to state government, private sector entities, institutions, the media, and residents of the state in the event of an energy emergency, and to set forth appropriate actions that each sector should undertake. These activities range from calls for voluntary energy conservation measures, to the enactment of emergency regulations, rules, and laws, as well as other actions as deemed necessary by the State. The SEERP was revised and updated in late 2002.

The events of September 11, 2001 brought into sharper focus the importance of energy emergency planning. In response, Governor Shaheen convened an interagency task force known as the New Hampshire Commission on Preparedness and Security to reevaluate our state's security and emergency preparedness. The Commission worked to identify steps that New Hampshire could take to protect utilities, energy transmission systems, nuclear power plants and fuel storage facilities. ECS played an active role in this Commission and worked with representatives of the Public Utilities Commission, the Department of Safety, the Office of Emergency Management, and other state agencies to ensure better communication and coordination during energy emergencies and threats to our energy infrastructure. The Commission's final report, "Assessment of New Hampshire's Preparedness and Security," was issued on November 27, 2001, and is available at www.state.nh.us/governor/preparedness.pdf.

1.1.4 Energy and the Environment

Energy production – for electricity, manufacturing, transportation or other uses – is a major contributor to pollution in New Hampshire and around the world. Changes in fuel use, energy conservation and efficiency, and advances in technology all play a role in reducing pollution levels associated with energy production. However, these approaches alone will not protect New Hampshire's environment, so we need to take appropriate actions to ensure that the energy we need for our homes and businesses is produced in the cleanest, most efficient way practical.

To further these goals, Governor Shaheen signed the Clean Power Act into law in May 2001, making New Hampshire the first state in the nation to require fossil-fuel power plants to reduce emissions of four major pollutants. The legislation requires reduction in emissions of sulfur dioxide, the chief cause of acid rain; nitrogen oxides, a contributor to ozone smog; and carbon dioxide, which contributes to climate change. It also requires that the NH Department of Environmental Services make a recommendation regarding regulation of mercury emissions from fossil-fuel power plants, which threaten the health of humans and wildlife. This legislation is seen as an important first step to addressing the environmental and public health impacts of our energy choices, and has been considered a model for other states and for the federal government.

In addition to cleaning up the production of energy, we also need to increase our understanding of the environmental and public health "costs" of producing and using various forms of energy. During the public hearing and stakeholder meeting process the issues of quantifying and "internalizing" the environmental costs of energy were raised as key issues in moving toward cleaner, more sustainable forms of energy. At this time, many of the public health and environmental impacts of energy production and use are not incorporated into the price we pay for most forms of energy, from gasoline to home heating oil to electricity. This issue is one that has received attention from both national and international experts, but data is still not widely used that accurately captures the true costs of energy.

Despite the lack of widely accepted information on environmental costs of energy, throughout the New Hampshire Energy Plan we have incorporated many of the environmental impacts of energy production and use. For example, emissions of greenhouse gasses, which contribute to climate change, are shown for each of the policy scenarios tested in ENERGY2020. However, we recognize that more study is needed to create information on environmental impacts and costs of energy that all parties can agree upon. This will help us make more informed choices about the energy that we use, and understand the true costs of those choices.

1.2 New Hampshire Energy Plan Overview

The following sections provide brief summaries of the data, research, and modeling found in the New Hampshire Energy Plan. Significantly greater detail on each issue can be found in the body of the NHEP in the relevant chapters.

1.2.1 New Hampshire's Energy Use Today

New Hampshire currently generates more electricity annually than it uses, making it a net exporter of electricity. However, we import the vast majority of the fuels used to generate the energy we use. New Hampshire generates a limited amount of renewable energy from native sources, primarily through wood-fired power and hydroelectric facilities. New Hampshire also has two trash-fired power plants, which burn municipal solid waste to produce electricity.

Petroleum-derived energy, whether for transportation or home heating, dominates the New Hampshire energy picture, constituting more than 54% of the energy we use in the state, and more than 85% of what we pay for energy.

Our consumption of gasoline is highest among all of the fuels used in the state, representing nearly half of the state's energy consumption costs. It is followed closely by petroleum distillate, which is used as both #2 heating oil and diesel fuel for transportation. Together, gasoline and distillates make up 70% of the cost and 40% of the Btus consumed in the state.

1.2.2 Data and Analysis for the New Hampshire Energy Plan

Two energy and economic forecasting models, ENERGY2020 and REMI (Regional Economic Models, Inc.), were used in the development of the New Hampshire Energy plan. These two models, which can be integrated to capture the economic impacts of energy policies, provided much of the forecasts and projections contained in this document.

ENERGY2020 is a multi-sector energy analysis system that simulates the supply, price and demand for all fuels. In the development of the New Hampshire Energy Plan, ENERGY2020 was used to provide information on energy use in the residential, commercial, industrial and transportation sectors of New Hampshire's economy. To determine the impact of energy policies on our economy, we worked with the state's Department of Employment Security, which has created a New Hampshire-specific REMI model. REMI is used by Employment Security to predict the economic and demographic effects that policy initiatives have on the state's economy. More detailed information on ENERGY2020 and REMI is provided in Appendices 2 and 3, respectively.

1.2.3 Base Case or "Business as Usual" Forecast

In order to understand energy use in New Hampshire, a "Base Case" forecast was developed to predict energy use in New Hampshire over the next decade and beyond based on current trends. The Base Case forecast is an attempt to project a most likely or "best guess" future trajectory of the energy and economic system in New Hampshire, for the purposes of stimulating ideas for potential policies, and testing for the expected impacts of potential policies.

Overall, the Base Case projects that total New Hampshire energy demand is expected to grow at an average rate of 2.2% annually between 2000 and 2020. Oil, the fuel with the highest demand, is forecasted to grow at only 2.0% per year, while electricity and natural gas grow at 3.1% and 3.2% respectively. It is important to note that this projection shows that the use of energy is forecast to grow at rates well above the growth in population (projected to be only 1%), meaning that we will see an increase in energy use per capita over the next 20 years.

The Base Case shows the greatest increase in demand in the transportation sector, which includes both business and government fleets, as well as personal automobile use. Increased demand for energy is also expected from all sectors of energy users, including industrial, commercial and residential consumers.

In addition to the "Base Case," the impact of a hypothetical "Price Shock" was also modeled, in order to measure the impacts on New Hampshire of a sudden and sustained rise in fossil fuel prices, as was seen in the late 1970's and early 1980's. This Price Shock scenario is not intended to be a prediction, but simply a tool to help New Hampshire understand the impacts such a rise in fossil fuel prices would have on the energy, economy and environment in New Hampshire. The full Base Case forecast is discussed in detail in Chapter 3.

1.2.4 Electricity Consumption in New Hampshire

One of the main realities for most states, including New Hampshire, is that its electricity market is part of a regional market. Changes in demand by New Hampshire energy users are responded to by changes in electric power production at the regional level, not necessary at the state level. These responses will in some cases influence generation from New Hampshire power plants, while in many cases they will not, as demand is met by plants outside the state. This is true both in the short term (in which existing electric power plants change their levels of generation) and in the long term (in which investors decide whether and when to construct new generating capacity). In the Base Case, electric generating capacity increases, with the addition of 1080 MW of gas combined cycle capacity and 280 MW of combustion turbines and the retirement 77.6 MW of biomass capacity. More details on the state's electricity use can be found in Chapters 3 and 6.

1.2.5 Natural Gas Consumption in New Hampshire

Natural gas arrives in New Hampshire via interstate pipelines, which are in turn supplied directly by wells or by specialized tanker ships. It is then delivered to industrial, commercial and residential customers through a series of supply distribution pipelines. In the Base Case scenario, consumption of natural gas is expected to increase dramatically over the next decades. Demand is predicted to grow from 86 trillion British Thermal Units (tBtu) in 2000 to over 200 tBtu in 2020. This growth, predicted at between 4% and 5% per year, is expected to occur at a fairly steady rate.

Absent the construction of a new commercial natural gas power plant beyond those expected to be online in 2002, existing capacity is sufficient to meet the anticipated needs of New Hampshire businesses and residents for the next decade. With the exception of facilities already permitted and under construction, no new large-scale users of natural gas are expected in the state, and the Energy2020 model does not show construction of any plants in New Hampshire for more than ten years. More details on the state's natural gas use can be found in Chapters 3 and 7.

1.2.6 Fuel Diversity in New Hampshire

The variety and proportions of energy sources used to power New Hampshire are referred to as "fuel diversity." By having a variety of energy sources available, the state can spread risk and opportunity across a wide variety of fuels, taking advantage of emerging technologies and in-state resources while buffering us from price swings for any one particular fuel type.

It is the energy policy of the State of New Hampshire that the needs of citizens and businesses be met while "…providing for the reliability and diversity of energy sources…" NH RSA 378:37. New Hampshire has long enjoyed a diverse mix of energy sources, and this has helped provide our consumers with some level of price stability over time.

Proponents of policies to increase fuel diversity note that having a variety of fuel sources available for energy needs – including electricity, transportation, heating and other uses – provides numerous benefits, including:

- Competition among different fuels to provide the least-cost energy to consumers, helping to lower overall prices;
- A hedge against significant price increases for any particular fuel type;
- An energy system that is less subject to exchange rate fluctuations and geopolitical uncertainties often associated with imported fuels;
- Encouraging emerging technologies to participate in the energy market, driving commercialization of renewable and more efficient fuel uses; and
- Encouraging the use of indigenous fuels as part of the energy mix, often with significant positive economic and environmental benefits for the local area as well as for the state as a whole.

New Hampshire currently produces electricity from a wide variety of fuel types, including natural gas, coal, oil, and nuclear. New Hampshire also produces electricity from alternative sources, including biomass, water (hydroelectric), and municipal solid waste. In order to understand some of the impacts of renewable energy upon the energy, environmental and economic future of New Hampshire, two scenarios were tested against the "Base Case":

- Retention of the wood-fired power plants after expiration of their rate orders; and
- Development of commercial scale wind farms in New Hampshire.

These two scenarios demonstrate the positive impacts that renewable power generation can have on New Hampshire, including significant benefits on local economies, a reduction in greenhouse gas (and other) emissions, and a stabilization of energy prices. However, renewable power often has difficulty competing directly in a competitive market, and the cost of public policies designed to support renewable power need to be carefully weighed against these benefits. More details on fuel diversity in the state can be found in Chapter 8.

1.2.7 Energy Efficiency and Conservation in New Hampshire

Energy efficiency has been widely recognized as the most cost-effective way to increase the reliability, safety, and security of our energy infrastructure. Lowering demand is the most economical way to avoid congestion problems, maintain stable prices, and minimize the environmental impacts of our energy use. It has been estimated that as much as 40-50% of the nation's anticipated load growth over the next two decades could be displaced through energy efficiency, pricing reforms, and load management programs. As a result, states around the country are investing in policies and programs to realize the energy, economic, and environmental benefits of energy efficiency.

New Hampshire, like most other states that have restructured their electric utilities, has recognized the value of energy efficiency and the role that it should play in a restructured marketplace. In response to state policy, New Hampshire electric utility customers can now take advantage of new statewide energy efficiency products and services. These "core" energy efficiency programs offered by utilities are a consistent set of innovative, statewide programs available to all New Hampshire ratepayers. The core programs will increase the availability of cost-effective energy-efficient measures and services, while providing economic and environmental benefits to the state. Similar energy efficiency programs are being established for users of natural gas.

One of the policy scenarios tested in the development of the New Hampshire Energy Plan is the continuation of these "core" programs for electricity users for three years after their current termination date of December 2003. The ENERGY 2020 model clearly demonstrates that extending the core energy efficiency programs would provide significant lasting benefits to New Hampshire's energy security, reliability, and economy, and environmental improvements for the state's residents and businesses. The economic benefits start immediately and persist for as long as the higher-efficiency devices and capital stocks are in place. The policy would also reduce the risk to residents and businesses posed by the possibility of a fuel price shock. More details on energy efficiency and conservation can be found in Chapter 9.

1.2.8 State of New Hampshire as an Energy Consumer

The government agencies of the State of New Hampshire constitute the largest energy user in the state. Because of this significant energy use, there are opportunities for the State to lower its energy costs, improve its efficiency, and serve as a leader in responsible energy use.

Recognizing this opportunity, the Legislature authorized funding for the position of State Energy Manager in 2001. The State modeled this position on the private sector, where most large corporate organizations have one individual that helps coordinate energy use throughout the company. The primary responsibility of the State Energy Manager is to serve as a "change agent" within state government, reformulating the way the state plans for, purchases, and consumes energy.

Under the leadership of Governor Shaheen, the State also instituted an innovative program to increase energy efficiency and cut energy costs at State buildings. The Building Energy Conservation Initiative (BECI) is a program to cut energy and water costs in more than 500 state buildings by up to $4 million annually through building upgrades and retrofits. BECI utilizes a "paid from savings" procedure known as "performance contracting" that allows current energy efficiency upgrades to be financed with future utility savings. This allows state agencies to perform energy retrofits and building upgrades that would otherwise not be funded through the capital appropriations process, using energy savings to pay back the cost. BECI requires that energy savings pay for a project within ten years. To date, two projects encompassing five buildings have delivered over $250,000 in annual energy savings to the state. BECI has been recognized by the U.S Environmental Protection Agency as a model for other states.

While a number of programs and activities have been developed to manage energy use by the State, there are opportunities to build upon these efforts and increase the effectiveness of this work. In addition to saving taxpayer money through better use of energy, the State can play a leadership role that will impact energy use by others. A detailed discussion of the State as Energy User can be found in Chapter 10.

1.3 Recommended Action Steps

The New Hampshire Energy Plan (NHEP) sets forth a number of recommendations for future action by the State of New Hampshire, based upon information developed through the energy planning process. Overall, these recommendations are designed to reduce energy costs, improve our energy infrastructure, increase the use of indigenous natural resources, enhance environmental quality and provide a process for future energy planning in New Hampshire. Each recommendation is summarized below; a complete discussion of each recommendation, as well as the background supporting this recommendation, can be found in the referenced chapters of the NHEP.

Some of these recommendations can be implemented immediately. Other recommendations may require more time or discussion in order to be fully implemented. In either case, we should begin the process of preparing to implement these action steps, which will enable the State to realize the benefits of these policy objectives as soon as practical.

1.3.1 Recommendations for Short-term Implementation

The following recommendations are opportunities that New Hampshire can and should implement within the next year. These recommendations build upon the work New Hampshire has already begun to improve its management of energy and energy policy.

1.3.1.1 Establish an Energy Planning Advisory Board

The energy planning process undertaken by the Governor's Office of Energy & Community Services engaged stakeholders in a productive dialogue about New Hampshire's energy future. The development of the NHEP provided opportunities for state agencies, legislators, energy users, energy companies, environmental organizations and concerned citizens to explore energy issues in a non-regulatory setting. The value of this dialogue was noted by many stakeholders and members of the public in meetings, public input sessions, and through written comments.

Building upon the foundation developed through the establishment of the NHEP, the State should continue to engage in public discussions, in neutral settings, on the state's energy future. The information and policies contained in the NHEP will need updating as more information becomes available, or as circumstances change.

The best way to accomplish this is to establish an on-going Energy Planning Advisory Board to meet on a regular basis to discuss energy policy and planning issues at the state level. The responsibilities of this committee should include strategic planning for New Hampshire's energy policies, including but not limited to:

- Supply and demand for energy resources,
- Transmission and distribution infrastructure for electricity and natural gas,
- Fuel diversity within the state and region,
- Supporting NH Department of Transportation's planning efforts,
- Deliverable fuels,
- Energy efficiency and conservation opportunities,
- The State's role as a major user of energy,
- The environmental impacts of energy generation, transmission and distribution,
- New Hampshire's role in regional energy issues.

The Board should regularly update the New Hampshire Energy Plan, in order to keep it a current and meaningful document. Revising the NHEP, or appropriate sections of the plan, every three years would allow for updates on a cycle appropriate for policy-making in New Hampshire.

The Energy Planning Advisory Board should be based upon the makeup of the current New Hampshire Energy Plan Executive Committee, which includes government leaders in the areas of energy policy, environmental protection, transportation, and economic development. While the Energy Planning Advisory Board should be comprised exclusively of representatives from state government, others should be encouraged to participate in the activities of the Board. Utilities, energy suppliers, energy users, environmental organizations, businesses, and others all have important perspectives on energy planning. The contributions of these groups and individuals should be recognized in order to make the work of the Board most effective, and can be achieved through open public meetings, invited presentations on topics of interest to the committee, and public comment.

The Energy Planning Advisory Board should be supported by the Governor's Office of Energy and Community Services (ECS), to provide for appropriate professional and administrative assistance, as well as institutional memory. ECS has encouraged energy planning dialogue through the development of this Plan, and has the expertise necessary to continue this activity in a way that benefits the State and stakeholders. Increased involvement in energy planning is a logical next step for ECS, following successful restructuring agreements with the state's electrical utilities.

It should be noted that while ECS is the logical home for such a Board, there are factors that may make it a challenge for the office. As with other state agencies, resources at ECS are limited, and funding for the development of the NH Energy Plan was a one-time legislative allocation. While professional and administrative support can be provided by ECS, the Board may want to use modeling or other technical analysis, and there would be a cost associated with this. This is a challenge that any state agency would face in providing the important function of state energy planning.

1.3.1.2 Encourage Energy Efficiency in New Construction

As the State constructs new buildings or conducts substantial renovation of existing state government buildings, every effort should be made to fully account for the "life-cycle" cost of the building, and not simply the initial cost. Instead of considering only the cost of design and construction when costing a building, life-cycle accounting considers the long-term energy, maintenance, and other costs that are traditionally considered "operating expenses." It is often true that failure to make modest investments at the time of construction in order to keep a building's construction budget low results in inflated long-term expenses. This is particularly true of investments in energy efficiency, which may carry a higher initial cost but quickly pay for themselves through energy savings. By considering the "life-cycle" approach to building design, the State will position itself to reduce overall expenses associated with its new construction and reduce long-term energy use.

The State should also consider incorporating "performance contracting" (see discussion on BECI, section 10.2.2) into new building construction. Performance contracting is a mechanism by which an Energy Service Company (ESCO) implements energy cost saving building improvements. Unlike the traditional contracting process, the performance contractor assumes project performance risk to *guarantee* to the building owner (State) that energy savings will be sufficient to pay for the project costs. In basic terms, this means that efficiency upgrades are funded through energy savings, so that no increase in up-front capital costs is required to implement energy cost saving measures in state buildings. More information on this recommendation can be found in Chapter 10.

1.3.1.3 Support Cost-Effective Statewide Energy Efficiency Programs

The electric energy efficiency programs funded through the Systems Benefit Charge (SBC) on electric bills can provide significant and ongoing benefits to the state. Investments in energy efficiency help reduce overall electric generation and associated emissions, reduce the state's reliance on imported fuel, lower long-term electricity prices, increase system reliability, and buffer the state from the effects of a potential fuel "price shock."

The least expensive energy plant is the one not built, and investments in energy efficiency help avoid the premature or unnecessary construction of new generating facilities. Programs that encourage investments in energy efficiency, such as the current "core programs," should continue to allow New Hampshire to realize their energy, economic and environmental benefits. The SBC has been widely recognized as the best approach to fund energy efficiency programs that will transform the market for these products, and fairly allocates expenses to ratepayers based upon their energy use.

However, in order to assure cost-effective use of money generated through the SBC, the state, utilities, consumers and other stakeholders should regularly evaluate the programs funded to ensure that they provide the necessary services to customers. While there may be ways to more efficiently deliver energy efficiency programs through a change in programmatic offerings or program administrators, there is no question that using the SBC to fund energy efficiency is a wise investment, and should be continued.

In addition, the state should continue to work with gas utilities to ensure that energy efficiency programs that they offer are cost effective and work with the electric core programs to the extent feasible to capture the efficiencies of collaboration. More information on this recommendation can be found in Chapter 9.

1.3.1.4 Purchase ENERGY STAR® Equipment for State Offices

To reduce energy costs and promote the importance of individual and corporate actions to reduce energy use, the State should commit to purchasing office equipment that achieves an ENERGY STAR® rating. ENERGY STAR® is a program that identifies products that meet or exceed premium levels of energy efficiency, making it easier for consumers to identify the most energy-efficient products in the marketplace. By purchasing and using products that meet the ENERGY STAR® standard, and assuring that the energy efficient features are utilized, the State can achieve meaningful energy savings. According to estimates prepared for the New England Governor's Conference, upgrading computers, copiers, printers, fax machines and scanners used by New Hampshire state agencies would result in annual energy savings of almost $70,000 and an annual reduction in carbon emissions of 1.2 million tons. This recommendation mirrors actions being taken by New England governors and premiers in several Canadian provinces, coordinated in the United States by the New England Governor's Conference. More information is available in Chapter 10.

1.3.1.5 Convert to LED Traffic Lights

It is now widely recognized that simply changing traffic lights from incandescent bulbs to light emitting diode (LED) technology results in significant energy savings and pollution reductions, using 85% less energy than conventional traffic lights. As a result, the State should work to replace these lights, in cooperation with our neighboring states in the region, by 2007. It is estimated that making these changes will result in reductions totaling 1120.9 pounds of CO_2/yr. *per light* and would save roughly $58.40 in electricity costs *per light*, each year. More information on this recommendation can be found in Chapter 10.

1.3.2 Recommendations for Near-term Implementation

The following six recommendations can be implemented by the State of New Hampshire in the next two to three years. These recommendations provide new opportunities to improve the availability, efficiency and environmental impacts of energy in New Hampshire. However, in order for all of these recommendations to be implemented, the State of New Hampshire and key stakeholders need to begin discussions and planning aimed at implementing these policies and programs.

1.3.2.1 Establish a Renewable Portfolio Standard

A Renewable Portfolio Standard, or RPS, is a regulatory requirement that any supplier of electricity must derive a portion of that electricity from renewable resources. Renewable Portfolio Standards are currently used in several states to ensure that electricity generated from renewable sources is part of the state's energy mix. An RPS assures that all consumers of electricity contribute to the environmental and economic benefits provided by renewable energy generation, while providing a system that delivers renewable energy to consumers in a cost-efficient manner.

The establishment of an RPS guarantees some market for the generation of renewable power, and spreads the burden of "above-market" costs associated with renewable power to all ratepayers, based upon their energy consumption. By allowing different renewable generators and technologies to compete against one another, consumers have access to least-cost renewable power, encouraging renewable power generators to be as efficient as possible.

It is appropriate for the Legislature to fashion an RPS that meets all of our state's renewable energy goals: to help support our existing indigenous renewable generation such as wood and hydro; to encourage investments in new renewable power generation in the state; and allow us to benefit from the diversity, reliability and economic benefits that come from clean power. Creating mechanisms that support renewable power also helps increase energy security and reduces our dependence on foreign oil. By enacting an RPS now, New Hampshire can help shape the environmental and energy future of the region, and recognize the benefits provided by renewable power. Before this is accomplished, however, a number of issues must be considered that will impact the implementation and success of such a program. These issues include:

- What is the appropriate definition of renewable power for purposes of an RPS, and how can this impact existing renewable generators and construction of new generation?
- What percentage of renewable power will each provider be required to purchase, and will this increase over time?
- What legal issues exist regarding electrical generation outside of New Hampshire participating in the state's RPS?
- What are the anticipated impacts on the retail price of electricity?

In a restructured electricity market, an RPS is the most efficient way to assure that existing renewable generation has the ability to compete, and that new renewable generation can be built. Allowing renewable generators the opportunity to compete against one another, with a guaranteed market for some fixed level of renewable generation, protects ratepayers while promoting environmental stewardship and energy security. More information on this recommendation can be found in Chapter 8.

1.3.2.2 Monitor and Develop Infrastructure for Natural Gas

As detailed in Chapter 6, natural gas will play an increasing role in New Hampshire's energy use. Both supply and demand for natural gas are predicted to rise steadily over the next decade and beyond. An increase in the use of gas, if it displaces the use of other fossil fuels, would reduce emissions in New Hampshire, and result in an even more diverse fuel supply than currently enjoyed by the state.

New Hampshire policy makers and regulators will need to carefully monitor the growth in natural gas use, and make certain that the infrastructure used to support natural gas delivery is sufficient to meet state needs. Current modeling shows that existing pipeline capacity is more than sufficient to meet demands over the next decade – the life of this energy plan. However, unforeseen events such as a new generation facility or a substantial increase in heavy manufacturing could cause demand in excess of the ability to provide natural gas.

New Hampshire should also consider ways to provide more customers with access to natural gas. Providing a choice for heating and other uses offers a more competitive marketplace, and enables more customers to make decisions based upon price, reliability, environmental impacts and other considerations. More information on this recommendation can be found in Chapter 7.

1.3.2.3 Enhance the Process for Siting Energy Facilities

When siting energy generation facilities, New Hampshire brings together several state agencies with overlapping jurisdiction to review and rule on applications. This approach, known as the Site Evaluation Committee (SEC), works well. However, the state needs to address how to approach projects that are not within the SEC's jurisdiction, including smaller projects, renewable generation, co-generation, and distributed generation. The SEC, working with the Energy Planning Advisory Board, should convene discussions with stakeholders to consider how to address the unique issues presented in the siting of new energy resources that are not typically within the jurisdiction of the Committee.

The SEC should also work to strengthen ties to the State's efforts to represent our interests at the regional and national level, perhaps by working with the PUC and the proposed Energy Planning Advisory Board to ensure that the State has the appropriate resources to participate regionally. The SEC should ensure that any regional siting committees, such as the NGA proposal for a Multistate Siting Entity discussed in Section 4.9, take into consideration the Committee's work. Similarly, the SEC should work to ensure that regional issues and planning are considered by the Committee in its deliberations on proposed projects. More information on this recommendation can be found in Chapter 4.

1.3.2.4 Strengthen State Energy Codes and Assist with Compliance

The adoption of modern building codes is one way the State can ensure that new construction meets certain levels of occupant safety and energy efficiency. As the State Building Codes Review Board moves forward, serious consideration should be given to adopting an energy code referred to as "ASHRAE 90.1 – 1999" for commercial and industrial buildings. This change would improve energy efficiency in new commercial and industrial construction, bring New Hampshire into compliance with pending changes to federal Department of Energy rules, and improve code enforcement due to clearer language in the new standard.

The State should also continue to pursue ways to help municipalities understand, value and enforce energy codes as part of building codes. Great strides are being made through a series of trainings offered statewide, which provide code officials an opportunity to learn about and discuss the energy code. More information on this recommendation can be found in Chapter 9.

1.3.2.5 Purchase "Green Cars" for the State Fleet

New Hampshire should strive for the most efficient, least polluting state vehicle fleet. One way to achieve this goal is to have the State purchase passenger vehicles that qualify for the New Hampshire Department of Environmental Service's "Green Label" designation. This designation, reserved for passenger vehicles that achieve 30 miles per gallon or better and meet a low-emission vehicle (LEV) standard, was developed in partnership with the New Hampshire Auto Dealers Association to provide information to consumers. When such vehicles meet the needs of the agency purchasing the vehicle, the State should direct purchases toward these clean and efficient vehicles. The State should also expand its efforts to purchase "hybrid" vehicles, which combine traditional internal combustion engines with electric car technology to achieve great fuel efficiency. The purchase of passenger vehicles meeting the "green label" requirements will not only produce fuel cost savings over time, it will also reduce emissions and help support the market for efficient vehicles. More information on this recommendation can be found in Chapter 10.

1.3.2.6 Partner with Colleges and Universities for Energy Efficiency

New Hampshire is home to some of the top secondary educational institutions in the country, and the state university system is one of the largest users of energy in the state system. ECS currently works with the state universities to encourage investments in energy efficiency and renewable energy to allow these institutions to realize the economic, energy, environmental and educational benefits of these technologies. For example, the University of New Hampshire campus in Durham was recognized by the U.S. Department of Energy in 2002 for being among the top 5% of research universities nationally for its efficient use of energy. UNH is eager to share its successes and strategies with others seeking to reduce energy use, save money, and improve environmental quality.

In support of the recent Climate Change resolution approved by the New England Governors and Eastern Canadian Premiers, coordinated by the New England Governor's Conference, the State should take a leadership role in working with colleges and universities to promote energy efficiency and renewable energy technologies. This effort would serve three purposes: it would expand the number of entities starting to reduce their pollution through energy efficiency and renewables; it would serve as a tool for educating students about climate change issues; and it would focus student research on finding innovative and creative solutions for making these reductions. More information on this recommendation can be found in Chapter 10, and at the NEGC website, www.negc.org.

1.3.3 Recommendations for Long-term Implementation

The following recommendations provide New Hampshire with opportunities for continual improvement and even greater savings in the future. However, the Governor's Office of Energy & Community Services recognizes that these recommendations could take time to implement. These recommendations are offered to begin the dialogue to identify the action steps necessary to achieve these policy objectives.

1.3.3.1 Purchase Renewable Power for Use by the State

As a large user of electricity, the State of New Hampshire has the ability to significantly impact the electricity market through its purchasing decisions. In a restructured marketplace with customer choice, one way the State can encourage environmentally responsible power is to purchase electricity generated from renewable sources. By requiring that some percentage of the electricity that the State uses comes from renewable sources, the State can help create a market for renewable power.

New Hampshire should consider purchasing a percentage of its power from renewable generation. Doing so will demonstrate the commitment of state government to using its market power to encourage environmentally responsible electricity generation, and serve as an example for others. By assuring a market for some baseline level of renewable power, the state will encourage electricity suppliers to develop renewable power options available to other customers as well. The State could leverage its power in the marketplace through this method, and help create a market for renewable power at levels above what is generally offered.

It is expected that the purchase of renewable electricity will cost more than the purchase of fossil fuel power, and the State should obviously consider this increased cost when weighing what percentage of power to purchase from renewable generation. However, as a major consumer of electricity and the steward of our state's rich natural resources, the State should not miss this opportunity to use market-based, non-regulatory power to help shape New Hampshire's competitive electricity market. More information on this recommendation can be found in Chapter 10.

1.3.3.2 Use Biodiesel Fuel in the State Fleet

The State of New Hampshire owns roughly 1,500 trucks, many of them diesel. These diesel trucks are used by the State for a variety of functions, primarily public works and transportation. These vehicles use roughly 2.2 million gallons of diesel fuel annually. Particulate matter and other toxic pollutants from diesel emissions are among the most harmful of any transportation fuel, and contribute to public health problems including lung and heart disease, as well as cancer.

Some diesel emissions may be reduced through the use of biodiesel, allowing diesel engines to run on fuel wholly or partially derived from renewable, domestic feedstocks such as soybean oil. One of the great benefits of biodiesel is that it can be used in existing diesel vehicles, without any modifications to the diesel engine. This is in contrast to other emerging diesel technologies (often referred to as "clean diesel"), which require costly modifications to engines and emissions treatment systems, but yield even better emissions reduction.

New Hampshire can take a leadership role in the use of biodiesel in state vehicles. By doing so, the state will be helping to reduce emissions of sulfur, particulate matter and other harmful pollutants. Increased use of biodiesel will also reduce dependency on imported fossil fuels, and support a market for agricultural products. If the pilot projects currently underway in New Hampshire provide positive results, the State should seriously consider transitioning to biodiesel in all of its diesel fleet, including passenger vehicles, trucks, and mobile generators. More information on this recommendation can be found in Chapter 10.

1.3.3.3 Use School Building Aid to Encourage Energy Efficiency

The State of New Hampshire invests between $25 and $30 million dollars each year in new school construction through direct aid to school districts. At present, school building aid requires that new construction or renovation comply with the state's energy code. School districts meet this standard by having their architect self-certify that the building meets the state's energy code. This code, while providing a minimum baseline for energy efficiency, does not incorporate some of the best practices and new design ideas that encourage truly energy efficient building design.

However, state aid for school construction provides an opportunity for the State to be a partner in new construction of schools, and to help local school districts go beyond the code and realize the many benefits of high performance schools, including lower operating costs, higher test scores, and better land use practices. "High performance school buildings" are schools that integrate healthy and productive learning space with energy efficiency, lower operating costs, and result in lower environmental impacts. High performance school buildings benefit students, teachers and taxpayers by providing an integrated approach to school design. Recent studies have shown a correlation between building design and learning success.

In order to ensure that New Hampshire students and taxpayers realize the many economic and environmental benefits of high performance schools, the State should continue to work with schools and municipalities to provide information and resources on the benefits, both educational and financial, of high performance building design. Part of this effort should focus on conducting and evaluating demonstration projects in New Hampshire, and sharing the results of these demonstration projects. In addition, the State should explore ways to use funding mechanisms available to it, including school building aid, to encourage the construction of high performance schools in New Hampshire. By utilizing this approach, the State can have more schools that are energy efficient, cheaper to operate, better places to learn, and have less impact on the environment. More information on this recommendation can be found in Chapter 10.

2. New Hampshire's Current Picture

2.1 Overview

The cost of energy is an important factor in New Hampshire's economy, in part because, like many other states in our region, we pay more for energy than many of our fellow Americans. In 1999, New Hampshire ranked sixth highest nationally for the cost of one million Btus, and its rank for dollars spent on energy per capita was 19th. These rankings are attributable mainly to the high cost of transportation and heating fuels in the Northeast.

However, recent reductions in electric rates in New Hampshire will have a positive effect on those rankings. Other factors positively influencing the cost per Btu and cost per capita are energy efficiency programs and new technologies that are being instituted in homes, businesses, schools and municipal and state buildings throughout the Granite State.

The table below (2.1) shows that New Hampshire's population increased by 11.4% between 1990 and 2000, as compared with the national growth of 13.1%.[1] However, as table 2.2 shows, our consumption of energy increased by 19.3% for the period 1990 - 1999. Based on 1999 EIA data, New Hampshire is 41st in population in the United States, and 45th in the amount of energy consumed, indicating that despite the increase in per capita energy use, New Hampshire residents consume slightly less per person than the rest of the nation.

Table 2.1 New Hampshire Demographics

US population	281.4 million
NH population 2000 census	1,235,000
1990 census	1,109,252
NH population growth 1990 - 2000	11.4%
U.S. population growth 1990-2000	13.1%
NH population rank nationally	41st
NH households	547,024 housing units

Source: US Census Bureau

[1] This information was compiled for NH Energy Facts, an ECS publication that contains more details on NH's energy use. NH Energy Facts can be found at www.nhecs.org.

2.2 State Energy Generation and Use

Although New Hampshire generates more electricity (16.2 million Megawatt hours) annually than it uses (11.5 million MWh), making it a net exporter of electricity (4,689,000 MWhs, or 28.9% of generation), we import the vast majority of the fuels used to generate the energy we use. As Table 2.4 below shows, $1.6 billion in energy costs for imported fuels represents money moving out of state for fuels including uranium, oil, natural gas, coal or other non-wood, usually fossil-based, sources.

New Hampshire generates renewable energy from native sources, largely by using wood and wood waste (31.0 trillion Btus from 1.3 million tons of wood chips and saw-mill residue costing $24.3 million). New Hampshire also productes hydroelectric power (2.36 MWh, for which the "fuel" is free).
The tables below include information on New Hampshire's total use of energy in 1990 and 1999, our growth rates during that period, and our rank overall in the U.S. The second table details our per capita energy use, showing that our use per person in New Hampshire is quite low relative to other states.

Table 2.2 New Hampshire Energy Consumption and Costs

NH Energy Consumption & Costs	
Energy consumed, Btus, 1999	335.4 trillion (335.4 TBtu)
Energy consumed, Btus, 1990	270.8 trillion (270.8 TBtu)
Growth in consumption	19.3% (64.6 TBtus)
National rank for energy consumed overall	45th
Dollars spent for energy	
Nominal dollars per million Btus	$11.05
Total nominal dollars for energy	$2,631,100,000
National rank for dollars spent	40th
Gross State Product (GSP)	$44,229,000,000
GSP per capita	$36,823
Efficiency (Btu/$GSP)	7,573 Btus
Efficiency (GSP Dollars/Tbtu)	$132,000,000
US average efficiency, GSP Dollars/TBtu:	$98,000,000

Source: US DOE EIA (1999 data)

Table 2.3 New Hampshire Energy Consumption and Costs

NH Per Capita Energy Data	
Total Energy consumed	335.4 TBtu
Population of State	1,235,000
Energy consumed *per capita* (Btu/person)	279,236,122
National rank	41st
Energy cost, nominal dollars total	$2,631,100,000
Energy cost, *per capita*	$2,190
National Rank	19th

Source: US DOE EIA (1999 data)

Petroleum-derived energy - whether for transportation or home heating - dominates New Hampshire's energy picture, constituting more than 54% of the energy we use in the state, and more than 85% of our energy costs.

Our consumption of gasoline is highest among all of the fuels used in the state, representing nearly half of the state's energy consumption costs. It is followed closely by the petroleum distillate, which is used as both #2 heating oil and diesel fuel for transportation. Together, these fuels make up 70% of the cost and 40% of the Btus consumed in the state.

Coal is our fourth largest energy source, primarily because of its use in electric generation, followed by wood. On the cost side, however, natural gas is third, while propane is fourth in overcall costs, although only 10th in its Btu contribution. The table below provides more information on our total consumption.

Table 2.4 New Hampshire Energy Consumption, 1999

Fuel Type	Quantity (Various Units)	Heat Equivalent (TBtu)	%	Total Cost $Million	%
Uranium (Nuclear Electric Power)	8,676,000 MWh	92.2	27.5	45.6	2.8
Motor Gasoline	15,659,000 barrels (bbl)	81.6	24.3	791.8	48.8
Distillate[1]	9,000,000 bbl	52.4	15.6	320.1	19.7
diesel (on road)	2,734,000 bbl	15.9	4.7		
#2 heating oil	6,266,000 bbl	36.5	10.9		
Coal	1,344,000 tons	35.3	10.5	53.6	3.3
Wood & Wood waste	Various units[2]	31.0	9.2	24.3	1.4
Hydroelectric power	2,368,000 MWh	24.5	7.3	0	0
Residual Fuel (i.e. #6 oil)	3,491,000 bbl	21.9	6.5	47.0	2.9
Natural Gas	20,000,000,000 cu. ft.	20.5	6.1	128.9	7.9
Other Petroleum[3]	2,591,000 bbl	13.9	4.1	52.3	3.2
LPG (propane)	2,407,000 bbl	8.7	2.6	103.3	6.4
Jet fuel	820,000 bbl	4.6	1.4	19.8	1.2
Kerosene	437,000 bbl	2.5	0.7	16.3	1.0
Asphalt & Road Oil	288,000 bbl	1.9	0.6	8.2	<0.5
Other nonpetroleum[4]	N/A	1.9	0.6	0	-
Lubricants	88,000 bbl	0.5	0.1	9	0.6
Aviation Gasoline	28,000 bbl	0.1	0.03	1.2	0.1
Net electric losses and exported electricity[5]	-18,778,000 MWh	-64.1	-19.1	Not known	
TOTAL	N/A	335.4[6]	100	$1,621.4[7]	100

[1] EIA does not distinguish between the two types of distillate fuels; total cost is combined.
[2] EIA does not specify units of wood or wood waste. Tons of wood burned at NH wood-fired power plants in 1999: 1,316,011; 97% was from whole-tree chips and sawmill residue (Source: NH DRED, Phase I Low Grade Wood Study).
[3] There are 16 petroleum products in the industrial sector. Cost figure also includes kerosene, which is not broken out by EIA.
[4] Includes geothermal, wind, photovoltaic and solar thermal energy.
[5] Losses occur primarily in transmission and average approximately 10% nationally.
[6] Columns do not add up to total, due to independent rounding in EIA data.
[7] EIA methodology, especially in accounting for electric utility fuel costs and electricity purchased by end users, precludes summing these figures to reach the total cost of $2,631.1 million. This table is useful for comparison purposes of different energy sources. For example, the cost breakdown does not include the cost of electricity to end users, which is $1.147 million. Also, dollars have not been adjusted to account for inflation.

Table 2.5. New Hampshire Total Energy Consumption by Type

Total Energy Consumption by Type, 1999	
Type	**Qty. TBtu**
Petroleum	188.3
Nuclear elec.	92.2
Coal	35.3
Wood and wood waste	31.0
Hydro elec.	24.5
Natural gas	20.5
Exports & loss	-64.1

Source: DOE EIA

2.2.1 Electric and Gas Utilities serving New Hampshire

New Hampshire customers receive electricity from five major regulated investor owned utilities, one electric cooperative, and five municipally-owned electric companies. Public Service of New Hampshire (PSNH), the state's largest electric utility, serves over 430,000 homes and businesses in 198 communities in the state. Formed in 1926, PSNH has grown to comprise three fossil fuel-fired generating plants and nine hydroelectric facilities, capable of generating more than 1,110 megawatts of electricity. PSNH is a wholly-owned subsidiary of Northeast Utilities, a utility holding company based in Connecticut.

The New Hampshire Electric Cooperative (NHEC), founded in 1939 by a group of farmers in Concord, is a nonprofit electric utility serving approximately 70,000 members in 115 towns across the state. Headquartered in Plymouth, the Cooperative serves members in 10 operating districts: Colebrook, Lisbon, Sunapee, Andover, Plymouth, Meredith, Conway, Alton, Ossipee and Raymond. An elected 11-member Board of Directors runs NHEC. The Board appoints a General Manager who oversees the Cooperative's day-to-day operations.

Unitil, a public utility holding company, has two subsidiaries providing electric service in New Hampshire: Concord Electric Company, Exeter & Hampton Electric Company. Concord Electric serves approximately 28,000 customers in the capital city and twelve communities in the Concord area: Bow, Boscawen, Canterbury, Chichester, Epsom, Salisbury and Webster, and limited areas in the towns of Allenstown, Dunbarton, Hopkinton, Loudon and Pembroke. Exeter & Hampton Electric serves approximately 40,000 customers in seventeen communities in the Exeter area: Atkinson, Danville, East Kingston, Hampton, Hampton Falls, Kensington, Kingston, Newton, Plaistow, Seabrook, South Hampton and Stratham, and portions of the towns of Derry, Brentwood, Greenland, Hampstead and North Hampton. Unitil's two New Hampshire companies are in the process of restructuring, and will do business under the Unitil name beginning in 2003 if the PUC approves its restructuring plan.

Granite State Electric Company, a subsidiary of National Grid USA, provides electricity to approximately 38,000 customers in 21 communities. The company's service area includes the Salem area in southern New Hampshire, as well as several communities located along the Connecticut River, primarily in the Lebanon and Walpole areas.

Connecticut Valley Electric Company (CVEC), a subsidiary of Central Vermont Public Service Company, serves approximately 10,000 customers in thirteen communities along the Connecticut River Valley, including the city of Claremont and portions of Bath, Charlestown, Cornish, Hanover, Haverhill, Lyme, Newport, Plainfield, Piermont, Pike, Plainfield, Orford and Unity.

Natural gas services are currently available to 53 communities in New Hampshire from two gas utilities, Northern Utilities and KeySpan Energy Delivery. Northern serves approximately 24,000 customers in the Seacoast area.[2] KeySpan serves approximately 75,000 customers in the south central part of the state.[3]

2.2.2 Restructuring and Electric Choice in New Hampshire

While work to bring competition to the state's electric industry began in earnest in 1995, its roots go back at least 20 years. Even so, after more than eight decades of monopoly regulation in the electric industry, competition is a fairly recent development.

The Electric Industry Begins

New Hampshire's electric industry began just after the turn of the century. The first electric companies in the state generated power and delivered it to local homes and businesses. These companies faced difficulties transmitting power over long distances due to inefficient wires. Often more than one provider of electric service operated in the same area, and those operations were virtually unregulated.

The Public Utilities Commission was established in 1911 in response to high rates and the recognition that duplication of inefficient wires and poles was wasteful and unsightly. The PUC granted franchised monopolies so that one company served an area, and was charged with determining reasonable rates for electric service. To check the power of these monopolies, the utility's operations were highly regulated.

Technological progress and innovation helped create larger and more efficient generating stations and the regulatory system worked well for many years. However, in the 1970s major changes in the industry began to occur. First, the cost for building plants to meet the growing demand, particularly nuclear power plants such as Seabrook Station, escalated. This was a marked difference from the electric industry's traditional trend of declining costs of generation for large plants. As a result, utilities and consumers were faced with paying for the higher costs of these nuclear generation plants that were built during this time.

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[2] Northern Utilities serves the towns of Atkinson, Dover, Durham, East Kingston, Exeter, Greenland, Hampton, Hampton Falls, Kensington, Madbury, Newington, North Hampton, Pelham, Plaistow, Portsmouth, Rochester, Rollinsford, Salem, Seabrook, Somersworth, and Stratham.

[3] KeySpan serves the towns of Allenstown, Amherst, Auburn, Bedford, Belmont, Berlin, Boscawen, Bow, Canterbury, Concord, Derry, Franklin, Gilford, Goffstown, Hollis, Hooksett, Hudson, Laconia, Lakeport, Litchfield, Londonderry, Loudon, Manchester, Merrimack, Milford, Nashua, Pembroke, Penacook, Sanbornton, Suncook, Tilton, and Winnisquam.

Rising Electric Rates

The oil crisis of the 1970's also forced us to reconsider our energy policies. One of the outcomes, the Public Utilities Regulatory Policy Act (PURPA), encouraged development of alternative generation and required utilities to purchase electricity from small power producers (SPPs). When PURPA was enacted, the State mandated the purchases of power from SPPs at rates that appeared reasonable given the rising energy costs in the 1970s under a law known as LEEPA (Limited Electrical Energy Producers Act, RSA 362-A, 1978). Long-term agreements to purchase power at set rates were entered into at that time. Today, PSNH continues to be obligated to purchase some power from SPPs even though the rates are significantly higher than current market prices. In an effort to reduce these costs, PSNH has "bought out" contracts of some wood-fired and hydroelectric facilities, so that the company no longer has an obligation to purchase the power from those facilities.

These changes in energy policy resulted in the recognition that independent generation plants could reliably produce electricity. The success of independent power laid the foundation for competition in the generation of electricity. In fact, LEEPA allowed retail competition on a small scale, as SPPs could sell directly to customers. However, this provision was never used, and SPP power was purchased by utilities under long-term contracts.

In January of 1988, a significant upheaval in the state's electric industry occurred when PSNH filed for bankruptcy protection. In 1989, the State reached an agreement with Northeast Utilities (NU) to bring PSNH out of bankruptcy and acquire the utility. The plan included seven annual rate increases of 5.5%. The legislature approved the plan, with some rate increases, and in 1990 the PUC approved the plan.

While that plan allowed PSNH to reorganize and emerge from bankruptcy, the effect of the annual rate increases began to impact New Hampshire residents and businesses. Soon, New Hampshire's electric rates surpassed those of the region and were among the highest in the nation.

A Competitive Electric Market

With the changes in the electric industry in the 1970s and 1980s, as well as the deregulation of other industries, the idea of a competitive electric market took hold throughout the U.S. during the 1990's.

In 1995, the PUC sponsored a Roundtable on Competition in New Hampshire's Electric Energy Industry. Also in that year, legislative committee work began on House Bill 1392, which was signed into law by the Governor in May of 1996 as RSA 374-F, the Electric Industry Restructuring Act.

HB 1392 directed the PUC to divide the traditional utility functions and "aggressively pursue restructuring and increased consumer choice." As a result, instead of utilities generating, transmitting and distributing electricity, the law separated of the generation of energy from the transmission and distribution functions. A consumer's utility will remain in place to deliver electricity, but customers can choose their energy supplier. The law maintains the monopoly for delivery of electricity, avoiding the duplication of wires and poles. However, for a period of time while a competitive market is established in New Hampshire, our utilities will continue to provide power through regulated "transition service."

Restructuring Overview

After passage of the Electric Industry Restructuring Act in May of 1996, the PUC developed a plan to implement restructuring. The PUC issued its "Final Plan" on February 28, 1997 which targeted full retail competition to begin on January 1998, or in any event no later than July 1, 1998.[4]

However, federal litigation filed within days of the Final Plan by PSNH and its parent Northeast Utilities challenged the Plan on federal preemption and constitutional grounds. At the heart of the matter was a dispute over who should pay for "stranded costs." Stranded costs are costs, liabilities, and investments that a utility would reasonably expect to recover in a traditional, regulated marketplace but, absent some legal mechanism to assure recovery, could not recover in a restructured marketplace. One example of stranded costs are contracts to purchase electricity at above-market prices from Small Power Producers (SPPs).

The existence of PSNH's 1989 Rate Agreement, as well as the claimed impacts on PSNH of the regional average rate approach adopted by the PUC, made PSNH's case somewhat unique, although the state's other investor-owned utilities - CVEC, Unitil and GSEC - all eventually joined the suit. PSNH obtained a Temporary Restraining Order, barring the PUC from implementing its restructuring orders.

In May of 1997, the case was referred for formal mediation, but this ultimately proved unsuccessful. In June 1998 an expanded injunction was issued, preventing the PUC from implementing restructuring for any of the state's utilities, except in voluntary or consensual filings. This injunction was later upheld by the First Circuit Court of Appeals. Consequently, statewide implementation of restructuring could not go forward, and instead there has been a utility-by-utility phase-in approach as settlements have been reached.

In July 1998, a settlement between Granite State Electric Company (GSEC), the State, and others was finalized. The agreement brought rate reductions, including a 10% reduction on July 1, 1998 and a further 7% reduction on September 1, 1998; unbundled rates; ratepayer funded efficiency and low income bill assistance programs; and opened the door to customer choice. In 2002, GSEC filed to take advantage of the Legislature's extension of the maximum length of transition service in HB489 (Ch. 29) in the 2001 Session. As a result, GSEC customers can remain on transition service through April 30, 2006.[5]

The New Hampshire Electric Cooperative (NHEC) opened its service territory to competition on January 1, 2000, after the State helped NHEC reach a settlement with its wholesale supplier, PSNH, to remove barriers to competition. As a result, NHEC customers saw a significant rate reduction of approx-

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[4] Information and documents related to restructuring can be found at www.puc.state.nh.us/d96150pg.html.

[5] See www.puc.state.nh.us/orders/2002ORDS/23966e.pdf for the PUC's Order approving GSEC's proposal to extend the length of transition service.

imately 22% on January 1, 2000, as well as ratepayer funded efficiency and low income bill assistance programs. NHEC customers still receive transition service from their electric utility because of a Legislative change. In HB489 of 2001 (Ch. 29), the Legislature expanded NHEC's exemption from regulation by the PUC, amending RSA 362:2, II, and making a distinction between investor-owned utilities and electric cooperatives in some instances related to restructuring. The amendment eliminated the PUC's jurisdiction over NHEC's transition service and other energy services that NHEC may provide to its customers. As a result, the PUC has jurisdiction only over NHEC's "default service," which is the last resort source of electricity to ensure that a utility's obligation to serve remains after restructuring.

On June 14, 1999 PSNH, along with the State negotiating team, including the Governor's Office of Energy and Community Services (ECS), NH Public Utilities Commission (PUC) settling staff, and the Attorney General's Office, announced a comprehensive Settlement Agreement on restructuring. The Agreement was filed on August 2, 1999, and the PUC approved the Agreement with conditions on April 19, 2000. On May 31, 2000 the Legislature passed legislation necessary to implement the settlement, and on June 12, 2000 Governor Shaheen signed Senate Bill 472 (RSA 369-B). The PUC issued final orders on September 8, 2000, incorporating legislative changes, approving a finance order, and denying motions for rehearing.

The PSNH restructuring settlement provided an automatic 5% rate reduction on October 1, 2000 and another reduction totaling a combined average of 15% - 17% for residential households when PSNH began retail competition on May 1, 2001. Additional rate reductions will occur in the future as certain "stranded" costs are paid off, including when the sale of Seabrook is completed in late 2002. PSNH customers will have the ability to choose their electricity supplier based on price, environmental factors, and other issues important to consumers.

The Settlement also required PSNH to sell its power plants and power supply contracts, with all proceeds going to reduce stranded costs, and provided a sizeable utility write-off of stranded costs amounting to over a third of the equity in the company.

In order to implement the PSNH settlement, the Legislature approved the issuance of up to $670 million in rate reduction bonds, a refinancing mechanism known as securitization that helped lower customers' electric rates, with additional securitization available to finance renegotiated small power producer contracts to obtain added savings.

As with GSEC and NHEC, PSNH's settlement also included programs designed to make consumers' bills more affordable, including energy efficiency and low income bill assistance programs, which are funded through a system benefits charge on customers bills. These programs are consistent with the Electric Industry Restructuring Act, in which the legislature specifically found that

> Restructuring of the electric utility industry should be done in a manner that benefits all consumers equitably and does not benefit one customer class to the detriment of another . . . . A nonbypassable and competitively neutral system benefits charge applied to the use of the distribution system may be used to fund public benefits related to the provision of electricity . . . . Such benefits, as approved by regulators, may include, but not necessarily be limited to, programs for low-income customers, energy efficiency programs . . .support for research and development, and investments in commercialization strategies for new and beneficial technologies.
>
> RSA 374-F:3, VI, Electric Industry Restructuring Act

The energy efficiency programs funded by the system benefits charge are discussed in more detail in Chapter 9. The low income bill assistance program, known as the Electric Assistance Program ("EAP"), was approved by the PUC in 2002 as a tiered discount program.[6] The EAP is operated statewide by the state's electric distribution companies, working with the Community Action Agencies around the state.

EAP provides income-eligible customers with discounts on their electric bills, intended to bring the customer's annual electric bill to approximately 4% of annual income for general use customers, and 6% for customers with electric heat. Eligibility is based upon 150% of the Federal Poverty Level, and the discount depends on a customer's income level, and the household's electric usage.

Since "Competition Day" for PSNH, the Legislature has amended the Electric Industry Restructuring Act to address new issues. In 2001 the Legislature passed HB489 (Ch. 29), which made several changes to transition service. The bill increased the length of transition service, allowing all restructured utilities to extend transition service to match up with PSNH's transition service period to facilitate all customers in the state entering competition simultaneously. PSNH's transition service periods were also extended so that residential customers can receive the service until as late as February of 2006, and larger customers until February of 2005. The pricing levels for transition service were also changed, so that the largest customers will receive PSNH's actual cost of providing the service beginning in February 2003, and residential customers move to actual pricing in February 2004.

The bill also required that PSNH keep its hydroelectric and fossil fuel assets, while moving forward with the sale of Seabrook, until at least February 2004. PSNH must provide transition and default service from those assets, and supplement any additional power needs from the market. The text of the bill can be found at www.gencourt.state.nh.us/legislation/2001/HB0489.html.

More recently, Unitil put forth a restructuring plan and a proposal to merge its two companies in New Hampshire. The PUC has approved Phase I of the settlement, and the second phase is proceeding with final approval expected in 2003. At this time, Connecticut Valley Electric Company is the last investor owned utility that has not yet opened its service territory to competition.

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[6] The Order approving the Tiered Discount Program can be found at www.puc.state.nh.us/Orders/2002ORDS/23980e.pdf.

Much has been written on the status of restructuring, and it is fair to say that New Hampshire must continue to work both within the state and with other states in the region to reach full retail competition. One remaining issue is default service, which is the safety net service designed to provide energy for short periods of time, such as when a customer is between competitive suppliers. There is usually no limit on the length of time a customer may remain on this service, and it will always be available from the utility to ensure that consumers receive uninterrupted power when they switch from one energy supplier to another. If for any reason consumers are temporarily without an energy supplier or, in some cases, if they choose not to choose an energy supplier, they will automatically receive default power service.

Another of the changes in HB489 of 2001 dealt with default service. Largely in response to the California electricity crisis of 2000 - 2001, the Legislature removed the requirement that New Hampshire default service prices must be based on the short-term market. Instead, new language gives the Commission oversight over pricing of default service in order to protect customers. More legislative changes may be needed as competition progresses in the state and in the region, and as new issues arise.

3. Base Case Forecast

3.1. Introduction

This chapter describes the Base Case or "business as usual" forecast developed for New Hampshire using the ENERGY2020 and REMI (Regional Economic Models, Inc.) models. More details on how each model works can be found in Appendices 2 and 3. ENERGY2020 forecasts demands by economic sectors (residential, commercial, industrial, and transportation). Section 3.1 provides an overview of the Base Case forecast. Sections 3.2 through 3.5 provide further detail related to the residential, commercial, industrial, and transportation sectors.

The Base Case forecast is an attempt to project a most likely or "best guess" future trajectory of the energy and economic system in New Hampshire, for the purposes of stimulating ideas for potential policies, and testing for the expected impacts of potential policies.

The Base Case forecast is based in part upon forecasts of global fossil fuel prices from the US Department of Energy's Energy Information Administration (EIA). EIA is currently forecasting prices to be very stable, with slight declines in real prices (that is, prices expressed in constant dollars such as year 2000 dollars) projected over the next twenty years. Historically, however, fossil fuel prices have shown periods of great volatility, largely due to geopolitical events. As a result, it was suggested in stakeholder discussions that the policy simulations conducted should consider a hypothetical scenario in which fossil fuel prices followed historical patterns of volatility, rather than only the EIA projections of stability and modest decline. This hypothetical "high price" scenario allows us to test potential energy policies against both the Base Case forecast and an alternative hypothetical price spike event. Section 3.4 describes the alternative fuel price scenario and the effects of these alternative fuel prices upon key variables relative to the base case forecast.

3.2 Base Case Forecast Overview

The Base Case forecasts energy demand using economic drivers, energy prices, and the model's calculations of the costs and benefits of investments in energy efficiency. Economic drivers of New Hampshire's energy demand include personal income, commercial output, and industrial output. The energy prices consist of the wellhead price of gas, the world price of oil, and the minemouth price of coal.

Electricity prices are calculated with data drawn from the model (Appendix 2 has more information on how the model calculates this data).

Overall, the Base Case projects that total New Hampshire energy demand is expected to grow at an average rate of 2.2% annually between 2000 and 2020. Oil, the fuel with the highest demand, is forecasted to grow at only 2.0% per year, while electricity and natural gas grow at 3.1% and 3.2% respectively. It is important to note that this projection shows that the use of energy is forecast to grow at rates well above the growth in population (projected to be <1%), meaning that we will see an increase in energy use per capita over the next 20 years.

Figure 3.1 Secondary Fuel Demands (TBtu)

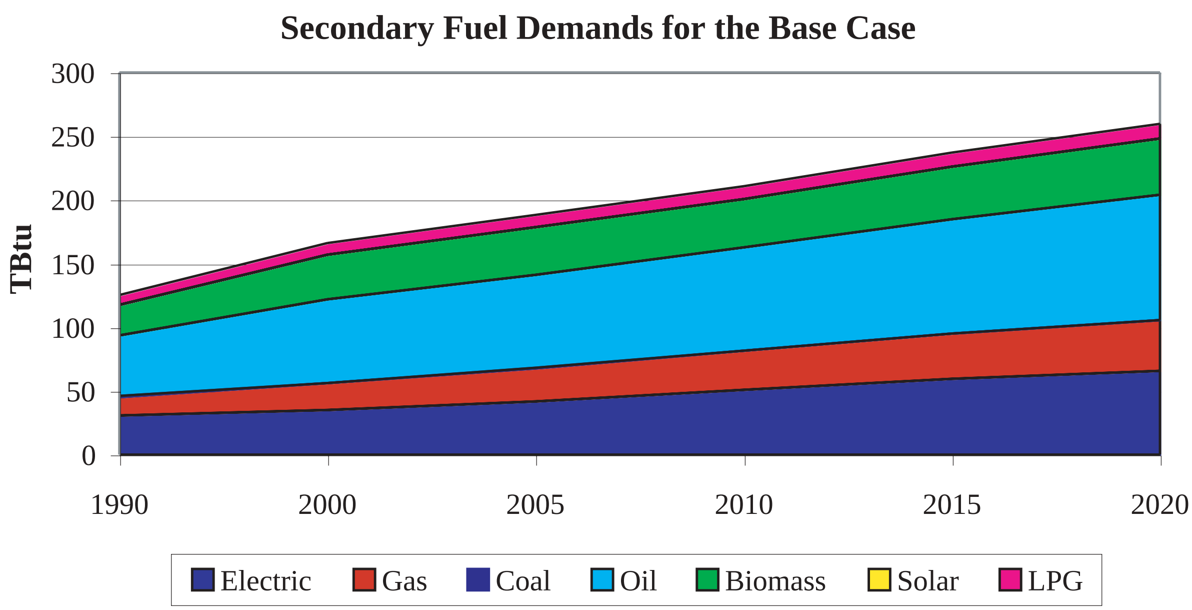

Figure 3.1 depicts the Base Case forecast of New Hampshire's secondary energy demand by fuel. Secondary energy demand refers to energy consumed at point of final use; for example, it includes the electricity we use to power our homes and business. By contrast, primary energy demand includes all energy at point of first use, which consists of the use of fuels at power plants to generate electricity, as well as to heat our homes. As a result, some fuels, such as natural gas that is used both to heat homes and to generate electricity, is included in both definitions. We use both definitions in order to understand how we use fuels overall, as well as how much electricity we use and how it is generated. For further detail, Table 3.1 below lists forecasted secondary demands and their growth rates.

Table 3.1 Secondary Fuel Demands (TBtu/Yr)

Base Case Forecast Secondary Fuel Demands (TBtu/Yr)						
	1990	2000	2005	2010	2015	2020
Electric	30.64	35.07	41.95	50.91	59.57	65.64
Gas	14.45	21.19	25.93	30.46	35.45	40.11
Coal	0.83	0.04	0.04	0.04	0.04	0.04
Oil	47.78	65.44	73.32	81.22	89.86	98.03
Biomass	23.71	35.20	37.12	38.06	41.15	44.39
Solar	0.00	0.00	0.00	0.00	0.00	0.00
LPG	7.64	8.99	9.60	10.16	10.86	11.64
Total	**125.05**	**165.93**	**187.96**	**210.86**	**236.93**	**259.85**
Cumulative Growth Rate (%)						
Electric	1.4%	0.0%	3.6%	3.7%	3.5%	3.1%
Gas	3.8%	0.0%	4.0%	3.6%	3.4%	3.2%
Coal	-29.9%	0.0%	-0.9%	-1.1%	-0.8%	-0.5%
Oil	3.1%	0.0%	2.3%	2.2%	2.1%	2.0%
Biomass	4.0%	0.0%	1.1%	0.8%	1.0%	1.2%
Solar	0.0%	0.0%	0.0%	-0.3%	0.2%	0.8%
LPG	1.6%	0.0%	1.3%	1.2%	1.3%	1.3%
Total	**2.8%**	**0.0%**	**2.5%**	**2.4%**	**2.4%**	**2.2%**

Table 3.2 shows the forecast of primary energy consumption, expected to increase at a rate of 1.66%. Natural gas is projected to grow at a much faster rate than oil (4.39% compared to 1.85%). As a result, the model projects a shift in consumption from oil to gas over the twenty year forecast period. This growth is largely due to the construction of new combined cycle gas plants for electric generation.

Table 3.2 Primary Energy Consumption (TBtu/Yr)

Base Case Forecast Primary Energy Consumption (TBtu/Yr)						
	1995	2000	2005	2010	2015	2020
Gas	33.159	86.232	129.121	152.085	184.384	207.514
Coal	21.148	60.701	56.872	60.142	60.455	60.697
Oil	61.801	116.509	121.637	140.705	156.036	168.637
Biomass	31.726	46.765	47.299	42.575	45.825	48.758
Solar	0.004	0.004	0.004	0.004	0.004	0.005
LPG	8.215	8.992	9.599	10.164	10.860	11.642
Hydro/Nuclear	46.694	144.682	149.423	149.423	149.423	149.423
Total	**202.746**	**463.884**	**513.954**	**555.098**	**606.986**	**646.676**
Cumulative Growth Rate (%)						
Gas	19.11%	0.00%	8.07%	5.67%	5.07%	4.39%
Coal	21.09%	0.00%	-1.30%	-0.09%	-0.03%	0.00%
Oil	12.68%	0.00%	0.86%	1.89%	1.95%	1.85%
Biomass	7.76%	0.00%	0.23%	-0.94%	-0.14%	0.21%
Solar	-0.52%	0.00%	0.00%	-0.27%	0.17%	0.85%
LPG	1.81%	0.00%	1.31%	1.23%	1.26%	1.29%
Hydro/Nuclear	22.62%	0.00%	0.64%	0.32%	0.21%	0.16%
Total	**16.55%**	**0.00%**	**2.05%**	**1.80%**	**1.79%**	**1.66%**

Table 3.3. New Hampshire Economic Summary

Base Case Forecast New Hampshire Economic Summary						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Employment (Thousands)	571.94	699.80	741.20	777.13	813.02	842.42
Population (Millions)	1.11	1.22	1.28	1.34	1.41	1.48
Nominal Dollars						
GRP (B$)	24.02	51.16	72.49	99.15	132.20	172.18
Personal Income (B$)	23.03	39.86	49.63	62.60	78.25	96.86
Disposable Income/Capita ($)	23,885	37,753	46,352	57,675	70,626	85,539
2000 Dollars						
GRP (2000 B$)	31.85	51.16	63.76	75.96	88.22	100.08
Personal Income (2000 B$)	30.54	39.86	43.65	47.95	52.22	56.30
Disposable Income/Capita (2000 $)	31,673	37,753	40,771	44,185	47,131	49,721
Cumulative Growth Rate (%)						
Employment	2.02%	0.00%	1.15%	1.05%	1.00%	0.93%
Population	0.92%	0.00%	1.04%	0.99%	0.98%	0.98%
GRP	4.74%	0.00%	4.41%	3.95%	3.63%	3.36%
Personal Income	2.66%	0.00%	1.82%	1.85%	1.80%	1.73%
Disposable Income/Capita	1.76%	0.00%	1.54%	1.57%	1.48%	1.38%

Economic growth largely influences the energy demand growth shown above. Table 3.3 summarizes the key economic indicators in the Base Case, which all show growth over the forecast period. Gross Regional Product (GRP) grows by 3.36%; personal income grows by 1.73%; and disposable income per capita grows by 1.38%. Employment and population also increase modestly at .93% and .98% respectively.

In addition to impacting the overall economy, energy prices also act as drivers on energy demand. Table 3.4 summarizes the Base Case projections of the prices of primary fuels. After a significant price spike in the year 2000, the energy prices settled back and are forecasted to have very little growth in real terms. The wellhead price of gas increases 0.9%, while the world oil price increases 0.3%. It should be noted that there is a significant level of disagreement over the future price of fossil fuels, which are notoriously difficult to project due to the many factors that impact their price. Figure 3.2 illustrates the trend of fuel prices used in the Base Case.

Table 3.4 Primary Fuel Prices

Base Case Forecast Primary Fuel Prices (2000$/mmBtu)						
	1990-1999 Average	2000	2005	2010	2015	2020
Wellhead Price of Gas	2.16	4.86	2.27	2.53	2.63	2.74
Minemouth Price of Coal	1.01	0.79	0.69	0.65	0.62	0.59
World Price of Oil	3.55	5.20	3.54	3.62	3.72	3.80
	Cumulative Growth Rate (%)					
Wellhead Price of Gas	0.0%	16.2%	0.5%	1.0%	1.0%	0.9%
Minemouth Price of Coal	0.0%	-4.9%	-3.7%	-2.9%	-2.4%	-2.1%
World Price of Oil	0.0%	7.6%	0.0%	0.1%	0.2%	0.3%

Table 3.5 lists the values for New Hampshire's energy-related carbon dioxide (CO_2) emissions. As can be seen in the table, total energy-related CO_2 emissions are expected to increase at a rate of 2.2% annually over the forecast period. This is the same amount that our overall energy use is projected to

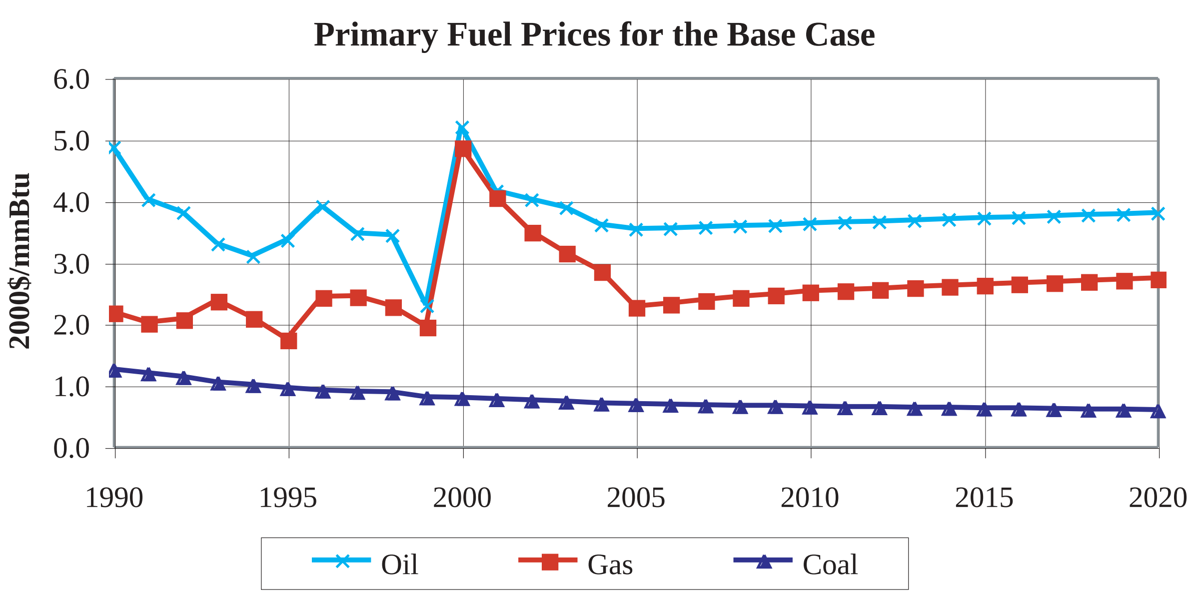

Figure 3.2 Primary Fuel Prices

Table 3.5 New Hampshire CO_2 Emissions (Million Tons CO_2e/Year)

Base Case Forecast New Hampshire CO2 Emissions (Million Tons CO2e/Year)						
	1995	**2000**	**2005**	**2010**	**2015**	**2020**
Residential	3.65	3.67	3.84	4.06	4.30	4.55
Commercial	1.24	1.37	1.60	1.81	2.01	2.20
Industrial	2.37	3.46	4.11	4.69	5.46	6.19
Transportation	5.73	7.04	8.77	10.05	11.47	12.90
Electric Utility	3.75	16.98	18.04	20.82	23.13	24.63
Total	**16.74**	**32.52**	**36.36**	**41.43**	**46.37**	**50.46**
			Cumulative Growth Rate			
Residential	0.1%	0.0%	0.9%	1.0%	1.0%	1.1%
Commercial	2.0%	0.0%	3.1%	2.8%	2.6%	2.4%
Industrial	7.6%	0.0%	3.5%	3.0%	3.0%	2.9%
Transportation	4.1%	0.0%	4.4%	3.6%	3.3%	3.0%
Electric Utility	30.2%	0.0%	1.2%	2.0%	2.1%	1.9%
Total	**13.3%**	**0.0%**	**2.2%**	**2.4%**	**2.4%**	**2.2%**

increase, so that under the "business as usual" forecast, our CO_2 emissions will continue at current rates. Consequently, if we remain on our current track, we will not be using cleaner energy over the next 20 years.

3.3 Residential Forecast

New Hampshire has approximately 1.2 million residents in the state's ten counties. According to the 2000 census, New Hampshire has 547,000 individual households. Most households in the state are single family. According to the ENERGY2020 model, New Hampshire's population is expected to grow by less than 1% annually through the year 2020.

In the residential forecast, demand grows moderately over the forecast period for each fuel. Table 3.6 summarizes the forecasted residential demand and growth rates. As shown in the summary table, total residential demand is projected to grow at an average rate of 1.3% between the years 2000 and 2020. This 1.3% growth in residential demand is slightly lower than growth of personal income, projected to be moderate at 1.7%. Residential demand grows at a slower rate than personal income due to higher levels of energy efficiency over time, a modest but positive outcome of our investments in energy efficiency.

With respect to specific fuels, ENERGY2020 projects that the growth of natural gas and electricity (1.9% and 2.0%) is higher than the growth of oil (0.9%) over the forecast period. This relationship reflects a higher market share for natural gas and electricity relative to oil.

Table 3.7 summarizes the forecast of residential demand for seven end uses. The end uses include space heating, water heating, refrigeration, lighting, air conditioning, other substitutable end uses and other non-substitutables. Other substitutable end uses include cooking and clothes drying, because several

Table 3.6 Residential Demand Summary

Base Case Forecast Residential Demand Summary						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Personal Income						
1998 B$/Yr	30.539	39.862	43.652	47.955	52.220	56.303
Cumulative Growth Rate	2.7%	0.0%	1.8%	1.9%	1.8%	1.7%
Demand (Tbtu/Yr)						
Electric	11.752	12.740	13.985	15.809	17.654	19.134
Gas	5.986	6.906	7.442	8.197	9.074	10.070
Oil	21.100	28.920	29.996	31.555	33.121	34.667
Biomass	3.684	2.700	2.814	2.996	3.215	3.458
Solar	0.003	0.003	0.003	0.003	0.003	0.004
LPG	5.254	6.727	7.137	7.493	7.867	8.281
Total	**47.778**	**57.997**	**61.376**	**66.054**	**70.935**	**75.613**
Cumulative Demand Growth Rate						
Electric	0.8%	0.0%	1.9%	2.2%	2.2%	2.0%
Gas	1.4%	0.0%	1.5%	1.7%	1.8%	1.9%
Oil	3.2%	0.0%	0.7%	0.9%	0.9%	0.9%
Biomass	-3.1%	0.0%	0.8%	1.0%	1.2%	1.2%
Solar	0.2%	0.0%	0.4%	0.5%	0.8%	1.1%
LPG	2.5%	0.0%	1.2%	1.1%	1.0%	1.0%
Total	**1.9%**	**0.0%**	**1.1%**	**1.3%**	**1.3%**	**1.3%**

energy sources can be used for these activities, including gas and electricity. Other non-substitutables, which are those items that must use electricity, include computers, TVs, clothes washers, and other electrical devices. All end uses are projected to grow moderately over the forecast period. The demand grows most significantly for other substitutables (1.9%), lighting (1.7%), and water heating (1.5%). Air conditioning (1.0%) and refrigeration (1.0%) have lower growth rates due to the impact of efficiency standards for these two end uses.

Between 2000 and 2010, residential electric prices are projected to decline at an average annual growth rate of –2.85%. By 2020, the average growth steadies at –.45%. Residential prices of gas, oil, biomass, and LPG remain relatively flat through 2020. Figure 3.3 shows the residential energy prices

Table 3.7 Residential End Use Demand Summary

Base Case Forecast Residential Enduse Demand Summary	1990	2000	2005	2010	2015	2020
Personal Income						
1998 B$/Yr	30.54	39.86	43.65	47.95	52.22	56.30
Cumulative Growth Rate	2.7%	0.0%	1.8%	1.9%	1.8%	1.7%
Demand (Tbtu/Yr)						
Space Heating	26.35	29.18	30.47	32.47	34.60	36.65
Water Heating	11.73	17.32	18.66	20.29	21.92	23.54
Other Subs	2.72	3.84	4.24	4.71	5.16	5.57
Refrigeration	3.32	3.71	3.81	4.01	4.25	4.50
Lighting	0.76	0.81	0.86	0.94	1.06	1.14
Air Condition	0.54	0.60	0.60	0.64	0.69	0.73
Other Non-Subs	2.36	2.53	2.74	3.00	3.26	3.50
Total	**47.78**	**58.00**	**61.38**	**66.06**	**70.94**	**75.62**
Cumulative Demand Growth Rate						
Space Heating	1.0%	0.0%	0.9%	1.1%	1.1%	1.1%
Water Heating	3.9%	0.0%	1.5%	1.6%	1.6%	1.5%
Other Subs	3.4%	0.0%	2.0%	2.0%	2.0%	1.9%
Refrigeration	1.1%	0.0%	0.5%	0.8%	0.9%	1.0%
Lighting	0.7%	0.0%	1.0%	1.5%	1.8%	1.7%
Air Condition	1.1%	0.0%	0.1%	0.6%	1.0%	1.0%
Other Non-Subs	0.7%	0.0%	1.6%	1.7%	1.7%	1.6%
Total	**1.9%**	**0.0%**	**1.1%**	**1.3%**	**1.3%**	**1.3%**

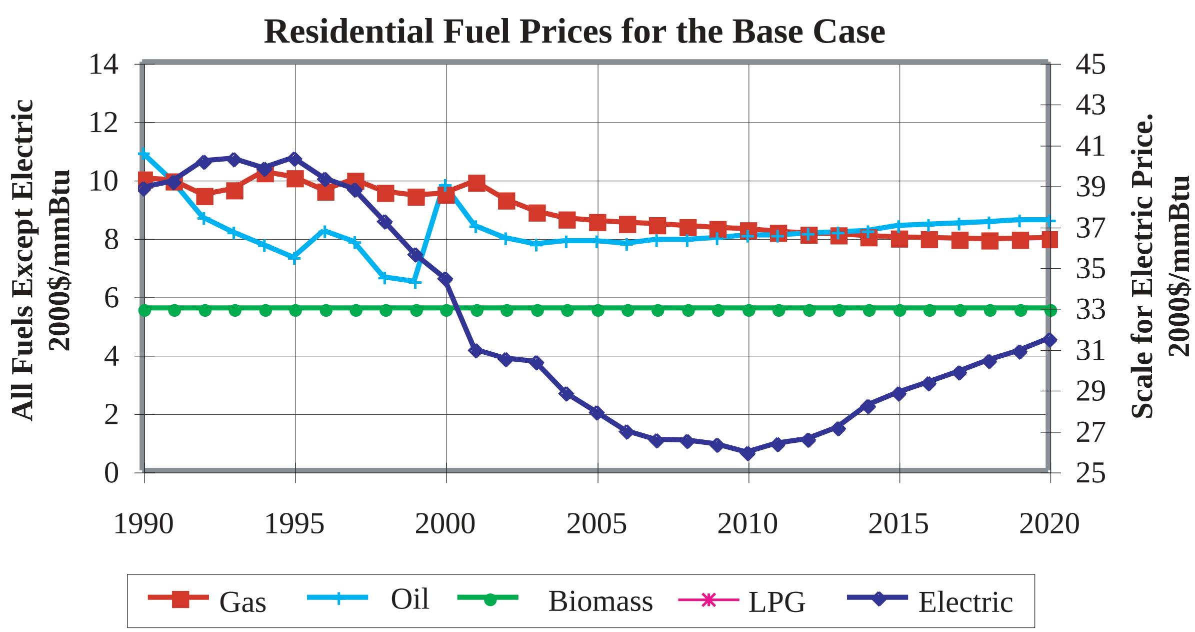

Figure 3.8 Residential Fuel Prices

Table 3.8 Residential Energy Prices

Base Case Forecast Residential Energy Prices (2000 $/mmBtu)						
	1990	2000	2005	2010	2015	2020
Electric	38.84	34.44	27.87	25.89	28.82	31.46
Gas	10.03	9.49	8.57	8.28	8.00	7.98
Oil	10.88	9.80	7.88	8.06	8.39	8.58
Biomass	5.57	5.57	5.57	5.57	5.57	5.57
Solar	38.84	34.44	27.87	25.89	28.82	31.46
LPG	17.72	17.23	17.39	17.57	17.20	17.10
Cumulative Growth Rate						
Electric	-1.20%	0.00%	-4.23%	-2.85%	-1.19%	-0.45%
Gas	-0.55%	0.00%	-2.06%	-1.37%	-1.14%	-0.87%
Oil	-1.05%	0.00%	-4.36%	-1.95%	-1.04%	-0.66%
Biomass	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Solar	-1.20%	0.00%	-4.23%	-2.85%	-1.19%	-0.45%
LPG	-0.28%	0.00%	0.19%	0.20%	-0.01%	-0.04%

by fuel and Table 3.8 summarizes the forecasted prices and their growth rates.

Overall, in the Base Case or "business as usual" forecast, prices for residential customers remain stable over the entire forecast horizon.

3.4 Commercial Forecast

New Hampshire has a strong commercial sector, with a significant presence in all parts of the state. Major commercial sectors in New Hampshire include retail establishments, computer programming and

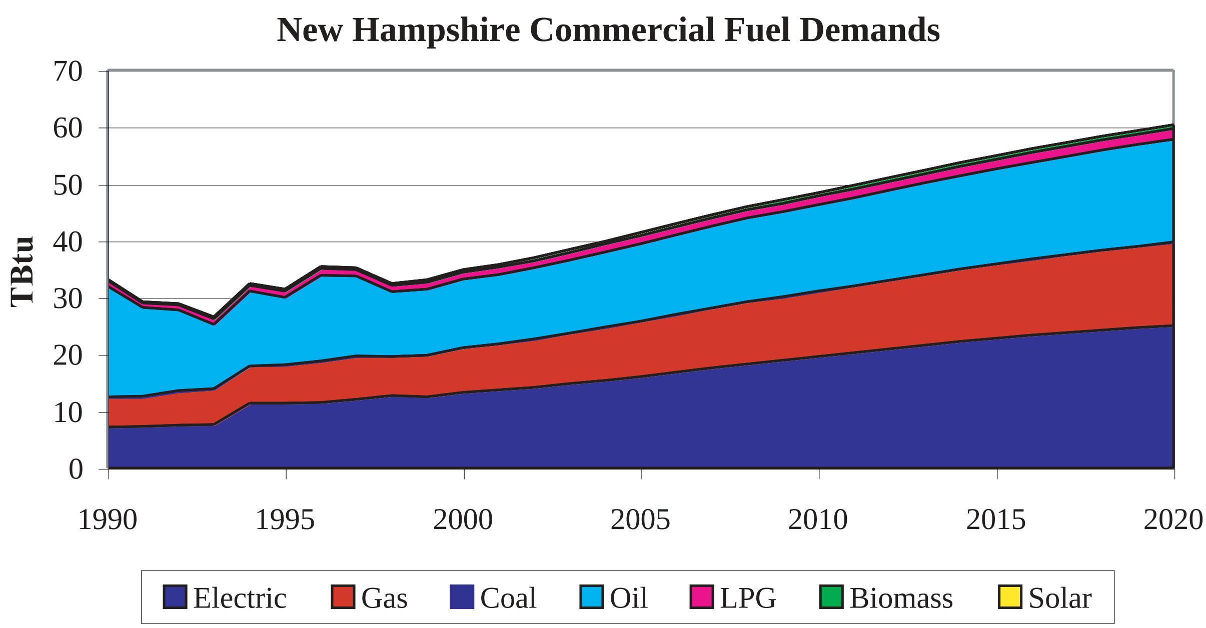

Figure 3.3 New Hampshire Commercial Fuel Demands

related services, health services, and other non-manufacturing professional activities.

Figure 3.4 illustrates the forecast of commercial demand by fuel type. Table 3.9 summarizes the forecasted demands and growth rates. As listed in Table 3.9, total commercial demand is expected to grow at a rate of 2.7% over the forecast period. The growth of commercial economic output is slightly less at 2.6%. The higher growth in energy usage is due to an increase in energy used by the commercial sector per dollar of output, which suggests that the commercial sector will actually become less efficient in our "business as usual" forecast unless polices or programs are created to increase efficiency.

Table 3.9. Commercial Demand Summary

Base Case Forecast Commercial Demand Summary						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Economic Output						
1998 B$/Yr	38.496	55.837	65.267	74.856	84.189	92.950
Cumulative Growth Rate	3.7%	0.0%	3.1%	2.9%	2.7%	2.6%
Demand (Tbtu/Yr)						
Electric	7.22	13.34	16.08	19.60	22.83	25.08
Gas	5.14	7.81	9.73	11.44	13.04	14.59
Coal	0.13	0.04	0.04	0.04	0.04	0.04
Oil	19.55	12.02	13.61	15.21	16.69	18.13
Biomass	0.23	0.43	0.52	0.59	0.64	0.70
Solar	0.00	0.00	0.00	0.00	0.00	0.00
LPG	0.93	1.25	1.43	1.55	1.69	1.85
Total	**33.20**	**34.90**	**41.41**	**48.43**	**54.94**	**60.39**
Cumulative Demand Growth Rate						
Electric	6.1%	0.0%	3.7%	3.9%	3.6%	3.2%
Gas	4.2%	0.0%	4.4%	3.8%	3.4%	3.1%
Coal	-11.1%	0.0%	-1.0%	-1.1%	-0.8%	-0.5%
Oil	-4.9%	0.0%	2.5%	2.4%	2.2%	2.1%
Biomass	6.1%	0.0%	3.7%	3.0%	2.7%	2.4%
Solar	-0.6%	0.0%	-0.3%	-2.7%	-2.1%	-0.3%
LPG	3.0%	0.0%	2.7%	2.2%	2.0%	2.0%
Total	**0.5%**	**0.0%**	**3.4%**	**3.3%**	**3.0%**	**2.7%**

The forecast of commercial demand indicates a shifting of dominant fuels over the forecast period. Consistent with the overall forecast, the historically dominant fuel, which is oil (2.1% growth), shifts to both natural gas (3.1% growth) and electricity (3.2% growth).

Table 3.10 summarizes commercial demand, showing moderate growth in the seven end uses. Air conditioning demand grows the most at a rate of 3.4%; lighting sees the slowest growth at 2.0%, showing the impacts of efficiency investments. Commercial energy prices are projected to decline overall. The Base Case projects electric prices to decline in the short term, and then begin to grow after 2009, resulting in an overall modest decline. By 2020, the average annual growth rate of commercial electric prices is –.72%.

Table 3.10 Commercial Enduse Demand Summary

Base Case Forecast Commercial Enduse Demand Summary						
	1990	2000	2005	2010	2015	2020
Economic Output						
1998 B$/Yr	38.50	55.84	65.27	74.86	84.19	92.95
Cumulative Growth Rate	3.7%	0.0%	3.1%	2.9%	2.7%	2.6%
Demand (Tbtu/Yr)						
Space Heating	17.97	20.42	24.54	28.92	32.93	36.23
Water Heating	1.21	1.39	1.59	1.78	1.95	2.13
Other Subs	0.11	0.18	0.22	0.25	0.29	0.32
Refrigeration	0.44	0.83	1.00	1.19	1.35	1.49
Lighting	3.42	6.18	6.92	7.70	8.45	9.26
Air Condition	1.93	3.60	4.44	5.49	6.47	7.11
Other Non-Subs	0.15	0.28	0.34	0.39	0.44	0.49
Feedstocks	7.95	2.02	2.36	2.71	3.05	3.37
Total	**33.20**	**34.90**	**41.41**	**48.43**	**54.94**	**60.39**
Cumulative Demand Growth Rate						
Space Heating	1.3%	0.0%	3.7%	3.5%	3.2%	2.9%
Water Heating	1.3%	0.0%	2.8%	2.5%	2.3%	2.2%
Other Subs	5.0%	0.0%	3.4%	3.2%	3.0%	2.7%
Refrigeration	6.2%	0.0%	3.9%	3.6%	3.3%	3.0%
Lighting	5.9%	0.0%	2.3%	2.2%	2.1%	2.0%
Air Condition	6.2%	0.0%	4.2%	4.2%	3.9%	3.4%
Other Non-Subs	6.2%	0.0%	3.6%	3.4%	3.1%	2.8%
Feedstocks	-13.7%	0.0%	3.1%	2.9%	2.7%	2.5%
Total	**0.5%**	**0.0%**	**3.4%**	**3.3%**	**3.0%**	**2.7%**

The non-electric prices show no change or a slight decline through 2020. Commercial natural gas prices decline by –0.43, while commercial oil prices decline by –0.62%. Table 3.11 summarizes the forecast of commercial energy prices, and Figure 3.5 illustrates the relationship among the fuel prices.

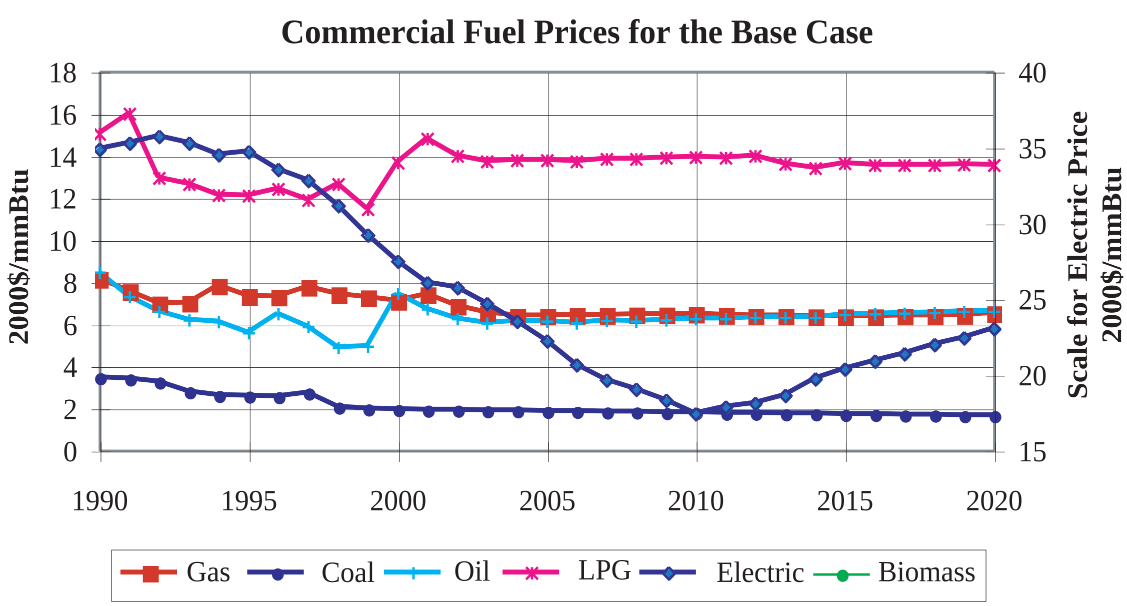

Figure 3.5 Commercial Energy Prices

Table 3.11 Commercial Energy Prices

Base Case Forecast Commercial Energy Prices (2000 $/mmBtu)	1990	2000	2005	2010	2015	2020
Electric	34.89	27.47	22.22	17.44	20.37	23.03
Gas	8.14	7.09	6.39	6.48	6.36	6.50
Coal	3.47	1.96	1.87	1.79	1.72	1.65
Oil	8.46	7.46	6.12	6.26	6.46	6.59
Biomass	4.14	4.14	4.14	4.14	4.14	4.14
Solar	34.89	27.47	22.22	17.44	20.37	23.03
LPG	15.04	13.66	13.79	13.93	13.63	13.56
Cumulative Growth Rate						
Electric	-2.39%	0.00%	-4.24%	-4.55%	-1.99%	-0.88%
Gas	-1.39%	0.00%	-2.06%	-0.90%	-0.72%	-0.43%
Coal	-5.72%	0.00%	-0.90%	-0.87%	-0.87%	-0.85%
Oil	-1.27%	0.00%	-3.94%	-1.75%	-0.96%	-0.62%
Biomass	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Solar	-2.39%	0.00%	-4.24%	-4.55%	-1.99%	-0.88%
LPG	-0.96%	0.00%	0.19%	0.20%	-0.01%	-0.04%

3.5 Industrial Forecast

New Hampshire has a strong and diverse industrial sector, with no single industry dominating. Some of the major energy users in the industrial sector include paper mills, machine and computer manufacturing, and electronic equipment manufacturing.

Overall energy demand of industrial customers is expected to increase at an average annual growth rate of 2.6%, while industrial output grows at 4.2%. This difference is largely due to the higher growth in economic output in the less energy intensive industries.

Electricity demand is expected to follow overall economic growth at a rate of 4.2%. These industries, such as the manufacturing of machines and electric equipment, although less energy intensive overall, still use a significant amount of electricity. Table 3.12 summarizes the forecast of industrial demand.

Industrial energy growth is dominated by two industries, Machines & Equipment (SIC 35) and Electric Equipment (SIC 36). The energy growth reflects the economic growth in these industries. Table 3.13 details the forecasted demand by industry.

Table 3.14 summarizes the forecast of industrial prices. As shown in Table 3.14, industrial energy prices drop in the early years. Electricity prices increase in later years producing a slight (0.22%) increase by 2020. Gas and oil prices also recover somewhat but still show a long-term (–0.94%) reduction.

Table 3.12 Industrial Demand Summary

Base Case Forecast Industrial Demand Summary						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Economic Output						
1998 B$/Yr	16.199	37.513	49.391	60.070	72.987	85.957
Cumulative Growth Rate	8.4%	0.0%	5.5%	4.7%	4.4%	4.2%
Demand (Tbtu/Yr)						
Electric	11.66	8.99	11.89	15.51	19.08	21.42
Gas	3.32	6.47	8.76	10.82	13.33	15.45
Coal	0.70	0.00	0.00	0.00	0.00	0.00
Oil	7.14	24.50	29.71	34.46	40.05	45.23
Biomass	19.79	32.06	33.79	34.48	37.29	40.23
Solar	0.00	0.00	0.00	0.00	0.00	0.00
LPG	1.46	1.02	1.04	1.12	1.31	1.52
Total	**44.07**	**73.03**	**85.18**	**96.38**	**111.06**	**123.85**
Cumulative Demand Growth Rate						
Electric	-2.6%	0.0%	5.6%	5.5%	5.0%	4.3%
Gas	6.7%	0.0%	6.1%	5.2%	4.8%	4.4%
Coal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Oil	12.3%	0.0%	3.9%	3.4%	3.3%	3.1%
Biomass	4.8%	0.0%	1.1%	0.7%	1.0%	1.1%
Solar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
LPG	-3.6%	0.0%	0.4%	0.9%	1.7%	2.0%
Total	**5.1%**	**0.0%**	**3.1%**	**2.8%**	**2.8%**	**2.6%**

3.6 Transportation Forecast

The legislation that mandated development of the New Hampshire Energy Plan, House Bill 443, did not call for an analysis of energy use in transportation. However, transportation is a major component of the state's energy use, and is larger than industrial, commercial or residential use. In addition, energy use for transportation is expected to grow more than any other type of use, making it an increasingly important issue in the state's future energy planning efforts.

Because it is an important part of energy use in all states and regions, the ENERGY2020 model used in developing information for this energy plan evaluates transportation energy use. While we do not focus on this issue, we present the information generated by ENERGY2020 so that policy makers and stakeholders have information available for future discussions.

Table 3.15 summarizes the forecast of transportation demands. Total transportation demand is expected to grow at a rate of 3.0% over the forecast period. Automobiles continue to be the dominant mode of transportation, with the largest demand of any sector and a growth rate of 3.0%. Train and marine modes, while having small demands, have the highest projected growth rates, 5.3% and 5.2% respectively.

Table 3.16 summarizes the forecasted transportation energy prices and growth rates, which shows

Table 3.13 Industrial Demand Summary by Industry

Base Case Forecast Industrial Demand Summary by Industry	1990	2000	2005	2010	2015	2020
Economic Output						
1998 B$/Yr						
SIC 26 Paper	1.10	1.13	1.12	1.17	1.29	1.41
SIC 35 Machines & Computer	3.27	13.50	21.60	28.51	35.96	43.48
SIC 36 Electric Equipment	1.73	6.89	10.14	13.15	16.22	19.08
SIC 29 Petroleum Products	0.03	0.47	0.49	0.48	0.50	0.53
SIC 30 Rubber	1.03	1.66	1.76	1.95	2.23	2.52
SIC 33 Primary Metals	0.65	1.48	1.57	1.68	2.07	2.50
SIC 38 Instruments	1.92	2.30	2.60	2.84	3.51	4.22
Rest of Industries	6.46	10.08	10.11	10.29	11.20	12.23
Total Industries	16.20	37.51	49.39	60.07	72.99	85.96
Cumulative Growth Rate						
SIC 20 Food & Tobacco	0.2%	0.0%	-0.1%	0.4%	0.9%	1.1%
SIC 30 Rubber	14.2%	0.0%	9.4%	7.5%	6.5%	5.8%
SIC 33 Primary Metals	13.8%	0.0%	7.7%	6.5%	5.7%	5.1%
SIC 35 Machines & Computer	26.5%	0.0%	0.9%	0.1%	0.4%	0.6%
SIC 36 Electric Equipment	4.8%	0.0%	1.2%	1.6%	2.0%	2.1%
SIC 37 Transport Equipment	8.2%	0.0%	1.3%	1.3%	2.2%	2.6%
SIC 38 Instruments	1.8%	0.0%	2.4%	2.1%	2.8%	3.0%
Rest of Industries	4.4%	0.0%	0.1%	0.2%	0.7%	1.0%
Total Industries	8.4%	0.0%	5.5%	4.7%	4.4%	4.1%
Demand (Tbtu/Yr)						
SIC 26 Paper	23.91	21.78	22.63	24.28	26.68	28.65
SIC 35 Machines & Computer	2.08	5.97	10.17	13.91	17.58	20.88
SIC 36 Electric Equipment	1.29	6.82	10.99	14.97	18.64	21.62
SIC 29 Petroleum Products	0.66	16.55	17.39	16.85	17.75	18.77
SIC 30 Rubber	1.22	2.74	3.21	3.80	4.39	4.86
SIC 33 Primary Metals	2.33	3.11	3.42	3.78	4.74	5.64
SIC 38 Instruments	1.36	1.89	2.41	2.87	3.76	4.62
Rest of Industries	11.22	14.18	14.95	15.93	17.52	18.82
Total Industries	44.07	73.03	85.18	96.38	111.06	123.85
Cumulative Demand Growth Rate						
SIC 26 Paper	-0.9%	0.0%	0.8%	1.1%	1.4%	1.4%
SIC 35 Machines & Computer	10.5%	0.0%	10.7%	8.5%	7.2%	6.3%
SIC 36 Electric Equipment	16.6%	0.0%	9.5%	7.9%	6.7%	5.8%
SIC 29 Petroleum Products	32.3%	0.0%	1.0%	0.2%	0.5%	0.6%
SIC 30 Rubber	8.1%	0.0%	3.2%	3.3%	3.1%	2.9%
SIC 33 Primary Metals	2.9%	0.0%	1.9%	1.9%	2.8%	3.0%
SIC 38 Instruments	3.3%	0.0%	4.8%	4.2%	4.6%	4.5%
Rest of Industries	2.3%	0.0%	1.1%	1.2%	1.4%	1.4%
Total Industries	5.1%	0.0%	3.1%	2.8%	2.8%	2.6%

that the energy prices experience an overall decline over the forecast period. The highway (automobile) price, the largest of the five transportation modes, decreases at an average rate of –0.70%. The marine energy price is the smallest price and declines at an average rate of –1.5%.

The New Hampshire Department of Transportation (NHDOT) is charged with developing Ten Year Transportation Plans under federal law, which serve as the State's transportation plan. The current plan, covering the years 2003 through 2012, provides a strong foundation for increasing the use of inter-modal transportation statewide. The Plan focuses on the infrastructure necessary to support reliable

Table 3.14 Industrial Energy Prices

Base Case Forecast Industrial Energy Prices (2000 $/mmBtu)	1990	2000	2005	2010	2015	2020
Electric	29.30	23.23	19.25	18.58	21.62	24.27
Gas	5.31	5.25	3.95	3.99	4.03	4.35
Coal	3.47	0.00	0.00	0.00	0.00	0.00
Oil	8.90	5.04	3.95	3.97	4.07	4.18
Biomass	4.14	4.14	4.14	4.14	4.14	4.14
LPG	15.04	13.66	13.79	13.93	13.63	13.56
Cumulative Growth Rate						
Electric	-2.32%	0.00%	-3.76%	-2.23%	-0.48%	0.22%
Gas	-0.12%	0.00%	-5.69%	-2.75%	-1.76%	-0.94%
Coal	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Oil	-5.68%	0.00%	-4.90%	-2.39%	-1.42%	-0.94%
Biomass	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
LPG	-0.96%	0.00%	0.19%	0.20%	-0.01%	-0.04%

intermodal transportation, including highways, bridges, rail, air, bicycle and pedestrian facilities. It does not, however, focus on energy use, efficiency, or alternative energy in the transportation system.

Table 3.15 Transportation Demand Summary

Base Case Forecast Transportation Demand Summary	1990	2000	2005	2010	2015	2020
Economic Output						
Residential						
1998 B$/Yr	30.54	39.86	43.65	47.95	52.22	56.30
Cumulative Growth Rate	2.7%	0.0%	1.8%	1.9%	1.8%	1.7%
Commercial						
1998 B$/Yr	38.50	55.84	65.27	74.86	84.19	92.95
Cumulative Growth Rate	3.7%	0.0%	3.1%	2.9%	2.7%	2.6%
Industrial						
1998 B$/Yr	16.20	37.51	49.39	60.07	72.99	85.96
Cumulative Growth Rate	8.4%	0.0%	5.5%	4.7%	4.4%	4.2%
Demand (Tbtu/Yr)						
Highway	69.44	94.24	116.96	133.59	152.20	170.98
Bus	0.00	0.01	0.01	0.01	0.01	0.01
Train	0.03	0.05	0.07	0.09	0.12	0.15
Plane	3.68	4.66	5.72	6.61	7.41	8.15
Marine	0.03	0.06	0.08	0.11	0.14	0.17
Total	**73.18**	**99.02**	**122.85**	**140.42**	**159.88**	**179.45**
Cumulative Demand Growth Rate						
Highway	3.1%	0.0%	4.3%	3.5%	3.2%	3.0%
Bus	8.0%	0.0%	4.3%	3.2%	2.6%	2.3%
Train	6.6%	0.0%	7.7%	6.2%	5.7%	5.3%
Plane	2.4%	0.0%	4.1%	3.5%	3.1%	2.8%
Marine	5.4%	0.0%	7.1%	6.0%	5.6%	5.2%
Total	**3.0%**	**0.0%**	**4.3%**	**3.5%**	**3.2%**	**3.0%**

See Chapter 10 for more information on the state's transportation energy use and opportunities to increase efficiency and use alternative fuels.

Table 3.16 Transportation Energy Prices

Base Case Forecast Transportation Energy Prices (2000 $/mmBtu)						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Highway	12.62	13.04	11.36	11.53	11.43	11.35
Bus	12.42	11.77	9.98	10.03	10.16	10.11
Train	12.42	11.77	9.98	10.03	10.16	10.11
Plane	7.73	5.94	4.93	5.04	5.18	5.30
Marine	3.23	3.77	2.62	2.62	2.71	2.80
Cumulative Growth Rate						
Highway	0.33%	0.00%	-2.77%	-1.24%	-0.88%	-0.70%
Bus	-0.54%	0.00%	-3.30%	-1.59%	-0.98%	-0.76%
Train	-0.54%	0.00%	-3.30%	-1.59%	-0.98%	-0.76%
Plane	-2.63%	0.00%	-3.74%	-1.64%	-0.92%	-0.57%
Marine	1.55%	0.00%	-7.26%	-3.65%	-2.21%	-1.50%

In order to provide a more integrated approach to transportation planning with an appropriate focus on the energy impacts of our transportation choices, the Governor's Office of Energy & Community Services and the Department of Environmental Services should increase efforts to collaborate with NHDOT to ensure that they have the latest information on energy use and fuel efficiency as it relates to transportation. As discussed in Chapter 1, we have recommended that NHDOT serve on an Energy Planning Advisory Board to ensure that transportation issues are considered in the State's future energy planning efforts.

3.7 Alternative “High Price” Scenario

At the suggestion of stakeholders and members of the public, a second hypothetical scenario was developed to understand how New Hampshire’s energy use, economic development, and environment would be impacted by a steep climb in fossil fuel prices. It was suggested that, while the Base Case provides valuable baseline information for decision-makers, it would be very helpful to also evaluate the effects of unforeseen increases in fossil fuel prices as the result of geopolitical events, resource shortages, or other reasons.

Energy forecasting is a difficult undertaking, with many variables that are likely to change rapidly. As a result, the primary value of a policy simulation model such as ENERGY2020 or REMI lies not in its ability to “predict the future,” but rather in its ability to estimate how potential policies would change future outcomes of interest to the state, relative to what would have happened without the particular policy. As discussed above, the Base Case forecast is an attempt to project a most likely or “best guess” future of the energy and economic system in New Hampshire, for the purposes of stimulating ideas for potential policies, and testing for the impacts of potential policies.

Some projections of changes that help shape the Base Case scenario are quite safe assumptions. For example, both the state population and the energy efficiency of the existing building stocks change slowly over time, so our projections of their values over the next 10 and even 20 years are likely to be accurate within a few percentage points. In contrast, several other key determinants of the Base Case energy forecast are notoriously difficult to predict. The most uncertain elements are future world prices of fossil fuels. As history has shown, unpredictable world events can lead to rapid and major changes in these prices, over the short or even long term. And over the long term, such prices have a strong influence on the decisions of people and businesses as they invest in energy-using devices and capital stocks.

For these reasons, it was suggested during the early series of meetings and discussions with stakeholders that it would be beneficial to the planning process to create and utilize a hypothetical alternative forecast of world fossil fuel energy prices. The purpose is not to provide a second “prediction” of fossil fuel prices, but instead to create a possible, albeit purely hypothetical, alternative view of fuel prices against which to test potential policies. This alternative price forecast allows us to see the impact of policies against both the flat EIA-based projections, as well as against a hypothetical price spike event that could occur for a variety of reasons.

As shown above in Figures 3.5 and 3.6, the Base Case forecast for fossil fuel prices from EIA is very stable and calls for gradually falling real prices over the next 20 years. During the past 30 years, fossil fuel prices have shown periods of great volatility, due largely to geopolitical events. It was determined that the policy test simulations conducted to support the energy plan should also investigate the sensitivity of conclusions to a scenario in which fossil fuel prices followed historical patterns of volatility in addition to the EIA projections of stability and modest decline. The next section summarizes the alternative fossil fuel price scenario that was developed, and the effects of these alternative fossil fuel prices upon key variables relative to the Base Case forecast.

3.7.1 High Price Scenario Definition

Rather than attempt to provide an "alternative forecast" of fossil fuel prices, we decided to simply create an alternative price scenario, in which price dynamics followed a pattern similar to those seen in recent history. Therefore, it is important to understand that this scenario is not meant to be a statement about, or forecast of, expected prices; instead, it is intended to provide a set of hypothetical prices against which the impacts of policies can be tested. The high price scenario is intended to provide a fossil fuel price scenario that is significantly different from the Base Case price scenario for the purpose of understanding policy impacts in different circumstances.

The benefit of this alternative scenario is that it provides more context for the potential policies that are tested in the model, as it can demonstrate whether the effects of potential policies depend significantly upon which of the fossil fuel price scenarios is used. If impacts of a policy are shown to depend strongly upon which fossil fuel price scenario is used, this indicates that policy makers should exercise caution in relying on the policy results to turn out in the way that any single scenario determines, because historically fossil fuel price forecasts have been inherently uncertain.

Historical price data are available from the EIA's State Energy Data System (SEDS). For the SEDS use category of "total energy consumption," real (that is, inflation-corrected) prices (per Million Btu) for coal, natural gas, and "all petroleum fuels" relative to their values in 1978 are plotted in Figure 6. It is interesting to note that natural gas prices actually rose higher relative to their 1978 price than did the aggregated set of all petroleum fuels. Specifically, crude oil prices climbed to a value just over two times their 1978 levels by 1981, and then slowly and gradually declined. Natural gas prices continued to rise through 1983, reaching a peak value nearly 3 times their 1978 level, after which they too declined. By 1990, both gas and oil prices were not far from twice their 1978 values.

Based on this information, the average deviation of natural gas and petroleum product price factors from 1978 to 1990 (per Million Btu, relative to 1978, in real dollars) was calculated as shown in Figure 3.7. These factors were then used to scale EIA's forecast of natural gas and each petroleum fuel's cost (per Million Btu, in real dollars) for the period 2008 – 2020, in order to create the "high price" (HP) scenario.

3.7.2 High Price Scenario Impacts

The hypothetical rise (and fall) in fossil fuel prices that was tested would have a variety of effects on some key variables, relative to the Base Case forecast, as summarized in Figure 3.8. The demand, at point of end-use, for fuels other than natural gas and electricity (primarily petroleum fuels) drops sharply

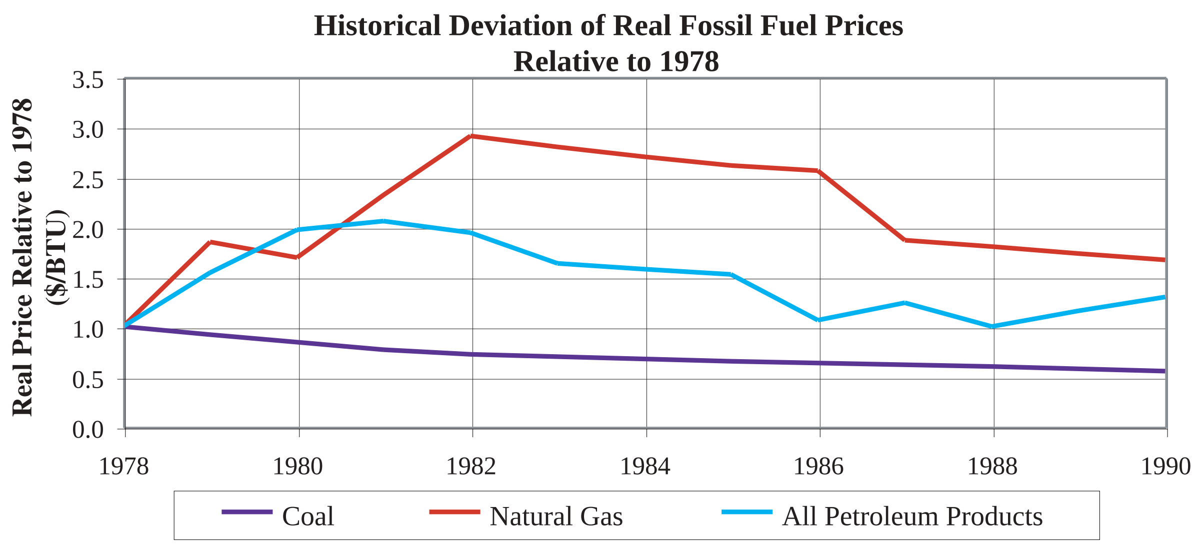

Figure 3.6 Historical deviation of real fossil fuel prices relative to 1978

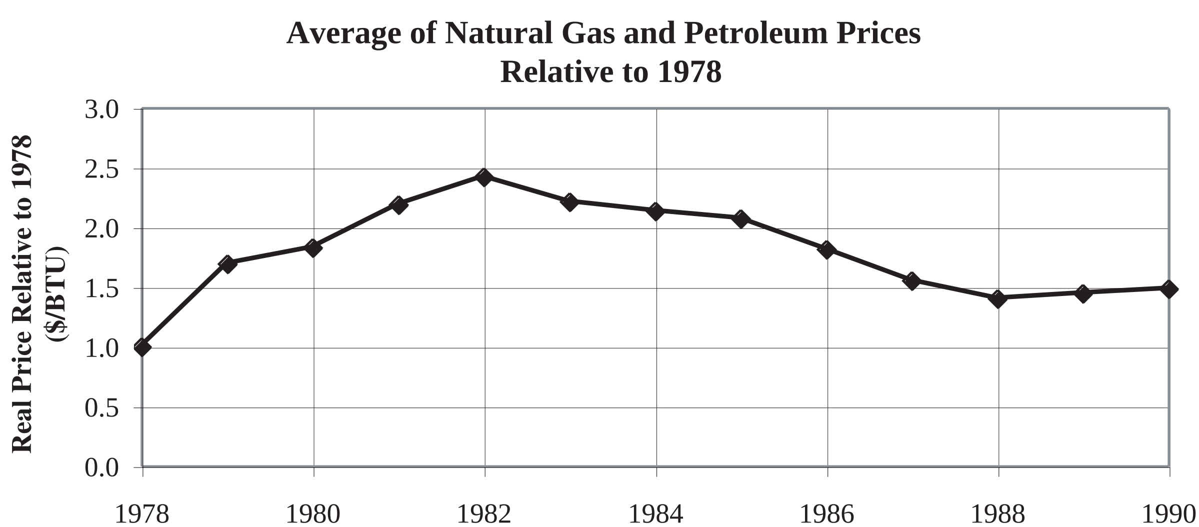

Figure 3.7 Price scaling factors to use for the forecast period 2008 – 2020,

after the price begins to rise. This shift away from petroleum (and natural gas) at point of use continues to grow even after the fossil fuel prices begin dropping again, because it takes time for capital for natural gas and all petroleum fuels to turn over (and for customers who are able to change fuels to do so), and because fossil fuel prices remain above those in the base case from 2009 onwards.

The shift away from natural gas and petroleum serves to increase the demand for electricity, as summarized in Figure 3.8 and Table 3.17. However, the resulting increase in electricity generation is likely to come largely from electric power stations whose fuel is natural gas. The resulting increase in natural gas consumption by the electric utility industry is greater than the reduction in natural gas consumption at the point of end-use, which results in a net increase in the use of natural gas. These users are not likely to switch to petroleum fuels (oil, diesel, or LPG) because their prices have also risen by the same factor as that of natural gas. For many end-uses, neither coal nor biomass are viable alternative fuels. Most users of gas and oil will either invest in greater efficiency or switch to electricity, whose price has not increased by the same factor as the prices of natural gas and petroleum.

The increased electricity generation also drives up the price for electricity (although not as high as petroleum as discussed above) as summarized in Figure 3.8 and Table 3.18. Note that wholesale electricity prices rise even more (in percentage terms relative to their base case levels) than average retail electricity prices. This higher wholesale price level is not enough of a jump, however, to stimulate earlier additions of new electricity generation capacity in New England relative to new additions forecast in the Base Case, as reflected by the line for "N.E. New Construction" in Figure 3.8. As a result, under this scenario, as with the Base Case, no new plants are forecast until 2019.

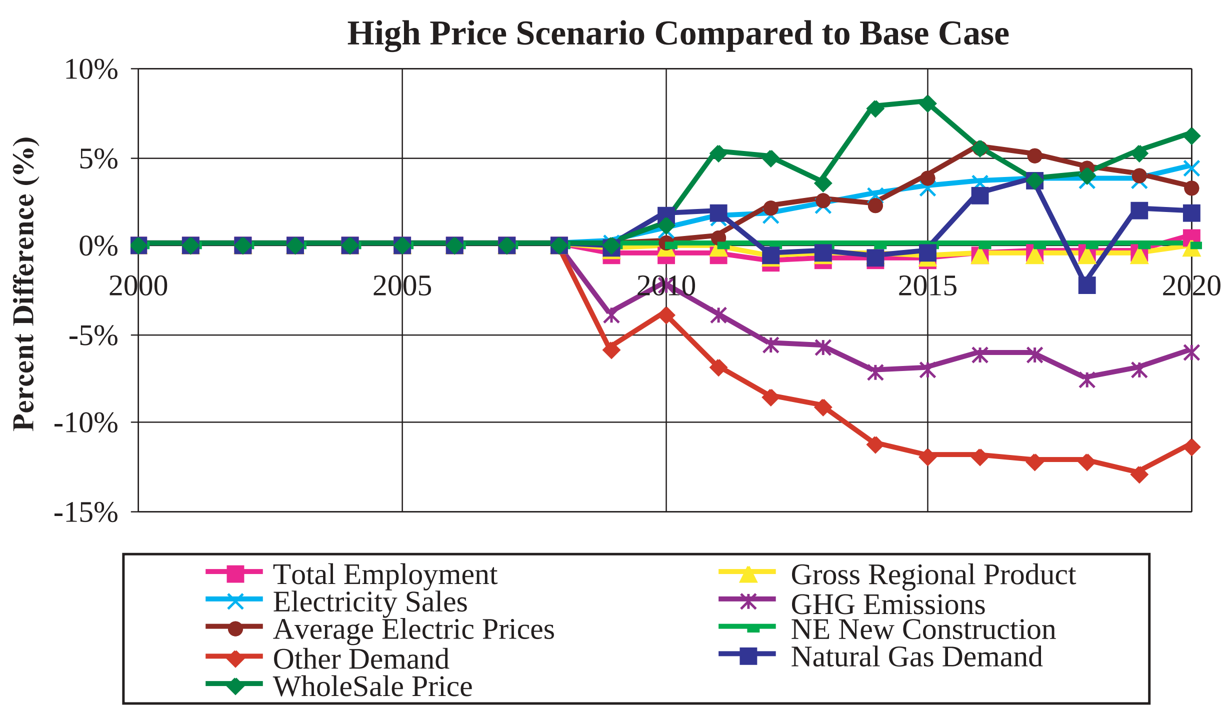

Figure 3.8 Effect of High Price Scenario on Key Variables, Relative to Base Case

Table 3.17 Changes in NH Electricity Sales Due to High Fossil Fuel Price Scenario

New Hampshire Electricity Sales (GWh/Year)						
	2000	2005	2010	2015	2020	20 Year Average
Base Case Comparison						
Base Case	10,405	12,422	15,048	17,585	19,364	**15,199**
High Price	10,405	12,422	15,173	18,156	20,205	**15,481**
Difference	0	0	125	571	841	**281**
Percent Change	0.00%	0.00%	0.83%	3.25%	4.35%	**1.85%**

Table 3.18 Changes in NH Electricity Prices Due to High Fossil Fuel Price Scenario

Average Electric Prices (2000 $/MWh)						
	2000	2005	2010	2015	2020	20 Year Average
Base Case Comparison						
Base Case	98.67	79.38	69.65	79.42	88.35	**79.61**
High Price	98.67	79.38	69.73	82.42	91.18	**80.97**
Difference	0.00	0.00	0.09	3.00	2.83	**1.36**
Percent Change	0.00%	0.00%	0.13%	3.77%	3.20%	**1.60%**

4. Energy Facility Siting in New Hampshire

4.1 The Energy Facility Siting Process in New Hampshire

The siting of energy facilities is a critical aspect of ensuring that New Hampshire continues to have a diverse, safe and plentiful energy supply to meet our state's future needs. However, with the increasing regionalization of the markets for electricity and natural gas infrastructure, the role of an individual state is evolving. In addition to the need to protect our state's interests and ensure adequate resources, we also need to be ready to address future siting challenges that are likely to arise from new technologies and new approaches such as co-generation and distributed generation. These diverse issues underscore the need for New Hampshire to have an effective process for the siting of energy facilities.

In recognition of the importance of siting, in 1990 the New Hampshire Legislature established a coordinated approach to the evaluation and permitting of plans for the siting, construction, operation, monitoring and enforcement of large energy facilities and high voltage transmission lines. This integrated multi-agency process for the review and permitting of energy facilities has been recognized as a successful approach to streamlining the siting process.

ECS convened a meeting in the Spring of 2002 to consider New Hampshire's siting process with a diverse group of stakeholders including regulators, members of the siting committee, applicants who have been through the process, utility representatives, and other interested parties. The consensus during the discussion was that New Hampshire's siting process has worked quite well, and with the exception of the need to finalize the siting committee's administrative rules, most did not see a need for major changes to the siting process at this time. However, it was acknowledged that the State should explore ways to review some projects that fall outside of the scope of New Hampshire's siting process, namely smaller projects such as distributed generation and renewable technologies.

The purpose of this section is to provide an overview of New Hampshire's siting statute, the siting evaluation committee, the process for an applicant, and identify potential future needs for the state's siting process.

4.2 The Statutory Framework

New Hampshire's "one-stop shopping" permitting approach to siting energy facilities is governed by the State's Energy Facility Siting Evaluation Committee (SEC). This integrated process, created by RSA 162-H, requires that the eight state agencies with jurisdiction over energy facilities sit as a joint committee to review proposed energy projects in the state. This approach provides a single forum for an applicant to present an integrated application, avoiding the duplication that might occur if separate applications had to be reviewed by each agency with jurisdiction over a portion of a proposed project.

The siting statute begins by explicitly making the important connection between energy, the environment, the state's economy, land use policy, and public health by stating:

> The legislature recognizes that the selection of sites for energy facilities will have a significant impact upon the welfare of the population, the economic growth of the state and the environment of the state. The legislature, accordingly, finds that the public interest requires that it is essential to maintain a balance between the environment and the possible need for new energy facilities in New Hampshire; that undue delay in construction of any needed facilities be avoided; and that the state ensure that the construction and operation of energy facilities is treated as a significant aspect of land use planning in which all environmental, economic and technical issues are resolved in an integrated fashion.
>
> RSA 162-H:1, I.

To ensure that all possible impacts that may result from a proposed energy facility are considered in the permitting process, the SEC includes fifteen officials (or their designees) from eight state agencies:

- Commissioner of the Department of Environmental Services, Chair of SEC
- Director of the DES Water Division
- Director of the DES Air Resources Division
- The three Public Utilities Commissioners, with the Chair of the PUC as Vice Chair of SEC
- The Chief Engineer of the PUC
- Commissioner of the Department of Resources and Economic Development (DRED)
- Director of Parks and Recreation, DRED
- Director of the Division of Forests and Lands, DRED
- Commissioner of the Department of Health and Human Services
- Executive Director of the Fish and Game Department
- Director of the Office of State Planning
- Director of the Governor's Office of Energy and Community Services
- Commissioner of the Department of Transportation

The statute also includes an Assistant Attorney General as "Counsel for the Public." The Public Counsel represents the public "in seeking to protect the quality of the environment and in seeking to assure an adequate supply of energy," and is treated as a formal party. (RSA 162-H:9). The participation of Public Counsel does not prevent any member of the public from participating in the process, but SEC may require that individual persons consolidate their cases with the Public Counsel if the Committee finds that their interests are "substantially identical." The role of Public Counsel has proven to be an important one with respect to environmental issues, and public health and safety concerns.

Although the participating agencies with jurisdiction over the different aspects of a proposed project do the work of reviewing the application and developing the certificate, permits and conditions, the Committee may not delegate the authority to hold hearings, issue certificates, actually determine the terms and conditions of the certificate, or enforce a certificate (RSA 162H:4, III). However, the Committee may delegate to a specific agency or official the authority to "specify the use of any technique, methodology, practice . . . or the authority to specify minor changes in the route alignment" when new information is available. RSA 162-H:4, III-a.

The statute provides that in order to undertake the thorough review necessary for an energy facility, the Committee, along with Public Counsel, may conduct all reasonable studies and investigations as it deems appropriate to carry out the purposes of the siting process. This includes the hiring of consultants, legal counsel and other staff. The costs of undertaking these studies and hiring necessary experts and counsel must be borne by the applicant.

4.3 The Siting Process

The siting process applies only to large projects, defined as those over 30 megawatts, transmission lines over 100 kilovolts and more than 10 miles, and energy facilities such as refineries, gas plants, pipelines, and storage and unloading facilities. RSA 162-H:2.[1] However, a project that does not meet these requirements may also be brought within the SEC process if the applicant requests that SEC take jurisdiction, or if two "petition categories" as listed in RSA 162-H:2, XI make such a request. Those categories include 100 or more registered voters in a host community or abutting community, or the selectmen of those communities.

As a result of this ability to "opt-in" to the SEC process, an applicant for a project less than 30 megawatts could utilize the SEC process to preempt local jurisdiction, as well as to access the aggressive schedule that the statute requires SEC to follow.

[1] The statute originally included "bulk power supply facilities," but the following language is now in effect: After the date when competition has been certified to exist, pursuant to RSA 38:36, in that portion of the state or in more than half of the state as whole, all proposed electric generating facilities of capacity greater than 30 megawatts shall be considered energy facilities, and shall not be considered bulk power supply facilities. RSA 162-H:5, IV(b).

The entire siting process must take place within 9 months from the time an application is accepted as complete. Upon the filing of an application, the Committee must forward the application to each state agency with jurisdiction over any aspect of the proposed project. Each agency must then conduct a preliminary review of the application to determine if it is complete. If the application is not sufficient, the Committee notifies the applicant of the deficiencies and indicates what information is needed, and the applicant has 10 days to cure the deficiencies or to file a new complete application. The Committee must decide whether or not to accept the application within 60 days of filing, defined as the date when the application was first submitted to the Committee.

If the Committee finds that "other existing statutes provide adequate protection of the objectives" of the siting statute, it may, within 60 days of the filing, exempt the application from the requirements of the statute. An exemption requires that the Committee find that:

1. Other statutes, rules or regulations meet the purposes of the siting statute;
2. It is appropriate for the application to be reviewed by agencies on the Committee, and that they may do so without the requirements of 162-H;
3. The agencies with jurisdiction over the project may meet the goals of the statute; and
4. Environmental impacts will be addressed by federal, state or local laws or rules.

RSA 162-H:4, IV.

When the Committee finds that an application is complete, it must hold at least one public hearing in the county where the facility will be located. The first hearing is held within 30 days after acceptance (90 days after filing). At this first informational hearing, the applicant must present information about the application to the SEC and the public. This hearing takes the place of any other hearing that would usually be required by such a proposed project, including those related to local land use regulation or state environmental regulations. This is a central aspect of the SEC, as it brings together the review of all aspects of the proposed project, preempting local control and providing one forum for local citizens to have input in the siting process.

With the exception of additional informational meetings, all future hearings in the application process are adversarial. These hearings may be held in Concord or in the county where the proposed project would be located, and the location is at the discretion of the Committee.

All agencies must report their progress on review of the application within five months after acceptance, including draft permit conditions and any additional information that is needed to make a final decision. It is customary during this process for an applicant to meet with the various state agencies to work through the details of each permit that is needed for the project, as the permit conditions set by the

SEC are one of the most important aspects of the application process. These conditions are developed with guidance and recommendations from the various agencies with expertise in areas such as water quality, public health, engineering, safety, and historical resources, in order to provide adequate protections for public health, natural resources, and the state's environment. Local issues are also often addressed through conditions placed upon the certificate.

Any state agency with jurisdiction over the project must submit a final decision within eight months after acceptance of the application. Finally, the SEC must decide whether to issue or deny a "certificate of site and facility" within nine months from acceptance of the application. The Committee may, during the review process, temporarily suspend the time frame discussed above if it finds that doing so is in the public interest.

The statute also provides enforcement authority for the Committee after the certificate is issued. The Committee may, at any time that it determines that any term or condition of any certificate issued is being violated, order that the violation be terminated. A recipient of such a notice has 15 days to address the violation, and if they do not, the Committee may suspend the certificate. Apart from emergencies, the Committee must provide written notice of the suspension, including the reasons, and provide an opportunity for a prompt hearing.

The Committee may also suspend a certificate if it determines that an applicant has made a "material misrepresentation" in its application, or if additional information shows that the applicant violated the statute or rules governing the project. The Committee may revoke a certificate that has been suspended after 90 days, after written notice and an opportunity for a hearing to address the issues.

4.4 Certificate Requirements (Findings)

The certificate issued by the SEC, after the review process outlined above, authorizes the applicant to proceed with the planned facility. The certificate is considered a final action of the Committee, and is subject only to judicial review. The Committee must find that the proposed site and facility:

> 1. Will not interfere with the orderly development of the region with due consideration given to the views of municipal and regional planning commissions and municipal governing bodies;
> 2. Will not have an unreasonable adverse effect on aesthetics, historic sites, air and water quality, the natural environment, and public health and safety;
> 3. That operation is consistent with the state energy policy established in RSA 378:37; and
> 4. That the applicant has the adequate financial, technical, and managerial capability to assure construction and operation of the facility in continuing compliance with the terms and conditions of the certificate.
>
> RSA 162-H:16, IV.

A majority of the Committee must make these findings based upon the record in the case. In addition to these findings, the terms and conditions placed upon the certificate are another important aspect of the siting process. Those terms and conditions can include a broad array of issues, including those under the jurisdiction of any state or federal agency involved in the project, and any "such reasonable terms and conditions as the committee deems necessary and may provide for such reasonable monitoring procedures as may be necessary." RSA 162-H:16, VI.

4.5 Certificate Terms and Conditions

The broad and often overlapping expertise of the state agencies that make up the SEC brings a wealth of resources to the Committee's decisionmaking process. Those areas of agency jurisdiction and expertise include wetlands, energy policy, safety, historic preservation, state lands, transportation, and public health. From a practical perspective, although it is the Committee as whole that issues the terms and conditions that accompany a certificate, it is the agencies themselves that draft those terms and conditions and make recommendations to the Committee.

Once a proposal is submitted to the SEC, the Committee forwards a copy of an application to each state agency with jurisdiction over a proposed project. This includes any state agency with jurisdiction over the project under any state or federal law. Each agency must conduct a preliminary review to determine if the application is complete for its purposes, and if it determines that the application is not complete, the agency must notify the Committee and specify what additional information is necessary RSA 162-H:7, IV. This communication with the Committee should take place during the first 60 days after filing so that the Committee can make its determination on completeness of the application.

Once the application is deemed complete and is accepted by the Committee, the agencies focus on reviewing the application, conducting site visits if necessary, and drafting the necessary permits and conditions for the certificate. Each agency must report its progress to the Committee within five months of the acceptance of the application, including draft permit conditions and any additional information that is needed, according to RSA 162-H:6, V. All agencies having jurisdiction over the project must submit final decisions on the pertinent parts of the application to the full Committee no later than eight months after acceptance, as required by RSA 162-H:6, VI.

The SEC statute makes clear that the Committee may delegate its authority to set specific terms and conditions to the state agencies or officials who are represented on the Committee. This delegation of authority allows the agency with jurisdiction over a particular part of a proposed project to "specify the use of any technique, methodology, practice or procedure," or to require minor changes in route alignment of a transmission line or pipeline. RSA 162-H:4, III-a. Any such requirements must be approved by the full Committee.

4.6 The Siting Application Requirements

An application for a certificate of site and facility must be submitted to the Chairman of the SEC. The application must include sufficient information for the Committee to make the findings required in RSA 162-H:16, IV discussed above. An application must include completed applications for each individual agency with jurisdiction over any aspect of the project, and must, according to RSA 162-H:7, V, provide the following information:

- Details on the type and size of each major part of the proposed facility;
- The preferred site and any other potential sites for each major part of the proposed facility;
- All impacts of the proposed facility on the environment;
- Proposals for studying and resolving environmental problems associated with the project;
- The applicant's financial, technical, and managerial capability for construction and operation;
- Documentation that written notification, including copies of the application, have been provided to the governing bodies of each community in which the facility would be located; and
- Any additional information needed for the Committee to fulfill the purposes of the siting statute.

Previous applications are on file with the Department of Environmental Services, and may be consulted by applicants for guidance with format.

4.7 Siting Evaluation Committee Administrative Rules

In addition to providing the information required by the statute in an application, an applicant must also consult the SEC's administrative rules. The Committee currently operates under draft rules, and is expected to promulgate final rules in 2003.

4.8 Non-jurisdictional Energy Facilities

Projects that do not fall within SEC's jurisdiction may opt in under the statute, or must comply with applicable local ordinance and state environmental statutes and rules. As discussed below in Chapter 8, siting of new sources such as wind, solar, and ocean-based generation face potential siting challenges due to siting in remote locations. The SEC, working with Energy Planning Advisory Board proposed earlier, should begin a process to consider how best to address the unique issues presented in the siting of new energy resources such as renewables, co-generation, and distributed generation.

4.9 The Impact of Regional Issues on Energy Facility Siting

As discussed in Chapter 5, siting is often a regional issue, and facilities sited in New Hampshire do not necessarily power our state's homes and businesses. In addition, the Base Case forecast, set forth in Chapter 3, projects that New England will not see significant increased siting until approximately 2017. As a result, most activity in siting energy facilities over the next ten years is likely to deal with renewable energy, distributed generation, and other alternative forms of energy production.

In an effort to address the siting challenges that currently exist on a multi-state and regional level, the National Governors' Association (NGA) has proposed that Governors form a Multi-State Entities (MSE) committee to coordinate transmission planning, certification and siting at the regional level. An MSE would be established by a memorandum of understanding, and governed by established by-laws. The proposed MSE would not overrule state authority, nor would it advocate federal preemption of state siting authority. However, it would ensure that regional and state needs are addressed in transmission planning, rather than leave all planning to regional transmission organizations (RTOs). This regional transmission planning would also include the review of alternatives to new transmission lines, such as energy efficiency and load response programs. The MSE would also recognize that siting and certification processes need to assure a timely resolution for all parties. If adopted, an MSE would adopt a set of best practices for member states and integrate into an Interstate Protocol.[2]

Many of these regional efforts deal with the siting of transmission and distribution resources, which in New Hampshire are often under the PUC's jurisdiction, rather than the SEC's. One major issue regionally is how to recover the costs of new transmission, particularly with the emerging wholesale electricity markets trading across the region. How these costs are assigned among states in our region is a complex matter, especially when the beneficiaries of investments are limited to a load pocket or congestion area. The National Association of Regulatory Utility Commissioners has taken the position that the FERC should establish a pricing policy that determines whether the costs of a transmission expansion or upgrade are the responsibility of the "cost-causer" if the project is not within the public interest of the region as a whole. However, many parties including state regulators and FERC are reviewing alternative approaches.

One approach under consideration is Locational Marginal Pricing (LMP). LMP allows market participants to determine where transmission upgrades or new lines will reduce costs that are rising due to congestion. Upgrades or new lines would be the responsibility of the companies that hold financial transmission rights (FTRs) that they could retain for their own use or sell to other market participants.

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[2] See the "*Interstate Strategies for Transmission Planning and Expansion*," a report of the National Governors Association's Task Force on Electricity Infastructure (www.nga.org).

These and other issues under discussion at the regional level underscore the need for New Hampshire to provide resources to the PUC and other agencies to adequately represent the state in these important discussions.

4.10 Recommendations for Improving the Siting Process

In sum, New Hampshire's integrated approach of bringing together several state agencies with overlapping jurisdiction to review energy siting applications has worked well. However, the state needs to address how to approach projects that are not within SEC's jurisdiction, including smaller projects, renewables, co-generation, and distributed generation. The SEC, working with Energy Planning Advisory Board proposed earlier, should convene discussions with stakeholders to consider how to address the unique issues presented in the siting of new energy resources that are not typically within the jurisdiction of the Committee.

The SEC should also work to strengthen ties to the State's efforts to represent our interests at the regional and national level, perhaps by working with the PUC and the proposed Energy Planning Advisory Board to ensure that the State has the appropriate resources to participate regionally. The SEC should ensure that any regional siting committees, such as the NGA proposal discussed above, take into consideration the Committee's work. Similarly, the SEC should work to ensure that regional issues and planning are considered by the Committee in its deliberations on proposed projects.

The SEC will be undertaking a rulemaking process in 2003, which provides an opportunity to address any issues with the process.

5. New Hampshire's Role in the Region

5.1. Introduction

New Hampshire's electric grid is a part of the Independent System Operator of New England (ISO-NE), a private non-profit organization charged by the Federal Energy Regulatory Commission (FERC) with providing open and fair access to the regional transmission system; managing a non-discriminatory governance structure, facilitating market-based wholesale electric rates; and ensuring the reliable operation of the bulk power system.[1]

ISO-NE includes six member states: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. ISO-NE is located in Northampton, Massachusetts and is governed by a ten member Board of Directors. No board member can be affiliated with any of the participants in the market, in an effort to ensure ISO-NE's independence and ability to administer a fair and efficient marketplace.

ISO-NE, created by the FERC in 1997 in response to deregulation of the wholesale electric market, is an outgrowth of the New England Power Pool (NEPOOL). NEPOOL was created in 1971 as a voluntary association of electric utilities in New England who established a regional network to direct the operations of the major generation and transmission facilities in the region. The NEPOOL members created a Control Center to centrally dispatch power using the most economical generation and transmission at any given time to match the load requirements of the region. This approach to a regional system saved money for NEPOOL participants and their customers, while increasing the reliability of the system. ISO-NE continues to use the knowledge of NEPOOL members, while operating through a competitive market.

NEPOOL members include investor-owned utility systems, joint marketing agencies, municipal and customer-owned systems, power marketers, load aggregators, generation owners and end users. The relationship among the NEPOOL owners is governed by an operating agreement, the Restated NEPOOL Agreement, which provides for the governance of the organization. The Agreement also provides guidelines for the operation of the wholesale power markets in New England, including a market-priced, bid-based power exchange into which participants can buy and sell electricity services. The NEPOOL Open

[1] More information on ISO and how it works is available at www.iso-ne.org.

Access Transmission Tariff requires that all entities are eligible to receive transmission service over Pool Transmission Facilities (PTF), which are transmission facilities in New England rated 69 kV and higher that move power around the region.

ISO-NE is responsible for operating the region's bulk power system, which includes more than 340 generators connected by over 8,000 miles of high voltage transmission lines, and for administering the region's wholesale power market. ISO-NE's mission is to ensure reliable service to New England's 6.5 million electricity customers, guarantee equal access to the transmission system, and to operate a fair, efficient wholesale electricity market.

5.2 Regional Electric Market Issues

New Hampshire's electricity industry is closely linked to regional, as well as national, electricity markets. While we have been interdependent with the larger New England power pool for several decades, regional and national electricity market issues have become increasingly important in recent years as deregulation of the electric industry has evolved. Several issues are of particular importance to the state.

First, the Federal Energy Regulatory Commission (FERC) is moving quickly to institute its vision of a competitive wholesale electricity market in New England and the rest of the nation. FERC's proposal for Standard Market Design (SMD) was released in July 2002, and is expected to be finalized in 2003. In the SMD proposal, FERC asserts the right to preempt states from exercising their traditional jurisdiction over electricity issues, and its proposal has become controversial on the national level. New England has already adopted some features now promoted by the FERC, but New England regulators and governors do not endorse all features proposed by the FERC. Some key open issues in wholesale market design include: who will be responsible for resource adequacy over time; how to maintain a level playing field between various resource options; how to prevent market abuses and extremely volatile prices; and how to promote sound environmental stewardship in electricity resource decisions.[2]

The price spikes and blackouts that plagued California after competitive markets were opened in the late 1990's have raised concerns across the nation about whether wholesale electricity can be supplied at reasonable prices and with sufficient reliability under competitive markets. Many agree that absent reforms to existing market models, these goals will not be achieved.[3]

In addition, the FERC has in recent years pushed the New England states (as well as other regions around the country) toward merging our markets with neighboring states to the south into a larger electricity market. Since the 1960's, New Hampshire's electricity transmission grid and generating plants have been operated by a regional power pool, and Independent System Operator of New England (ISO-NE)

[2] More information about SMD is available on ISO-NE's website, as well as at www.ferc.gov.

[3] Congress has been considering legislation regarding wholesale electricity markets, but prospects for such federal legislation remain unclear at this writing.

opened the competitive energy market for the region in 1999. FERC announced in 2000 that it would like to see the boundaries of regional markets expanded considerably, with no more than 4 to 6 regions nationally.

More recently, ISO-NE and the NY-ISO have proposed to merge, creating the NERTO (Northeast Regional Transmission Organization). The proposal to merge ISO-NE with the NY-ISO raises questions about fairness in sharing benefits between New England and New York, how markets will be governed, how states will have the ability to protect their consumers, assurance that environmental issues will be considered and addressed, and how resource planning can be managed across a larger footprint. This is of particular concern as a result of the alleged gaming in California, and FERC's failure to intervene in an expeditious manner when California raised legitimate concerns and allegations about market manipulation.

The recent acknowledgements of Enron and Reliant, and the fact that California was seriously harmed with no meaningful recourse, mean that the possible movement to a NERTO could create a larger market which may be easier to game. These issues and others deserve the attention of New Hampshire regulators and policymakers to ensure that our state's, and our region's, interests are protected. The PUC has played an active role through NARUC (National Association of Regulatory Utility Commissioners), and NECPUC (New England Conference of Public Utility Commissioners), and through other avenues, and should be provided with the resources to continue in this important role.

The New England region also faces some more localized issues. ISO-NE has been promoting the concept of socialized regional investments in transmission capacity, to move power into "load pockets," which are areas with more demand for energy than local resources can supply. At least in the near term, New Hampshire stands to lose if expensive transmission into the greater Boston area or into Southwest Connecticut is built and the costs are recovered through transmission rates spread across all New England electricity consumers.

A further risk related to socializing investments to relieve localized constraints against moving power around the region is that it provides a perverse incentive for load pocket utilities and consumers to "lean on" the pool, deferring their own investments until the problem becomes severe enough to warrant a regional transmission solution. ISO-NE has a Regional Transmission Expansion Plan process, with a Transmission Expansion Advisory Committee of which the New Hampshire Public Utilities Commission is a member.[4] This issue highlights the different situations of various sub-regions, and remains a problem that requires continued involvement of the PUC to represent the state's interests.

The Regional Transmission Expansion Plan (RTEP) is an annual engineering assessment of the region's electric power system, that FERC has charged ISO with developing. RTEP02 includes key findings

[4] Information on the RTEP02 can be found at www.iso-ne.com/transmission/Regional_Transmission_Expansion_Plan/RTEP_2002.

relative to congestion in Southwestern Connecticut; potential reliability problems in Northwestern Vermont; bottlenecks in Maine and the Southeastern Massachusetts-Rhode Island area where power can not be transported to higher demand areas; the potential role of demand response to address congestion and improve reliability; and an estimate that the region may need up to $900 million in transmission upgrades to improve reliability and efficiency.

The diverse stakeholders in the RTEP process believe that it could serve as the region's resource expansion plan, considering more than just transmission upgrades by analyzing other solutions to economic and reliability constraints through programs such as demand side management (energy efficiency) and distributed generation. Rather than being mandatory, the RTEP can serve to identify needs in the region so that that market will respond with creative solutions. In addition, the RTEP includes a regulatory backstop if there are reliability concerns that will not be served by the market participants - i.e. when reliability requires an improvement that is necessary to "keep the lights on." The RTEP process is an important one that New Hampshire, through the PUC, should continue to be highly involved in.

The disastrous problems with wholesale electricity markets in California during the winter of 2000 - 2001 have underscored the importance of getting regional electricity industry structures right. New England presently has a comfortable margin of reserve electric capacity, resulting in moderate prices. New Hampshire has contributed to this margin by its approval of two merchant power plants now under construction in Londonderry and Newington. However, the erosion of confidence in energy trading markets after the California debacle, as well as the normal boom and bust cycle of the capital-intensive electricity industry, mean that power plant developers cannot currently secure financing for any additional capacity. There is a concern that growth in load will take up any excess capacity, causing prices to rise significantly. New Hampshire and New England should use this window of opportunity to continue to plan for our future and put in place industry structures designed to assure fair and reasonable prices for reliable supply, consistent with our obligations to provide safe, reliable, environmentally sound energy.

The tragic events that took place on September 11, 2001 highlighted the importance of evaluating security risks in energy planning (whether the result of deliberate sabotage to the system or because of an operational risk) for both the short and long term. In addition to dealing with "how to keep the lights on" while maintaining reasonable rates, energy officials also need to ensure that system security risks are addressed, and the potentially significant costs associated with protecting large-scale remote generation sites and necessary transmission networks. In this new paradigm, there are no reliable cost estimates available for increased security needs. However, it has been suggested that the costs will emulate the stranded costs that utilities have encountered in restructuring. This should not be deemed an obstacle that inhibits our energy planning, but rather an opportunity to better plan our energy and security needs as a state and as a region.

Energy efficient technologies and clean distributed generation (DG) should be a part of this new planning effort. These resources are both practically easier and less costly to secure because they are smaller in size and are used in on-site locations. Because each small plant has a low-impact on the grid, they are also less likely to cripple the economy for a region or state if there is a system failure due to a human-made or natural disaster. A recent "Issueletter" from the Regulatory Assistance Project (RAP), a non-profit organization that provides assistance to state public utility regulators on electric utility regulation,[6] discusses ways to address energy security risks.[7] In the Issueletter, RAP concludes that "energy security (and relieving pressure on the grid) will come from a network with much more energy efficiency and distributed resources than it will from building fortresses around large, fragile facilities and trying to defend miles of transmission lines and gas pipelines." The report goes on to detail the existing technologies and policies that are needed to build this resilient energy infrastructure.

The report also provides a helpful table that summarizes the security risks for different energy technology choices, and suggests that distributed and renewable resources need to be part of our secure energy future:

Table 1:
Security Risks by Technology

Facility Type	Site Risk	Proximity Risk	Fuel Risk	Consequential Risk	Size Risk	Geographic Risk	Technological & Multi-Systems Risk
Large Remote Generation	High	High	High	High	High	Low	High
Large Local Generation	High	Medium	High	High	High	Low	High
Transmission	High	High	N/A	High	High	Medium to High	High
Distribution	Med.	Low	N/A	Low	Medium	Low	High
Distributed Fuel-Based Generation	Low	Low	High	Low to Medium	Low	Low	Low
Remote Renewable Resources	Low	Medium to High	None	Low	Low	Low	Low to Medium
Distributed Renewable Resources	Low	Low	None	Low	Low	Low	Low to Medium
Energy Efficiency/DSM	Neg.	Negative	Neg.	Negative	Neg.	Negative	Negative

Source: Regulatory Assistance Project, "Electrical Energy Security: Assessing Security Risks, Part I," April 2002, p. 10.

[6] RAP is committed to fostering a restructuring of the electric industry in a manner that creates economic efficiency, protects environmental quality, assures system reliability and applies the benefits of increased competition fairly to all customers. More information is available at www.rapmaine.org.
[7] See www.rapmaine.org for the April 2002 Issueletter "Electrical Energy Security: Assessing Security Risks, Part I."

In addition to the new security issues in energy planning, New Hampshire and the region must also address the load constraints that occur during each summer when we are dangerously close to peak capacity. During times when the grid is close to capacity, ISO-New England works closely with the industry and communicates with state officials in an effort to prevent rolling black-outs. This system has been successful in the past two summers; however, there is room for improvement, including better promotion of the Load Management Program. Load response is increasingly seen as a good short-term approach to dealing with capacity issues, and a diverse group of interested parties has been working on a new initiative called the "New England Demand Response Initiative" (NEDRI) over the past year to create both short-term and long-term programs for the region.[8]

NEDRI is working to develop a comprehensive, coordinated set of demand response programs for the New England regional power markets. NEDRI's goal is to outline workable market rules, reliability standards, and regulatory criteria to incorporate a demand response capability into the electricity wholesale and retail markets. The Initiative will promote best practices and coordinate policy initiatives, but will not replace the functions that the ISO and other organizations must perform to design and implement demand-side programs. NEDRI provides a broad-based, facilitated process involving the ISO-NE, state utility and environmental regulators, power generators and marketers, utilities, consumer and environmental advocates, and other stakeholder groups. NEDRI plans to meet at least ten times in plenary session in 2002. Throughout the process, a team of highly-skilled technical consultants will be providing the Stakeholders with "scooping" papers, draft program designs, meeting summaries and agendas, and a final report at the end of the process.

In addition to the work done by energy and environmental regulators on demand response and on a process for temporary easing of environmental restrictions during significant load constraints in the summer months, energy officials also need to coordinate with water regulators to allow for similar restrictions when the need for electricity requires full use of our hydroelectric resources. For example, this past summer when New England was dangerously close to capacity, regulators learned that at least 500 MW of energy was not available due to imposed water restrictions to address the drought conditions. A mechanism needs to be established to assure that in an effort to prevent rolling or spot black-outs, such bans may be temporarily lifted to avert a crisis. Despite the fact that NH is a net exporter of energy, if there is a blackout somewhere in the region, it can stress the entire grid network and have serious consequences for both our economy and our environment.

Other important energy - environmental collaborations at the regional level are facilitated by the New England Governor's Conference (NEGC). NEGC is an informal alliance among the six Governors in the

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[8] More details on NEDRI are available at www.nedri.raabassociates.org.

region. It has been in existence since colonial days, and was formally established in 1937 to promote New England's economic development and related issues. In 1981, the Conference incorporated as a non-partisan, non-profit corporation. The region's six governors serve as its Board of Directors, and annually select a Chairman to oversee the activities of the organization.

NEGC jointly administers the Northeast International Committee on Energy (NICE) with the Eastern Canadian Premiers (ECP), which includes the leaders of Newfoundland and Labrador, New Brunswick, Nova Scotia, Prince Edward Island, and Quebec. Through NICE, the NEGC/ECP have adopted the Climate Change Action Plan (CCAP), and formed a Steering Committee of staff members from the Governors and Premiers energy and environmental agencies to implement the CCAP.

The Steering Committee worked in five teams to develop initiatives to meet the goals of the CCAP: Energy, Transportation, Inventory and Registry, Adaptation, and "Lead by Example." In August 2002 the leaders met and adopted the initiatives proposed by the Steering Committee. The initiatives include several that will be implemented over the next year, including energy efficient traffic lights, working with colleges and universities to achieve emissions reductions, committing states and provinces to purchasing energy efficient office equipment, and the increased use of cleaner and more fuel efficient cars in state and provincial fleets. Details on these and other activities can be found at www.negc.org.

The work of NEGC/ECP has been recognized as a model for international cooperation on energy, environmental and economic issues. New Hampshire's continued role in this group will result in benefits to the state and the region.

5.3 Recommendations for Representing New Hampshire in the Region

New Hampshire has been well represented at the regional and national levels by the Public Utilities Commission, ECS, the Department of Environmental Services Air Resources Division, and the Governor's Office through participation in several groups and initiatives, including NASEO (National Association of State Energy Officials), NARUC (National Association of Regulated Utility Commissioners), NECPUC (New England Conference of Public Utility Commissioners), New England Governor's Conference (NEGC), and CONEG (Coalition of Northeast Governors). The increasing importance of regional issues requires the continued attention of New Hampshire regulators and policymakers to ensure that New Hampshire's interests are protected. The PUC has played a leadership role in representing the state's interest at the regional level, and should be provided with the resources to continue in this important role. It should also continue to coordinate with other state agencies working on related issues at the regional level.

6. Electricity

6.1 Forecasting Demand and Supply for Electricity

The ENERGY 2020 model contains the factors which influence the behavior of the electricity supply sector, including capacity expansion/construction decisions, rates and prices, load shape variation due to weather, changes in regulation, and wholesale and retail pricing.[1]

The electric sector of the model can simulate the full spectrum of deregulated markets, including the independent system operator (ISO), as we have in New England. The model dispatches plants according to ISO-NE rules, whether they are precisely and perfectly least-cost, or if they reflect other practical rules of dispatch which do not perfectly minimize costs. The model also recognizes transmission constraints as well as the associated costs.[2] A sophisticated dispatch routine selects critical hours along seasonal load duration curves as a way to provide a quick but accurate determination of system generation. Peak and base hydro usage is explicitly modeled to capture hydro plant impacts on the electric system. For the NH Energy Plan, the deregulation dynamics are not a focus and the model is set to produce a conservative dispatch where suppliers act to minimize societal costs consistent with their individual generation costs.

6.2 Electricity Demand Forecast

The ENERGY2020 Base Case forecast projects total electricity sales to grow at a rate of 3.1% over the forecast period. Electricity sales growth is led by the industrial sector with a 4.3% growth rate. The commercial sector remains the largest class with an average growth rate of 3.2%. The peak load growth rate is similar to the sales growth rate implying little change in the load factor. Table 6.1 summarizes the forecast values of electric sales and peak demand.

[1] Gas transmission data are provided by CERI and electric transmission data provided by Resource Data, International via the National Electric Reliability Council. The dispatch technologies present in the New Hampshire ENERGY2020 model include: Oil/Gas Combustion turbine, Oil/Gas Combined Cycle, Oil/Gas Steam Turbine, Coal Steam Turbine, Advanced Coal, Nuclear, Baseload Hydro, Peaking Hydro, Renewables, Baseload Purchase Power Contracts, Baseload Spot Market, Intermediate Purchase Power Contracts, Intermediate Spot Market, Peaking PP Contracts, Peaking Spot Market, and Emergency Purchases.

[2] A 70-node transmission system is used in the New Hampshire model.

6.3 Electricity Supply Forecast

As discussed in Chapter 5, one of the realities for most states in the US, including New Hampshire, is that its energy market is part of a regional market. Changes in demand by New Hampshire energy users are responded to by changes in electric power production at the regional level, not necessarily at the state level. These responses will in some cases influence generation from New Hampshire power plants, while in many cases they will not. This is true both in the short term (in which existing electric power plants change their levels of generation) and in the long term (in which investors decide whether and when to construct new generating capacity).

Table 6.1 Electric Sales and Peak Demand

Base Case Forecast Electric Sales and Peak Demand by Class						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
	Electric Sales (GWh/Year)					
Residential	3,444	3,734	4,099	4,633	5,174	5,608
Commercial	2,117	3,909	4,712	5,743	6,691	7,351
Industrial	3,418	2,635	3,484	4,545	5,592	6,278
Transportation	0	0	0	0	0	0
Street/Misc	107	127	127	127	127	127
Total Sales (GWh)	**9,086**	**10,405**	**12,422**	**15,048**	**17,585**	**19,364**
	Peak Load (MW)					
Winter Peak	2,469	1,881	2,222	2,673	3,109	3,413
Summer Peak	2,475	1,826	2,172	2,623	3,056	3,358
	Cumulative Growth Rate of Electricity Sales					
Residential	0.8%	0.0%	1.9%	2.2%	2.2%	2.0%
Commercial	6.1%	0.0%	3.7%	3.9%	3.6%	3.2%
Industrial	-2.6%	0.0%	5.6%	5.5%	5.0%	4.3%
Transportation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Street/Misc	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Sales	**1.4%**	**0.0%**	**3.5%**	**3.7%**	**3.5%**	**3.1%**
	Cumulative Growth Rate of Peak Load					
Winter Peak	-2.7%	0.0%	3.3%	3.5%	3.4%	3.0%
Summer Peak	-3.0%	0.0%	3.5%	3.6%	3.4%	3.0%

In the Base Case, electric generating capacity is unchanged except for the already planned addition of 1080 MW of gas combined cycle capacity and 280 MW of combustion turbines and the retirement 77.6 MW of biomass capacity. Table 6.2 summarizes the forecasted values of generating capacity.

Table 6.2 Generating Capacity

Base Case Forecast New Hampshire Generating Capacity (MW)					
	2000	**2005**	**2010**	**2015**	**2020**
Gas/Oil Turbines	13.0	293.0	293.0	293.0	293.0
Gas/Oil Combined Cycle	0.0	1080.0	1080.0	1080.0	1080.0
Gas/Oil Steam	511.0	511.0	511.0	511.0	511.0
Coal Steam	570.0	570.0	570.0	570.0	570.0
Nuclear	1161.0	1231.0	1231.0	1231.0	1231.0
Hydro	440.0	440.0	440.0	440.0	440.0
Biomass	77.6	63.8	0.0	0.0	0.0
Landfill Gas/Waste	19.6	19.6	19.6	19.6	19.6
Wind	0.0	0.0	0.0	0.0	0.0
Total	**2792.2**	**4208.4**	**4144.6**	**4144.6**	**4144.6**

Electric generation follows a similar pattern as capacity, with higher amounts of gas combined cycle and combustion turbine generation and an elimination of biomass generation. Table 6.3 summarizes the Base Case forecast of generation by plant.

Table 6.3 New Hampshire Generation by Plant

Base Case Forecast New Hampshire Generation by Plant (GWh)					
	2000	**2005**	**2010**	**2015**	**2020**
Gas/Oil Turbines	46	389	641	972	1,167
Gas/Oil Combined Cycle	0	927	1,606	2,903	5,108
Gas/Oil Steam	1,562	1,562	1,562	1,562	1,562
Coal Steam	3,286	3,286	3,286	3,286	3,286
Nuclear	8,684	9,208	9,208	9,208	9,208
Hydro	1,348	1,348	1,348	1,348	1,348
Biomass	589	484	0	0	0
Landfill Gas/Waste	159	159	159	159	159
Wind	0	0	0	0	0
Total	**15,674**	**17,362**	**17,810**	**19,438**	**21,838**

Table 6.4 summarizes forecasted values for New Hampshire's wholesale price of electricity. As noted in the summary table, the annual wholesale price of electricity is expected to grow at a real rate of 3.4% over the forecast period. The winter wholesale price grows at 3.4%, while the summer price grows at 3.5%.

Table 6.4. Average Wholesale Price

Base Case Forecast New Hampshire Average Wholesale Price ($/MWh)					
	2000	2005	2010	2015	2020
Nominal Dollars					
Summer	68.78	50.92	74.20	107.76	137.28
Winter	54.21	34.01	50.42	76.20	107.02
Annual	61.61	42.58	62.46	92.17	122.33
2000 Dollars					
Summer	68.78	44.79	56.84	71.91	79.80
Winter	54.21	29.91	38.63	50.85	62.20
Annual	61.61	37.45	47.85	61.51	71.11
Real Cumulative Growth Rate (%)					
Summer	0.0%	-6.0%	0.8%	3.0%	3.5%
Winter	0.0%	-9.3%	-0.7%	2.3%	3.4%
Annual	0.0%	-7.4%	0.1%	2.7%	3.4%

In summary, the Base Case forecast for electricity demand and supply calls for considerable growth in industrial electricity consumption, which will make state electricity consumption grow faster than the state's population. Due in part to current and near-term additions of generation capacity in the region, electricity prices are forecast to continue their recent declines through most of the next ten years, after which time a tightening regional supply situation is forecast to bring prices back up again as we approach 2020.

6.4 Electricity Scenarios Relative to Base Case

Two electric scenarios were created in response to stakeholder input suggesting that the impacts of premature closure of one or more of New Hampshire's baseload electricity generating stations should be tested. One of these scenarios tests the impact of closing New Hampshire's two coal-fired power plants, Schiller and Merrimack stations, in Portsmouth and Bow respectively.

The concept for this scenario stems from the possibility that future environmental regulations, the age of the plants, fuel supply issues, economic conditions, or a combination of these factors could potentially lead to the closure of these plants by 2020. The value of this scenario is to more fully understand the importance of these facilities to New Hampshire's energy future, and the impacts that their closure would have on energy costs, fuel diversity, the environment, and other factors.

The second scenario is the premature closure of the Seabrook nuclear power station. This scenario, albeit highly unlikely, is based on the conceptual possibility that a terrorist threat or "homeland security" considerations might lead to such a shutdown of nuclear plants. The scenario is also of interest because Seabrook's capacity and generation are such a significant share of the total capacity and generation in New Hampshire. The value of this policy scenario, as with the coal plant closure, is to more fully understand Seabrook's role in New Hampshire's energy future, and the impacts of its closure on several variables.

It cannot be over-emphasized that these scenarios were run in order to undertsand the impacts of such plant closures, and are not meant to serve as recommendations to close the facilities, which at this point are very important to the electricity supply of New Hampshire and New England.

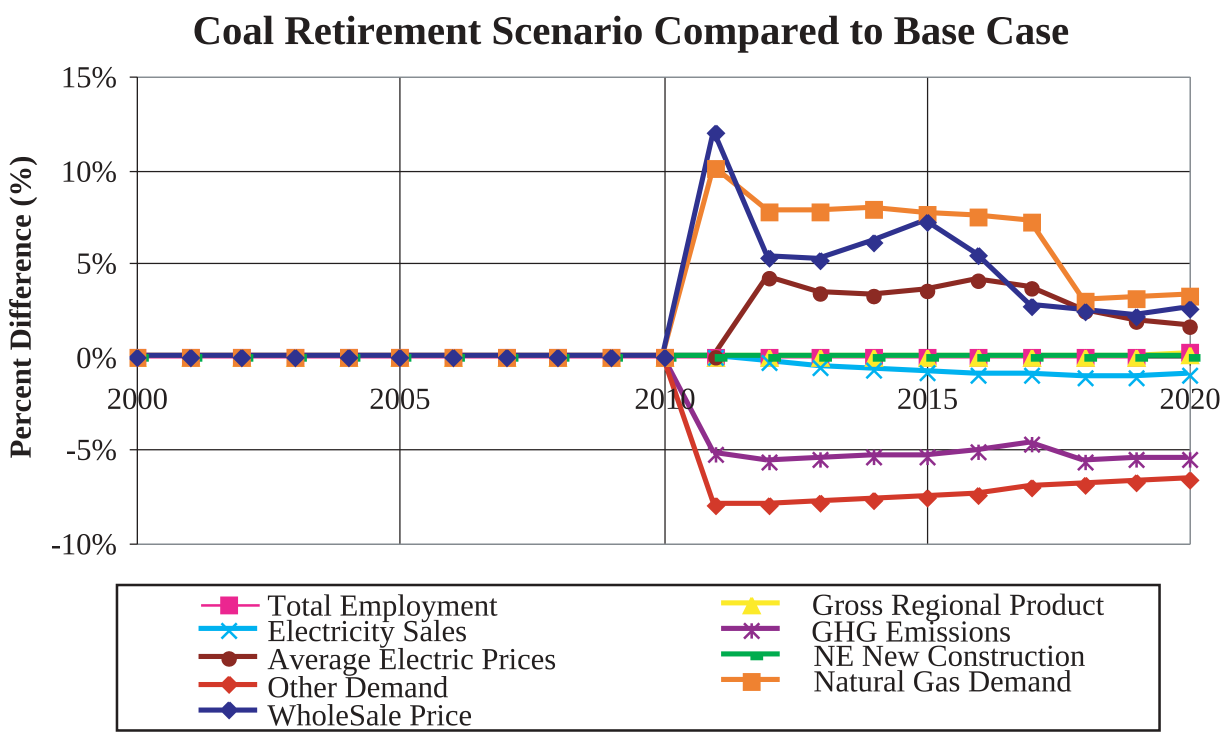


Figure 6.1. Impacts of Coal Plants Shutdown Relative to Base Case

6.4.1 Hypothetical Coal Plant Closure

New Hampshire has two coal-fired power plants, both presently owned and operated by PSNH. Merrimack Station on the Merrimack River in Bow is PSNH's prime base-load plant with a net generation capacity of 433.5 megawatts from its two coal-fired units. Unit One has a net capacity of 113.5 MW; Unit Two has a net capacity of 320 MW.

The plant is supplied by roughly 1 coal train per week from Pennsylvania, Virginia or Kentucky coal mines. PSNH's other coal-fired facility, Schiller Station, is on the Piscataqua River in Portsmouth. The source of coal used in this facility varies based upon price, availability and sulfur content. This plant has obtained coal by barge from Virginia or by ship from Venezuela or Nova Scotia.

In order to understand the role these plants play in New Hampshire's energy future, as well as the impact of losing the generation from these plants, we modeled the hypothetical shutdown of New Hampshire's two coal-fired power stations occurring in 2011. The effects of this shutdown on the set of key variables, relative to the Base Case, are illustrated in Figure 6.1. Overall, the wholesale electricity price rises sharply (over 10%) in the first year and then recovers during subsequent years to a level 2-3% higher than its base case level by 2020. Retail prices rise by a more modest percentage, under 5% for the duration of the simulated impacts.

Table 6.5. Electricity Sales Impacts of Coal Plant Retirement

New Hampshire Electricity Sales (GWh/Year)	2000	2005	2010	2015	2020	20 Year Average
Base Case Comparison						
Base Case	10,405	12,422	15,048	17,585	19,364	**15,199**
Coal Retire Coall	10,405	12,422	15,048	17,445	19,177	**15,132**
Difference	0	0	0	-139	-187	**-67**
Percent Change	0.00%	0.00%	0.00%	-0.79%	-0.96%	**-0.44%**
High Price Scenario Comparison						
High Price	10,405	12,422	15,173	18,156	20,205	**15,481**
Coal Retire HP C	10,405	12,422	15,173	18,003	20,193	**15,466**
Difference	0	0	0	-153	-12	**-15**
Percent Change	0.00%	0.00%	0.00%	-0.88%	-0.06%	**-0.10%**

Figure 6.1 also shows that natural gas generation would pick up the deficit created by the loss of the coal plants. Natural gas plants provide electricity with lower CO_2 emissions per kWh, so total NH greenhouse gas emissions would drop as a result of the shutdown, by approximately 5%, or 3 million tons of CO_2 (see Table 6.7). Because the retail price of electricity would rise, the total demand for electricity would fall slightly, by approximately 1%. Electricity price and demand responses are also summarized in Table 6.5 and Table 6.6.

Table 6.6. Electricity Price Impacts of Coal Plants

Average Electric Prices (2000 $/MWh)	2000	2005	2010	2015	2020	20 Year Average
Base Case Comparison						
Base Case	98.67	79.38	69.65	79.42	88.35	**79.61**
Coal Retire	98.67	79.38	69.65	82.19	89.73	**80.72**
Difference	0.00	0.00	0.00	2.76	1.38	**1.11**
Percent Change	0.00%	0.00%	0.00%	3.48%	1.56%	**1.33%**
High Price Scenario Comparison						
High Price	98.67	79.38	69.73	82.42	91.18	**80.97**
Coal Retire HP	98.67	79.38	69.73	85.33	96.25	**82.23**
Difference	0.00	0.00	0.00	2.90	5.07	**1.26**
Percent Change	0.00%	0.00%	0.00%	3.52%	5.57%	**1.44%**

Finally, we investigated the impacts of the higher electricity price and the loss of the plant upon the state's economy. As shown in Table 6.8 the early impact is negative, with a net loss of 160 jobs relative to the Base Case in 2015. Table 6.8 also shows the results in the context of the high fuel price scenario, which in 2015 amount to a loss of 136 jobs relative to the no-shutdown, high price scenario.

Table 6.7. Greenhouse Gas Emission Impacts of Coal Plant Retirement

Greenhouse Gas Emissions (Million Tons CO2e/Year)	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	36.37	40.48	46.16	51.63	56.07	**46.94**
Coal Retire Coall	36.37	40.48	46.16	48.90	53.01	**45.55**
Difference	0.00	0.00	0.00	-2.73	-3.07	**-1.39**
Percent Change	0.00%	0.00%	0.00%	-5.29%	-5.47%	**-2.55%**
High Price Scenario Comparison						
High Price	36.37	40.48	45.12	48.03	52.73	**45.17**
Coal Retire HP C	36.37	40.48	45.12	45.36	49.45	**43.78**
Difference	0.00	0.00	0.00	-2.67	-3.28	**-1.40**
Percent Change	0.00%	0.00%	0.00%	-5.57%	-6.21%	**-2.73%**

Interestingly, the energy-economic modeling system actually predicts an increase in employment by the year 2020 compared to Base Case resulting from the closure of the coal plants. The gains in jobs relative to the respective no-shutdown cases are roughly 1,500 jobs relative to the Base Case, and over 17,000 jobs in the event of the fuel price shock. The reason for these longer-term economic gains for the state is the fact that with the sustained, slightly higher retail electricity rates starting in 2011, the state's businesses and homeowners invest in higher energy efficiency as they buy new capital stocks or replace worn-out stocks and equipment in response to higher prices.

Table 6.8. Employment Impacts of Coal Plant Retirement

Total Employment (Thousands)	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	699.797	741.202	777.134	813.023	842.421	**779.501**
Coal Retire CoalRe	699.797	741.202	777.134	812.863	843.959	**779.518**
Difference	0.000	0.000	0.000	-0.160	1.538	**0.017**
Percent Change	0.00%	0.00%	0.00%	-0.02%	0.18%	**0.00%**
High Price Scenario Comparison						
High Price	699.797	741.202	773.287	806.896	846.290	**776.937**
Coal Retire HP Co	699.797	741.202	773.287	806.760	863.465	**780.986**
Difference	0.000	0.000	0.000	-0.136	17.175	**4.050**
Percent Change	0.00%	0.00%	0.00%	-0.02%	2.03%	**0.46%**

These investments create a positive impact on the economy and result in the creation of new jobs as the energy efficiency goods and services are produced and delivered in the state.

While the economy does not shrink overall due to the closure of the coal plants, by 2015 total electricity sales in the state would drop by nearly 1%. This drop represents increased efficiency, which pays longer-term economic dividends by 2020 as the state's businesses are more cost-competitive relative to the Base Case. The benefits of these efficiency gains are quite large in the case of the fuel price shock because the fuel price shock leads to a combination of higher electricity prices and higher fuel shares for electricity. Under the conditions of a hypothetical price shock, the economic benefits to New Hampshire's economy of the coal shutdown-induced efficiency gains are quite significant: 2% of total state employment in 2020.

The electricity provided by New Hampshire's coal plants are important to the state, and this hypothetical scenario shows these plants help make electricity in the state more affordable. In the event that these plants were closed in the near term, it is important to understand the economic, environmental and energy consequences. The model shows that, when compared to the base case scenario, electricity prices – both wholesale and retail – would be higher, emissions of greenhouse gasses would decrease, and the impacts on gross regional product and employment would be quite modest.

6.4.2 Premature Closure of Seabrook

Seabrook Station is New Hampshire's largest electrical generator. Located on an 889-acre site on the coast of New Hampshire in the town of Seabrook, it uses a 1,150 MW pressurized-water nuclear reactor to produce enough power for approximately 1 million New England homes. Florida Power & Light is in the process of purchasing Seabrook Station as a result of the sale of plant after electric restructuring.

Since the September 11, 2001 terrorist attacks, there has been much discussion concerning other potential targets for future terrorist attacks. These have included chemical plants, fuel pipelines, and nuclear power stations, among others. Discussions with stakeholders raised the possible, though far from probable, scenario that policy makers may eventually determine that operation of nuclear power stations presented too great a risk in relation to terrorist attacks. For this reason, and because Seabrook represents such a large share of New Hampshire electricity generating capacity and annual generation, it was determined to be of interest to consider the possible consequences from the premature closure of Seabrook. We selected the arbitrary year of 2005 for the hypothetical closure, in order to provide time (15 years) in the remaining forecast horizon for the consequences to be measurable.

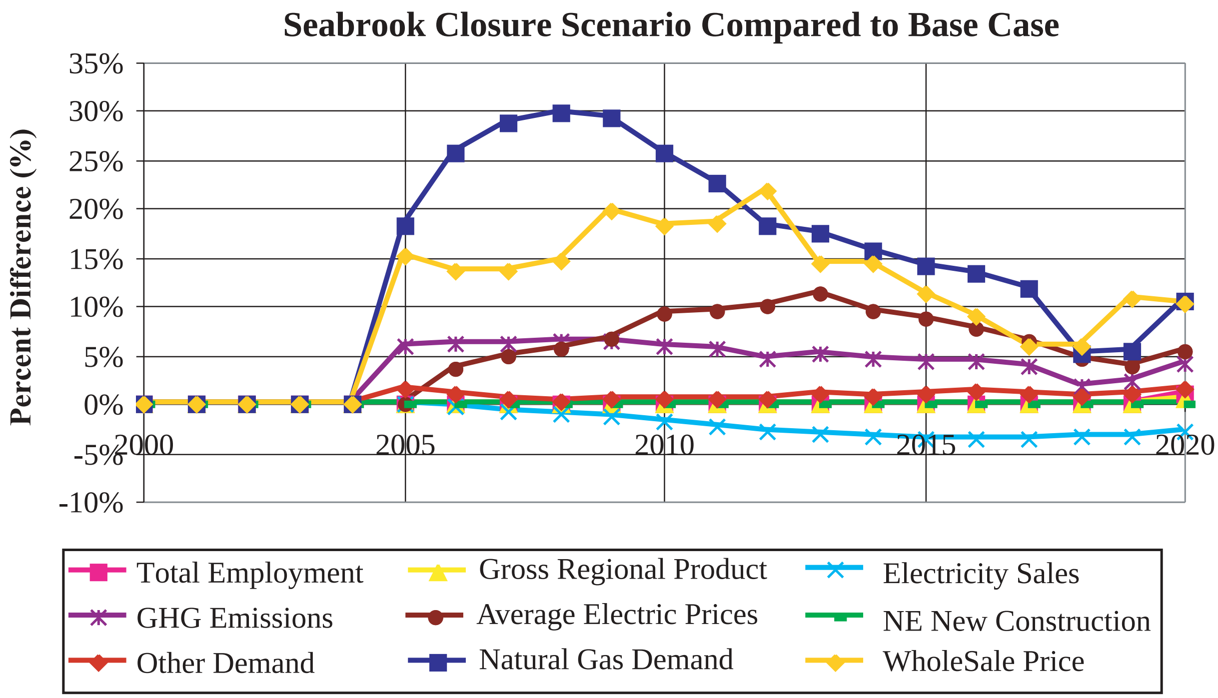


Figure 6.2. Impacts of Seabrook Shutdown versus Base Case

The closure of Seabrook nuclear station in 2005 would lead to some rather significant consequences for the New Hampshire and the New England regional energy system, as summarized in Figure 6.2. The Seabrook shutdown is forecast to cause retail electricity prices to rise by as much as 10%

Table 6.9. Employment Impacts of Seabrook Shutdown

Total Employment (Thousands)	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	699.797	741.202	777.134	813.023	842.421	**779.501**
Nuke Retire	699.797	741.202	776.754	812.625	852.079	**779.758**
Difference	0.000	0.000	-0.380	-0.398	9.658	**0.257**
Percent Change	0.00%	0.00%	-0.05%	-0.05%	1.15%	**0.03%**
High Price Scenario Comparison						
High Price	699.797	741.202	773.287	806.896	846.290	**776.937**
Nuke Retire HP	699.797	741.202	772.972	806.651	863.016	**782.104**
Difference	0.000	0.000	-0.315	-0.245	16.726	**5.167**
Percent Change	0.00%	0.00%	-0.04%	-0.03%	1.98%	**0.59%**

relative to the Base Case. As in the hypothetical coal closure scenario, this leads to modest near-term economic impacts, with longer-term economic gains as a result of efficiency improvements. However, with the higher price impact of Seabrook closure, it takes longer (more than 10 years) for the economic impacts to turn positive. In contrast to the coal hypothetical, the closure of Seabrook would cause a major increase in greenhouse gas emissions, as fossil fuels (largely natural gas) would likely replace the lost nuclear generation.

Table 6.10. Effects of Seabrook Shutdown on Average NH Electricity Prices

Average Electric Prices (2000 $/MWh)	2000	2005	2010	2015	2020	20 Year Average
Base Case Comparison						
Base Case	98.67	79.38	69.65	79.42	88.35	**79.61**
Nuke Retire	98.67	79.38	76.13	86.48	93.24	**83.72**
Difference	0.00	0.00	6.49	7.05	4.89	**4.11**
Percent Change	0.00%	0.00%	9.32%	8.88%	5.53%	**5.13%**
High Price Scenario Comparison						
High Price	98.67	79.38	69.73	82.42	91.18	**80.97**
Nuke Retire HP	98.67	79.38	76.18	87.37	99.01	**85.35**
Difference	0.00	0.00	6.45	4.95	7.83	**4.38**
Percent Change	0.00%	0.00%	9.25%	6.01%	8.59%	**5.28%**

Lastly, it is important to note the rather dramatic rise in total New Hampshire natural gas consumption that is forecast to result from the Seabrook closure, which may have other implications with regard to both the supply and price of natural gas in the state and the region.

7. Natural Gas

7.1 Natural Gas Use in New Hampshire

Natural gas (often referenced as "gas" in the New Hampshire Energy Plan) is a natural mixture of hydrocarbons found issuing from the ground or obtained from specially driven wells. Natural gas arrives in New Hampshire via interstate pipelines, which are in turn supplied directly by wells or by specialized tanker ships. It is then delivered to industrial, commercial and residential customers through a series of supply distribution pipelines. In New Hampshire, natural gas is used for the generation of electricity, is used for heating of buildings and hot water, powers a number of manufacturing processes, and has a number of other applications. Natural gas is currently available to approximately 53 communities in New Hampshire, serving about 100,000 customers.

7.2 ENERGY2020 Base Case Forecast for Natural Gas

In general, oil, natural gas, and coal supply are included in the model based on the EIA/DOE primary energy price forecast and the historical delivery costs (by product) within New Hampshire and New England. While gas pipeline access is a potential issue in New Hampshire, pipeline constraints are not. Therefore, gas pipeline flow dynamics are not included as part of the New Hampshire Energy Plan process. The model does consider the fraction of the population (and businesses) with access to natural gas.

Table 7.1. Forecast of New Hampshire Natural Gas Demand, by Price Scenario

Natural Gas Demand (Tbtu/Year)						
	2000	**2005**	**2010**	**2015**	**2020**	**20-Year Average**
Base Case Comparison						
Base Case	86.23	129.12	152.08	184.38	207.51	**158.28**
High Price	86.23	129.12	154.66	183.65	211.42	**159.18**
Difference	0.00	0.00	2.58	-0.73	3.90	**0.91**
Percent Change	0.00%	0.00%	1.70%	-0.40%	1.88%	**0.47%**

7.3 Demand for Natural Gas

In both the Base Case scenario and the High Price scenario, consumption of natural gas is expected to increase dramatically over the next decades. Demand is predicted to grow from 86 trillion British Thermal Units (tBtu) in 2000 to over 200 tBtu in 2020. This growth, predicted at between 4% and 5% per year, is expected to occur at a fairly steady rate.

7.4 Natural Gas Supply Issues

Absent the construction of a new commercial natural gas power plant beyond those expected to be online in 2002, existing capacity is sufficient to meet the anticipated needs of New Hampshire businesses and residents for the next decade. With the exception of facilities already permitted and under construction, no new large-scale users of natural gas are expected in the state, and the Energy2020 model does not forecast construction of any plants in New Hampshire for over ten years. While supply appears adequate for anticipated demands, there are many businesses, and a large majority of residences, without access to natural gas. Expansion of natural gas infrastructure to significant new service areas has the potential to place demands upon the existing supply infrastructure, but no such expansions are currently underway.

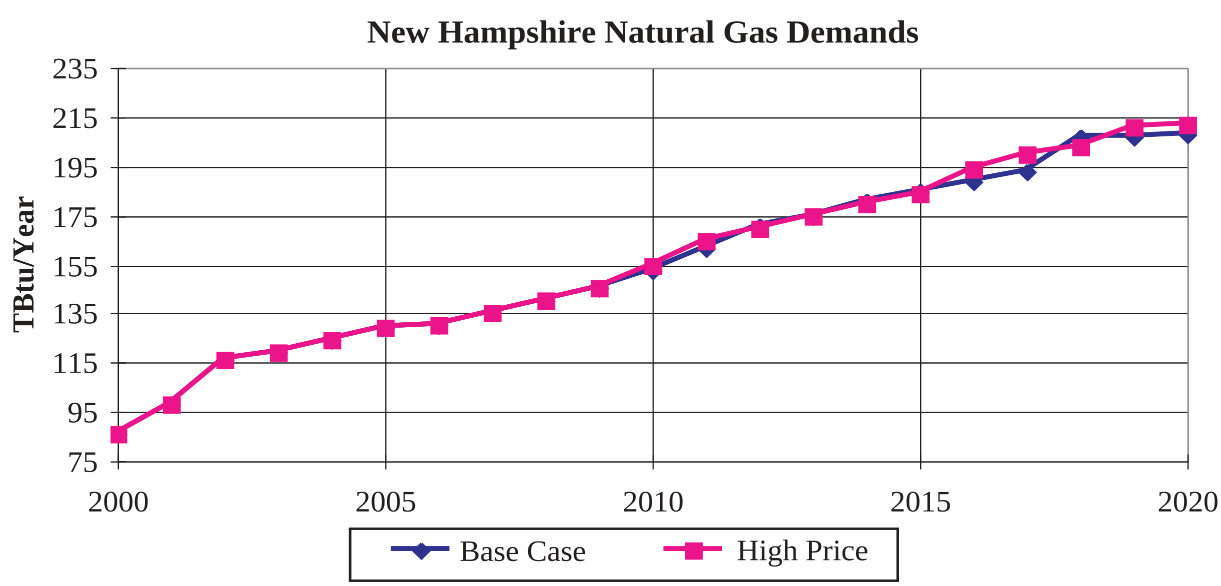


Figure 7.1 Forecast of New Hampshire Natural Gas Demand, by Price Scenario

7.5 Policy recommendations

Natural gas will play an increasing role in New Hampshire's, and New England's energy use. Both supply and demand for natural gas are predicted to rise over the next decade and beyond. This will provide New Hampshire with reduced emissions compared to many other forms of generation, an even more diverse fuel supply than currently enjoyed by the state, and added electricity generation.

New Hampshire policy makers and regulators will need to carefully monitor the growth in natural gas use, and ensure that the infrastructure used to support natural gas delivery is sufficient to meet our needs. Current modeling shows that existing pipeline capacity is more than sufficient to meet demands over the next decade. However, events such as a new generation facility or a great increase in heavy manufacturing could cause demand in excess of the ability to provide natural gas.

New Hampshire should also consider ways to provide more residential customers with access to natural gas. Providing another choice for heating and other uses provides for a more competitive marketplace, and allows residential customers to make decisions based upon price, reliability, environmental impacts and other considerations.

8. Fuel Diversity

8.1 Defining Fuel Diversity

The variety and proportions of energy sources used to power New Hampshire is often referred to as our state's "fuel diversity." By having a variety of energy sources available, the state can spread risk and opportunity across a wide variety of fuels, taking advantage of emerging technologies and in-state resources while buffering us from price swings for any one particular fuel type.

It is the energy policy of the State of New Hampshire that the needs of citizens and businesses be met while "…providing for the reliability and diversity of energy sources…" NH RSA 378:37. New Hampshire has long enjoyed a diverse mix of energy sources, and this has helped provide our consumers with some level of price stability over time.

Proponents of policies to increase fuel diversity note that having a variety of fuel sources available for energy needs – including electricity, transportation, heating and other uses – provides numerous benefits, including:

- Competition among different fuels to provide the least-cost energy to consumers, helping to lower overall prices;
- A hedge against significant price increases for any particular fuel type;
- An energy system that is less subject to exchange rate fluctuations and geopolitical uncertainties often associated with imported fuels;
- Encouraging emerging technologies to participate in the energy market, driving commercialization of renewable and more efficient fuel uses; and
- Encouraging the use of indigenous fuels as part of the energy mix, often with significant positive economic and environmental benefits for the local area as well as for the state as a whole.

8.2 Overview of NH's Current Fuel Diversity

8.2.1 Electricity Fuel Mix

Annual electricity generation by plant and fuel type, as well as total generating capacity by plant and fuel type, were presented in Section 6.3, the Supply section of the chapter on Electricity. Here we consider these same data in terms of shares of total – for example, share of total capacity, generation, and consumption.

As shown in Table 8.2, in the year 2000 Seabrook station accounted for greater than 40% of the total generation capacity in the state, followed by coal, then gas/oil steam, and then hydro, each between 15 and 21%. The biomass plants represent just under 3% of capacity in 2000. Capacity refers to the ability of a plant to produce electricity, and is not the same as generation, which is the actual amount of energy actually produced by a facility.

By 2005, major new natural gas combined cycle plants will be online, accounting for approximately one quarter of total generating capacity in the state. In the Base Case these shares stay essentially fixed, except for the assumed retirement of the biomass plants by 2010 based upon the expiration of their current rate orders.

Table 8.1 New Hampshire Generation Share by Plant

Base Case Forecast New Hampshire Generation Share by Plant (%)					
	2,000	**2,005**	**2,010**	**2,015**	**2,020**
Gas/Oil Turbines	0.3%	2.2%	3.6%	5.0%	5.3%
Gas/Oil Combined Cycle	0.0%	5.3%	9.0%	14.9%	23.4%
Gas/Oil Steam	10.0%	9.0%	8.8%	8.0%	7.2%
Coal Steam	21.0%	18.9%	18.4%	16.9%	15.0%
Nuclear	55.4%	53.0%	51.7%	47.4%	42.2%
Hydro	8.6%	7.8%	7.6%	6.9%	6.2%
Biomass	3.8%	2.8%	0.0%	0.0%	0.0%
Landfill Gas/Waste	1.0%	0.9%	0.9%	0.8%	0.7%
Wind	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Shares of actual generation by fuel type are shown in Table 8.1. Nuclear power's variable cost – which is the incremental cost of operating the station to generate power, rather than leaving it dormant, and generally reflects cost of fuel – is very low, so it operates as a baseload plant, meaning that it runs whenever available to the grid. As a result, while Seabrook represents 41.6% of capacity in 2000, its annual output (generation) is 55.4% of in-state generation. In other words, the actual output from Seabrook in the year 2000 exceeded the output from all other electric generating stations in the state combined. This share is forecast to decline somewhat in the future as more capacity is added, especially through natural gas plants. Even so, by 2020, Seabrook is still forecast to account for over 40% of total annual generation. By

Total Demand by Fuel for the Base Case

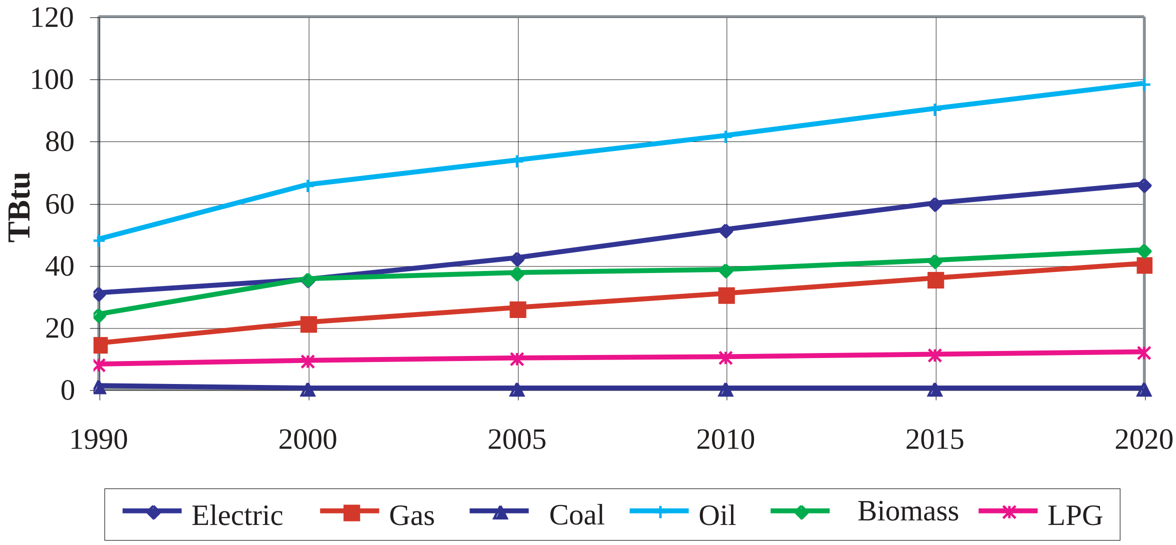


Figure 8.1 Energy Demand at Point of Use, by Fuel

contrast, while hydro plants represented 16% of the state's capacity in 2000, they accounted for only 9% of the state's actual generation. This is largely because hydro facilities operate only when water is available to power them and, unlike other forms of electricity generation, are not available all of the time.

Table 8.2. New Hampshire Generating Capacity Share by Plant

Base Case Forecast New Hampshire Generating Capacity Shares by Plant (%)					
	2,000	**2,005**	**2,010**	**2,015**	**2,020**
Gas/Oil Turbines	0.5%	7.0%	7.1%	7.1%	7.1%
Gas/Oil Combined Cycle	0.0%	25.7%	26.1%	26.1%	26.1%
Gas/Oil Steam	18.3%	12.1%	12.3%	12.3%	12.3%
Coal Steam	20.4%	13.5%	13.8%	13.8%	13.8%
Nuclear	41.6%	29.3%	29.7%	29.7%	29.7%
Hydro	15.8%	10.5%	10.6%	10.6%	10.6%
Biomass	2.8%	1.5%	0.0%	0.0%	0.0%
Landfill Gas/Waste	0.7%	0.5%	0.5%	0.5%	0.5%
Wind	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

8.2.2 Fuel Diversity in Energy Demand

At point of use – combining the residential, commercial, industrial and transportation sectors – oil accounts for the largest single share of use energy, at just over 65 trillion Btus in the year 2000, as shown in Figure 8.2. Electricity comes second over the forecast horizon, followed by biomass energy, reflecting the heavy use of biomass energy by the paper industry. (N.B., for these numbers, the electricity line item includes the Btu value of fuel used to generate electricity – including coal, oil, natural gas, and biomass.

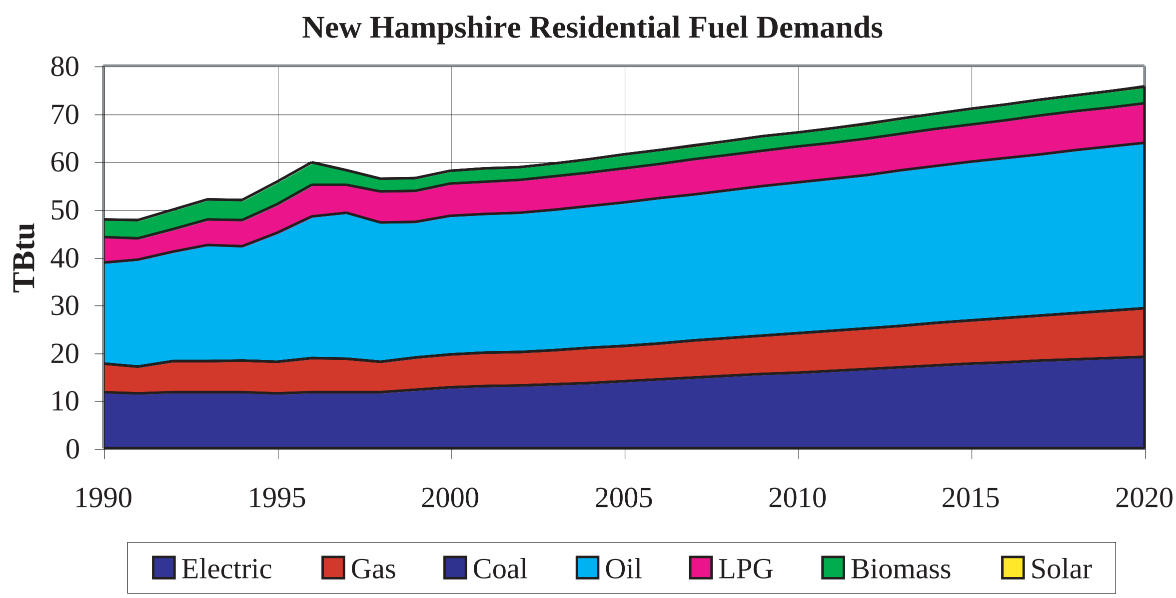


Figure 8.2 Residential Demand by Energy Type

8.2.3 Fuel Shares by Sector

8.2.3.1 Residential Fuel Use

Oil accounts for the largest share of residential energy use, measured in terms of Btu at point of use, followed by electricity, as shown in Figure 8.2. Virtually equal amounts of natural gas and LPG are consumed by New Hampshire's residential sector, and biomass makes a noticeable contribution (just over 5% of total residential energy use) over the forecast period.

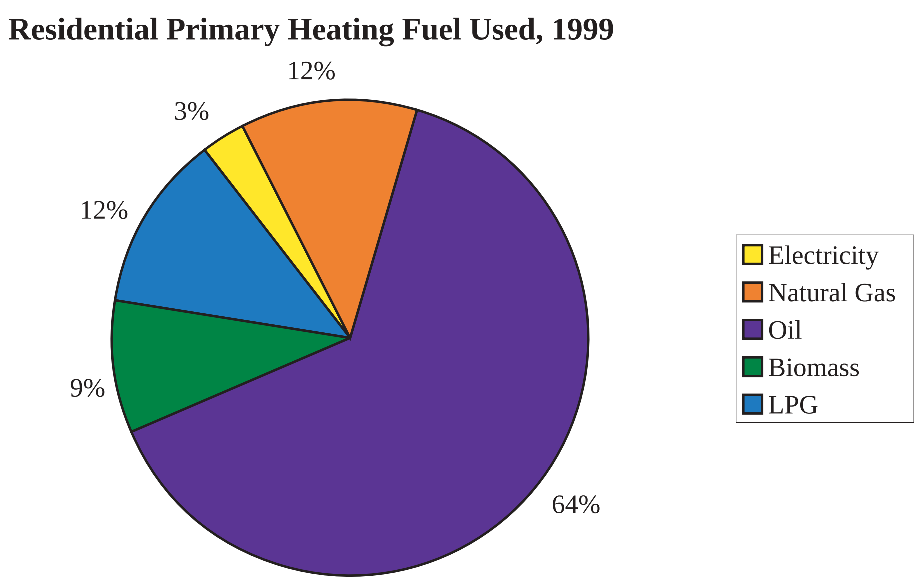
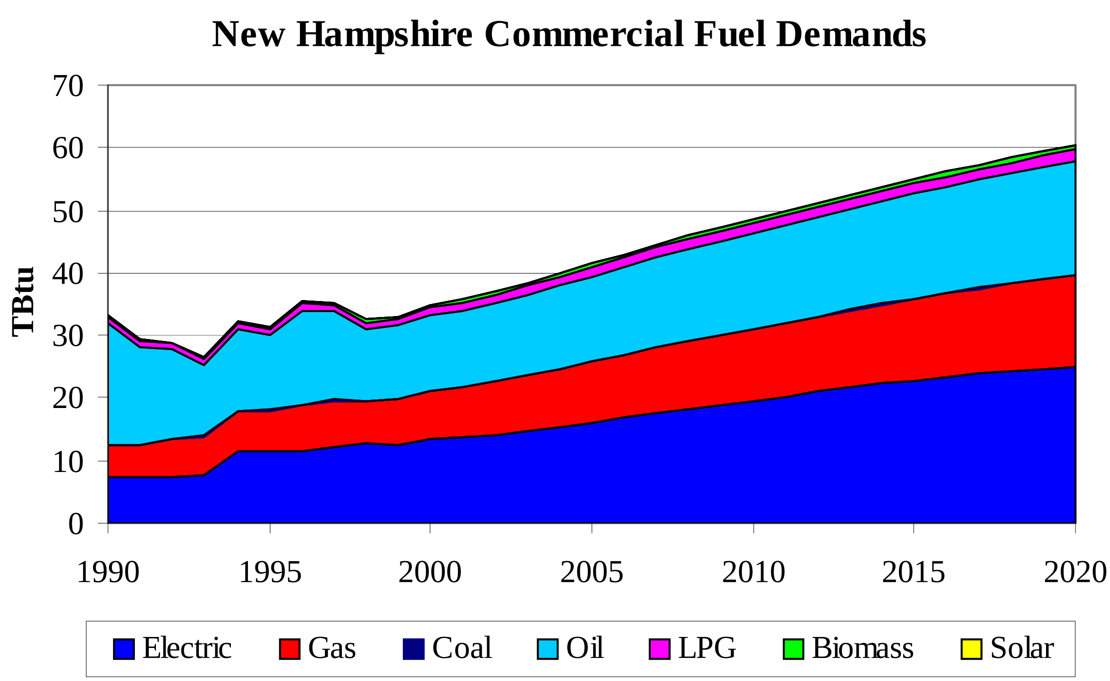


Figure 8.3 Choice of Primary Heating Fuel, Residential 1999 - 2000

Some energy end uses are "substitutable" uses, which means that users can make choices to move from one type of fuel use to another. These kinds of substitution decisions must generally be made at the time of purchase of a new energy-using device. Examples of substitutable end-uses are space heating, water heating, and cooking. Other important end-uses such as lighting, air conditioning, and "miscellaneous" (which refers to home appliances, computers, etc.) are considered nonsubstitutable because they are tied strictly to electricity. Approximately 85,000 residential customers use natural gas in New Hampshire. However, the majority of households lack access to natural gas, so it is not a real option for many residents.

One of the primary uses of energy in residential settings is for heating. The Governor's Office of Energy & Community Services regularly monitors the type of fuel used in New Hampshire households. As shown in Figure 8.3, a survey covering the years 1999 and 2000, New Hampshire households indicated that the majority – 53% – use oil for their primary heating fuel. Natural gas, wood stoves (biomass), and propane are also popular choices.



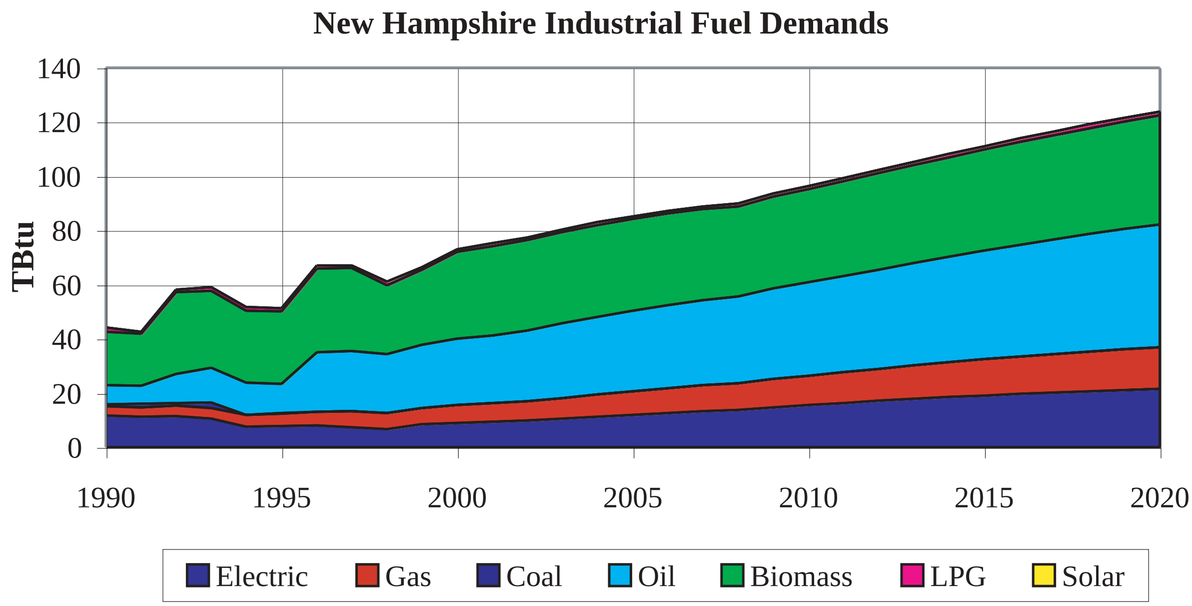


Figure 8.5. Industrial Demand by Energy Type

8.2.3.2 Commercial Fuel Use

Electricity accounts for the largest fuel share in the commercial sector, followed by oil and natural gas, as shown in Figure 8.4. As in the case of residential energy use, only a portion of commercial energy end-uses are "substitutable" end-uses, which means that users can make choices to substitute one fuel for another. In the commercial sector, the non-substitutable end-uses (such as lighting) account for much greater shares of the total than in the residential sector, as shown in Figure 7.4. Overall, in the year 2000, substitutable end-uses made up 63% percent of total commercial energy demand at point-of-use.

8.2.3.3 Industrial Fuel Use

In the industrial sector, oil and biomass play major roles, followed by electricity and natural gas, as shown in Figure 8.5. One of the interesting features of past developments in industrial energy use is the significant increase in the consumption of oil that occurred during the second half of the 1990s.

8.2.4 Transportation Fuels

Transportation energy use is outside the scope of the energy plan called for by the New Hampshire legislature. However, transportation represents our largest use of energy in New Hampshire and in the country, and the following information is intended to help readers better understand how transportation fits into New Hampshire's energy future. Therefore, we have only summarized the Base Case forecast results for transportation, and have not developed or tested any policies that might be directed at increasing the efficiency of transportation in New Hampshire in the future. However, it is clear that this energy use category presents an important topic for future policy development, modeling and consideration.

The bulk of transportation energy use in New Hampshire is associated with the residential sector, which means our own private automobiles, as shown in Figure 8.6. This automobile use is nearly all gasoline, with a very small share of diesel fuel use. As a result, gasoline represents the major transportation fuel used in New Hampshire. Commercial and especially industrial transportation rely more heavily on diesel fuel.

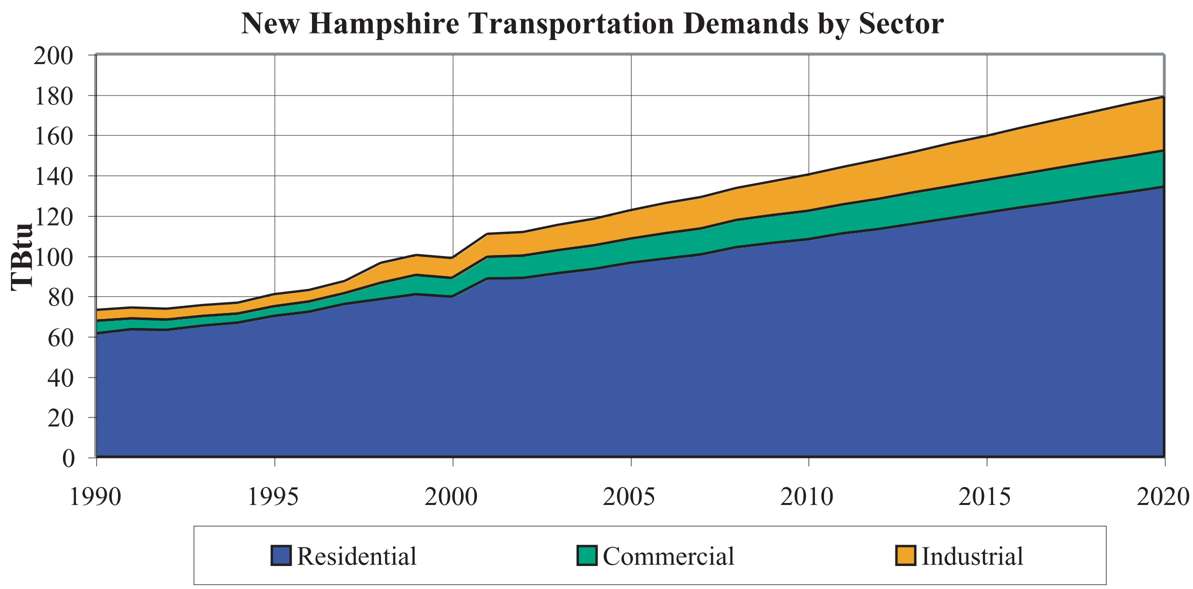


Figure 8.6. Transportation Demands by Sector

The projected growth in energy consumption by private automobiles in New Hampshire between the year 2000 and 2020 is dramatic, reflecting greater than a 50% increase. This corresponds to an increase of over 50 trillion Btus (more than the total energy consumption occurring at point of use in the commercial sector in 2000). This dramatic increase also results in significant increases in emissions of air pollutants, as well as major increases in annual expenditures on transportation (vehicles, insurance, fuel, and maintenance and repair expenses) for New Hampshire residents. Therefore, New Hampshire should include transportation in future energy planning efforts, in order to reap the many benefits of cost effective investments in transportation that result in environmental, economic, public health, and energy benefits for the state.

8.2.5 Current Electric Power Generation Using Alternative Energy

New Hampshire uses a number of renewable and alternative sources of energy to produce electricity and provide heat for residential, commercial and industrial uses. They are discussed below.

Wood Energy

New Hampshire has eight wood-fired power plants that can produce electricity, five of which are presently operating. The future of these five plants is uncertain after their rate orders (contracts mandated by statute that guarantee purchase of their power at predetermined prices) or other agreements to operate expire. Independent analysis of the economics of these facilities completed for the New Hampshire Department of Resources & Economic Development in 2001, as well as market experience with facilities following termination of rate orders, show that these facilities do not operate economically in a fully competitive environment. The five operating wood-fired power plants have a combined output of approximately 77.6 MW, and consume around 1.1 million green tons of wood each year. Wood-fired power plants, and the possible benefits of retaining them, are discussed in further detail in Section 8.3.1 below.

Energy from Municipal Solid Waste

New Hampshire residences and businesses generate roughly 1.4 million tons of solid waste annually. A small portion of this waste is used to fuel two trash-fired energy facilities, one in Claremont and one in Penacook. Both of these facilities are owned and operated by Wheelabrator Technologies, Inc. of Hampton. The facility in Claremont produces roughly 4 MW of power, using almost 70,000 tons of municipal solid waste annually. The facility in Penacook is larger, generating 12.8 MW of electricity through the combustion of almost 175,000 tons of waste each year. Both of these plants operate under rate orders, which guarantee a fixed price for electricity output. These rate orders expire in 2007.

Hydroelectric

Hydroelectric generation plays an important role in our state's energy diversity, with nine utility owned and 27 independently owned hydroelectric generating sites in the state. In 1999, their 440 MW of capacity represented 15.5% of the state's total generating capacity. However, because hydroelectric facilities generate only when water is available, their actual generation is less that their total capacity.

Hydroelectric generation produces electricity using a free renewable fuel source, and has no emissions. Hydroelectric generation does raise concerns about impacts upon both aquatic and terrestrial ecosystems from change in stream flow and impoundments. Based upon existing dams and the lengthy environmental review process that would be required for siting a new project, it is unlikely that many (if any) new sites for hydroelectric generation will be developed in New Hampshire's foreseeable future. Nonetheless, the current hydro facilities in the state are an important part of our overall diverse energy portfolio, and policies that impact them should take this into consideration.

8.2.6 Emerging Issues for Fuel Diversity in New Hampshire

8.2.6.1 Net Energy Metering

Net energy metering allows small renewable power generators to sell electricity back to their utilities at the retail electric rate. For example, net metering allows a household to install a small wind turbine for generation of electricity, while remaining tied to the electricity grid. The household will use electricity from the wind turbine when available, and from the electricity grid when not available. In addition, when the electricity generation from wind is greater than the household's needs, the excess power is purchased by the utility, in essence having the electricity meter run backwards. Net metering is authorized by NH RSA 362-A:9, and New Hampshire's rules may be found at www.puc.state.nh.us.

8.2.6.2 Environmental Disclosure of Electricity Attributes

The New Hampshire Public Utilities Commission has recently begun work to develop rules for environmental disclosure for electricity suppliers operating in New Hampshire. Once adopted, it is anticipated that these rules will provide ratepayers with information on the type of electricity generation we use, and the emissions associated with this electricity. By providing ratepayers with this information, they will have a better understanding of the environmental impacts of our energy use, and allows us to use environmental factors as one criterion when selecting an energy supplier.

8.3 Results of Policy Tests Compared with the Base Case

In order to understand some of the impacts of renewable energy upon the energy, environmental and economic future of New Hampshire, two scenarios were tested against the "Base Case:"

- Retention of the wood-fired power plants after expiration of their rate orders; and
- Development of commercial scale wind farms in New Hampshire.

The results of these scenarios are described in detail below. It should be noted that members of the public suggested a large number of possible renewable power scenarios, and only a limited number could be tested. Both of these scenarios are presented for information purposes, and should not necessarily be considered recommendations.

8.3.1 Retention of Wood Energy Plants Current Rate Orders

New Hampshire currently has five wood-fired steam turbine power plants, or "biomass plants," operating in the state. Three others have closed following termination of their rate orders. The locations and generating capacity of each of these plants are listed below. These plants were constructed following the era of rapidly rising oil prices in the 1970s, and were granted rate orders for long-term guaranteed power sales at rates that have turned out to be significantly above market prices. These rate orders, which are 20 years in length, are scheduled to expire during the next five years, as summarized in Table 8.3 below.

Table 8.3. Biomass Historical Generation and Rate Order Expiration Dates

Plant Location	Historical Generation	Rate order expiration date	Modeled expiration timing
Bridgewater	15 MW	8/31/2007	end of 2007
Springfield	13.8 MW	11/30/2007	end of 2007
Bethlehem	15 MW	11/30/2006	end of 2006
Tamworth	20 MW	3/31/2008	end of 2007
Whitefield	13.8 MW	3rd Q 2003*	end of 2003

* anticipated closure date, rate order already terminated

New Hampshire also has three wood-fired power plants that closed after their rate orders were bought out. These facilities and their historic generation levels are Bio-Energy in Hopkinton (11 MW), Alexandria Power in Alexandria (15 MW), and Timco in Barnstead (4 MW).

While the electricity from these plants has been expensive, they have also brought important benefits to the state. Each plant employs people directly, and in addition, they provide a market for low-grade wood and biomass, which has several secondary benefits.

The biomass plants pay an average of $18 per green ton of wood chips from logging and chipping of low-grade trees. These are trees that are not of high enough quality to be sawn into lumber, or have other commercial defects. If they are not harvested for chips and burned at the biomass plants, they continue to grow, shading out other trees that might grow straight and tall and become high value timber. As a result, the loss of the market for chips would significantly reduce the level of such "thinning" activity that takes place in New Hampshire's forest, with the long-term result that the value of standing timber and the supply of marketable timber would be reduced.

The market provided for whole tree chips by the wood energy plants is important to the state's forest industry and forest landowners. In 2002, the New Hampshire Department of Resources & Economic Development commissioned a report on the market for low-grade wood provided by the wood energy plants. This report, available at www.nhdfl.org, identifies the following benefits of the low-grade wood market these plants provide (figures include benefits from Bio Energy in Hopkinton, an 11 MW plant that has closed since the release of the DRED report):

- The plants have a direct and indirect economic impact of roughly $96 million each year. Of this, an estimated $70 million in economic activity is tied directly to the harvesting and processing of fuel for the facilities.
- The wood-fired power plants are responsible for between 213 and 444 jobs in the state. Most of these jobs are related to forest management or timber harvesting and transportation.
- Markets for low-grade wood are important to sustainable forest management, diverse wildlife habitat, and the conservation of open space.
- New Hampshire's sawmills rely upon wood energy plants for a residue market. Sawmills in the state have tripled their production from the early 1980's to today, and New Hampshire mills now produce an estimated 400,000 to 600,000 green tons of mill residue each year.

Table 8.4. Direct Economic Impacts of Biomass Plants in New Hampshire

Direct Economic Impacts of Biomass Plants in New Hampshire, 1999					
Plant	KWh / year	MW	Estimated no. of jobs	Estimated wages & benefits	Estimated property tax
Bridgewater	124,830,000	15.0	32	$1,432,453	$ 200,000
Hemphill	114,843,600	13.8	29	$1,317,857	$ 200,000
Whitefield	114,843,600	13.8	29	$1,317,857	$ 200,000
Bethlehem	124,830,000	15.0	32	$1,432,453	$ 200,000
Tamworth	166,440,000	20.0	42	$1,909,938	$ 200,000
Totals	***645,787,200***	***77.6***	***165***	***$7,410,559***	***$1,000,000***

As a market for sawmill waste, the plants also pay roughly $15 per green ton of sawmill residue. Without this market, the sawmills' next best option is to pay $35 per green ton to dispose of the sawmill residue – a cost increase of $50 per ton, and increase to our state's waste stream. As the sawmills now sell to the wood fired power plants over 100,000 tons of sawmill residue, the loss of the biomass plant market would cost the state's sawmills in excess of $5 million per year, reducing their profitability and competitiveness.

Table 8.5. Prices & Amounts Paid by Biomass Plants for Chips & Sawmill Residue

Plant	Tons of Chips Used	Chip Purchases ($18/ton)	Sawmill Residue (Est. green tons)	Residue Purchases ($15/ton)	Disposal ($35/ton)	Lost Sawmill dollars
Bridgewater	229,320	$ 4,127,760	22,932	$ 343,980.00	$ (802,620)	$(1,146,600)
Hemphill	207,577	$ 3,736,386	20,758	$ 311,365.50	$ (726,520)	$(1,037,885)
Whitefield	187,392	$ 3,373,056	18,739	$ 281,088.00	$ (655,872)	$ (936,960)
Bethlehem	226,600	$ 4,078,800	22,660	$ 339,900.00	$ (793,100)	$(1,133,000)
Tamworth	286,178	$ 5,151,204	28,618	$ 429,267.00	$(1,001,623)	$(1,430,890)
Totals	***1,137,067***	***$20,467,206***	**113,707**	**$1,705,600.50**	**$(3,979,735)**	**$(5,685,335)**

The wood plants also burn an indigenous renewable resource. While the combustion of wood does produce air pollutants such as particulates and NOx, it is not a netsource of the greenhouse gas CO_2 as long as the wood supply is continually re-growing, versus being lost to other types of land uses. In New Hampshire, the state presently grows more trees than are removed through harvesting or lost to development. Trees absorb CO_2 from the air during growth, which is released when the wood is combusted or when the wood decays naturally in the forest. As a result, wood is widely considered to be a "CO_2-neutral" fuel – that is, its combustion and re-growth leads to no net increase in atmospheric CO_2 emissions over the long term when the supply is continually re-grown in a sustainable manner.

Based on the set of considerations outlined above, it is of interest to some industries, landowners, and policy makers in the state to understand the potential benefits and costs that might be associated with alternatives to retirement of the state's biomass plants over the next five years. For this reason, we have studied the impacts of retaining the plants in operation.

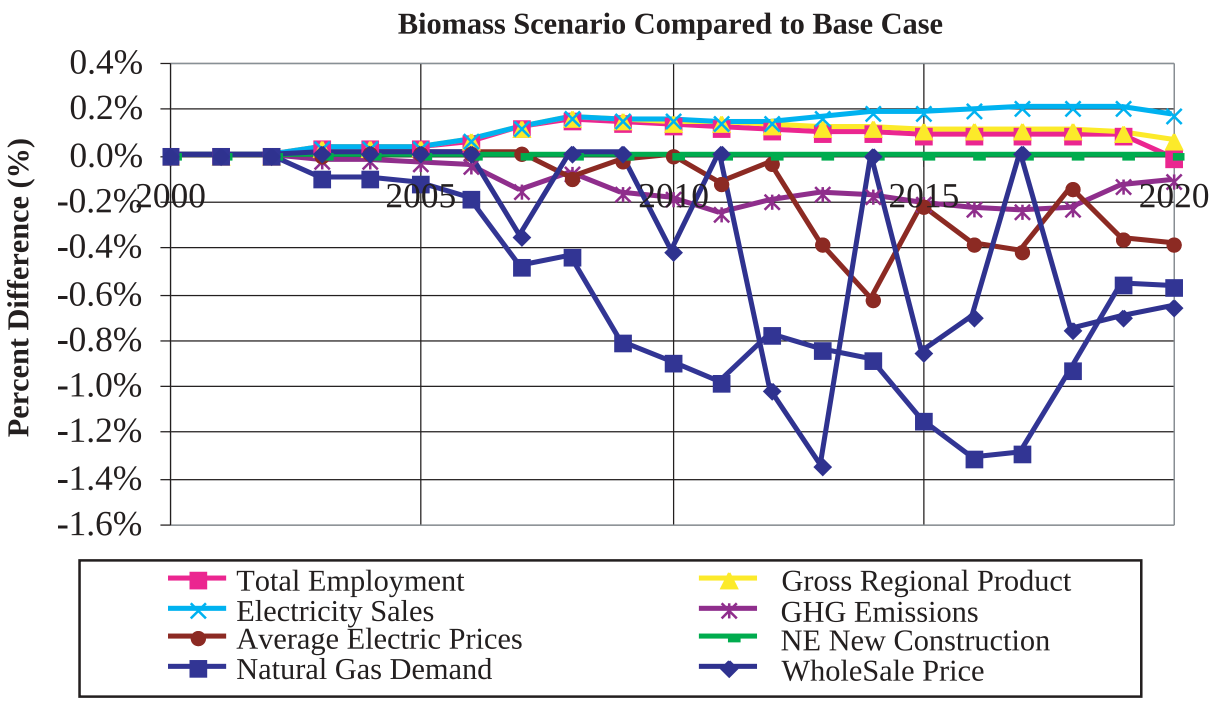


Figure 8.7. Impacts of Biomass Plant Retention Relative to Base Case

The report completed for the New Hampshire Department of Resources & Economic Development estimated that – if operating constantly – fuel, operations and maintenance for a wood-fired power plant cost roughly 5.4 cents per kWh. This figure does not include profit or contingencies. For the purposes of this report, it is assumed that in order to cover all expenses associated with wood-fired power, including profit for the operator and contingency expenses, the electricity would need to be sold for 5.8 cents per KWh. The evident conclusion is that for at least the next ten years, some sort of program would be required to make up the difference between expected annual average wholesale prices and the price for profitable operation.

Rather than specify and simulate a specific mechanism for bridging the gap between wholesale and break-even prices, we have simulated a scenario which retains the plants, quantifying the energy and economic impacts of doing so, as well as the annual electricity price gap which would need to be bridged to operate the plants profitably. The results of this simulation are intended to identify both the costs and the benefits of retaining the plants, as an input to policy formulation on the part of interested stakeholders, and to build upon the work of the recent Legislative study committee charged with consdering these issues.

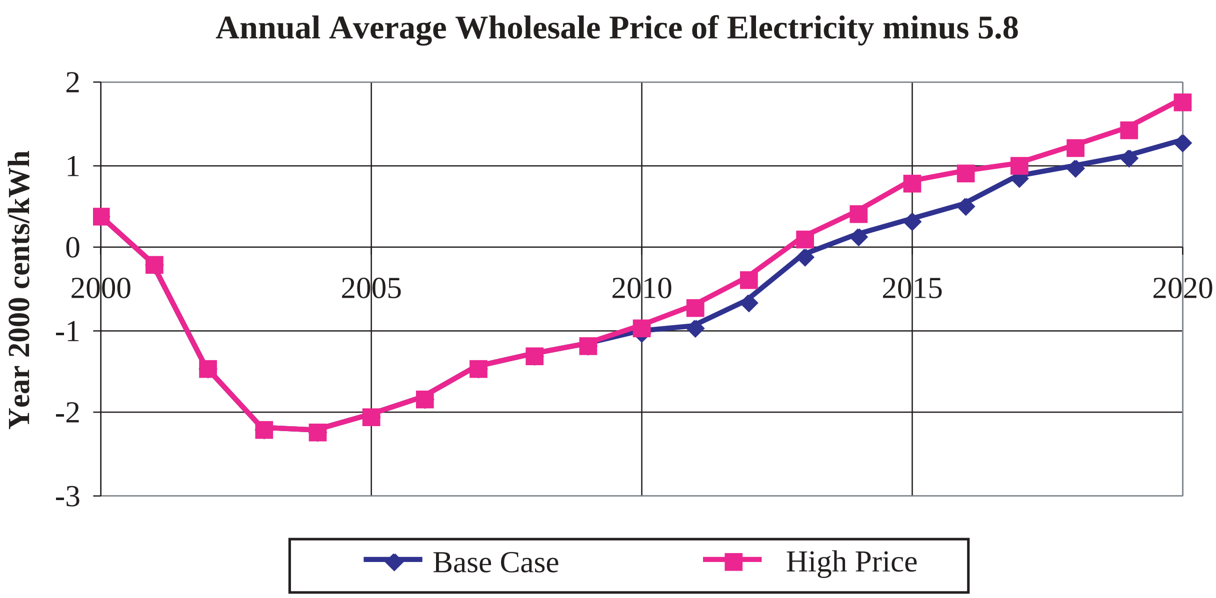


Figure 8.8. Difference in Wholesale and Break-even Electricity Prices

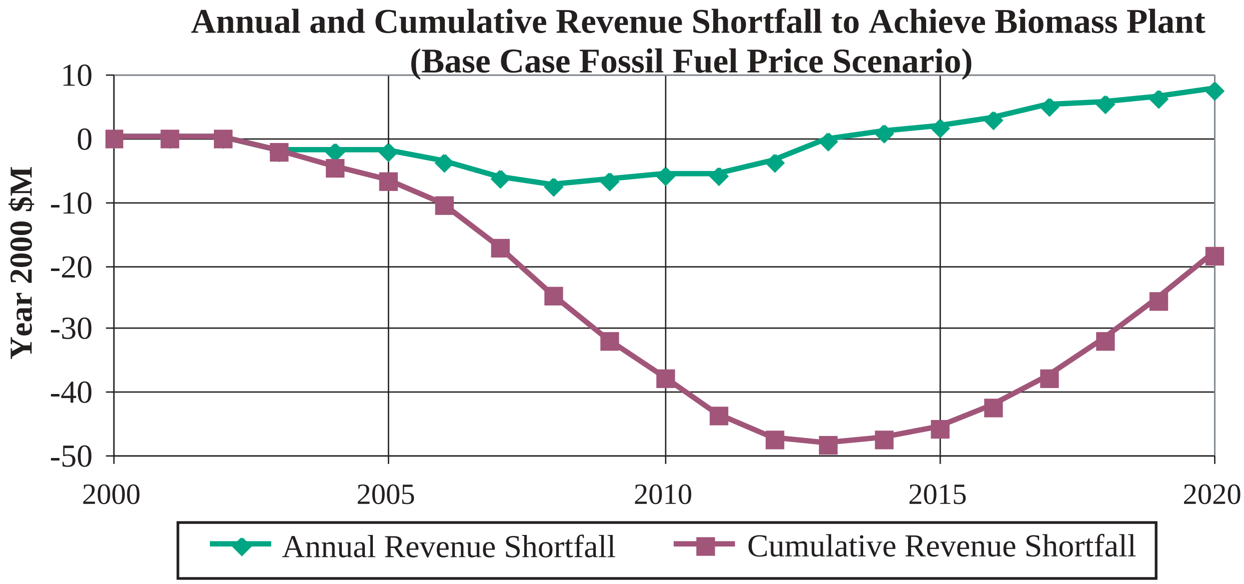


Figure 8.9. Annual and Cumulative Revenue Shortfall to Achieve Biomass Plant Operation

The elements of the simulation are as follows:

• The plants continue to operate through 2020, rather than closing as assumed in the Base Case;

• The plants sell their power at the wholesale price, not at 5.8 cents/KWh;

• The employment and payments to logging and sawmills are phased into the base case economic forecast based on plant retention rather than retirement.

We do not, in the present simulation, attempt to account for the potential economic effects of plant-enabled forest management activity that increases the value of standing timber over time. This is an important benefit, but one which is difficult to quantify.

Table 8.6. Seasonal and Annual Base Case Wholesale Electricity Price Forecast

Base Case Forecast New Hampshire Average Wholesale Price ($/MWh)					
	2000	**2005**	**2010**	**2015**	**2020**
Nominal Dollars					
Summer	68.78	50.92	74.20	107.76	137.28
Winter	54.21	34.01	50.42	76.20	107.02
Annual	61.61	42.58	62.46	92.17	122.33
2000 Dollars					
Summer	68.78	44.79	56.84	71.91	79.80
Winter	54.21	29.91	38.63	50.85	62.20
Annual	61.61	37.45	47.85	61.51	71.11
Real Cumulative Growth Rate (%)					
Summer	0.0%	-6.0%	0.8%	3.0%	3.5%
Winter	0.0%	-9.3%	-0.7%	2.3%	3.4%
Annual	0.0%	-7.4%	0.1%	2.7%	3.4%

The impacts of the plant retention, relative to the Base Case forecast, are displayed in Figure 8.7. The retention of the plants serves to avoid slight (perhaps 6 tenths of a percent on average) increases in wholesale electricity prices that would otherwise occur; as a result, this impact is shown as a modest reduction in wholesale prices relative to the Base Case. Some new natural gas generation is avoided, and retail electricity prices are also slightly lower (by 2-3 tenths of a percent on average) than in the Base Case. The plants provide economic benefits as shown in Table 8.7. Note that the dip in the economic benefits relative to the Base Case dip in the year 2020; this is because, in the absence of the biomass plants, the model forecasts new plant construction in the last years of the simulation, which would bring jobs to the state. By slightly reducing the wholesale price of electricity and thus delaying new plant construction until after the forecast horizon, retention of the biomass plants also delays the new plant construction jobs to later years. Retaining the plants reduces greenhouse gas emissions by two tenths of a percent relative to base case, or roughly 100 thousand tons of CO_2 per year.

Table 8.7. Employment Impacts of Biomass Plant Retention

Total Employment (Thousands)	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	699.797	741.202	777.134	813.023	842.421	**779.501**
Biomass	699.797	741.387	778.078	813.736	842.299	**780.077**
Difference	0.000	0.185	0.944	0.713	-0.122	**0.576**
Percent Change	0.00%	0.02%	0.12%	0.09%	-0.01%	**0.07%**
High Price Scenario Comparison						
High Price	699.797	741.202	773.287	806.896	846.290	**776.937**
Biomass HP	699.797	741.387	774.230	807.651	846.481	**777.529**
Difference	0.000	0.185	0.943	0.755	0.191	**0.592**
Percent Change	0.00%	0.02%	0.12%	0.09%	0.02%	**0.07%**

Finally, we examine what it would cost to achieve the benefits of biomass plant retention, by examining the gap between the forecast wholesale price of electricity (in the presence of the plants) and the price of 5.8 cents per KWh (2000 dollars). The results are plotted above in Figure 8.9. There is a gap from the present until either 2013 or 2014 depending upon the (fossil) fuel price forecast scenario. After this cross over point, the wholesale price rises and stays above the break-even price point.

The price gap times the electricity generation from the biomass plants yields an estimate of the revenue shortfall or amount needed to keep the plants open. Recall that three of the plants' rate orders expire in 2007, one in 2006, and one ceases operation in 2003, as discussed above. In order to estimate the annual revenue shortfalls, we multiply the "artificially retained" annual biomass plant generation (which phases in over time between 2003 and 2007) by that year's price gap.

The annual revenue gap drops to its most negative value of $7.7M in 2008, and becomes positive in 2014. The cumulative revenue shortfall dips to its lowest value just shy of $50M in 2013, and thereafter rises back towards parity. The implication is that if the biomass plants were guaranteed a price of 5.8 cents per KWh until approximately 2023, then the net price support over the 2003 - 2023 time period could be zero. Of course, it must be remembered that this estimate and analysis is based on forecasts of wholesale electricity prices, and it is faulty forecasts of energy prices that led to the original rate order contracts in the first place.

In conclusion, we have analyzed and described the costs and benefits of retaining the biomass plants in operation past the scheduled expiration of their rate orders. One of the major benefits of plant operation – increased forest management activity and its impacts on long-term value of standing timber in the state – has been mentioned but not quantified. Retaining the plants would provide for retaining 700-950 jobs, and help the state's growing sawmill industry. It would require some type of supplement starting in 2003, when wholesale electricity prices are below the estimated 5.8 cents per KWh break-even price for profitable operation of the plants. Any policy that makes a commitment to provide a supplement to fill the gap between wholesale prices and a break-even price would be a commitment to an uncertain amount, since it relies on a forecast of wholesale electricity prices.

It must be noted that while this analysis considers the energy, economic and environmental benefits associated with continued operation of the wood-fired power plants, the costs are not fully considered. This is because a funding source for continued operation of the facilities (e.g., a Renewable Portfolio Standard, a tax on electricity, or revenue from the state's general fund) was not identified, and was not used in the model. Prior to creation of any policy to support continued operation of the wood-fired power plants, the costs would need to be weighed against the benefits.

8.3.2 Establishing Wind Farms in New Hampshire

The State's Wind Resource

Northern New England, including New Hampshire, has a considerable wind resource. The technology for wind turbines has developed rapidly in recent years, so that utility-scale sites of wind turbines (so-called "wind farms") are now competitive with conventional (e.g., fossil fuel based) generation.

Around the world, over 50,000 wind turbines are currently in operation.[1] In the last six years, 1,100 MW of new wind generation has been established in Texas alone. Wind turbines have been generating electricity in the US for decades, but they have remained at least until now, a niche technology, accounting for less than 1% of US electricity. With recent advances in technology that improve wind power's economics, the role of wind energy is advancing rapidly. Last year alone, 1,700 MW of new wind capacity was installed in the US, doubling total US wind power capacity.[2] This is an amount equal to 60% of New Hampshire's total capacity in 2000, or roughly the capacity of Seabrook plus the state's coal power plants combined. And in 2002 alone, approximately $3 billion in wind power projects were proposed or planned for the next several years at sites in the Midwest, New Jersey, New York, and New England.

The following paragraph, excerpted from the National Renewable Energy Laboratory's Wind Energy Atlas, describes the wind power resource in New England:

> *An extensive area, including most of Vermont and New Hampshire, as well as much of Maine, Massachusetts, and Connecticut, has annual average wind power of class 3 or higher on exposed locations. Highest powers (class 5 and 6) occur on the best-exposed mountain and ridge tops in Vermont's Green Mountains, New Hampshire's White Mountains, and Maine's Longfellow Mountains. The remainder of the hilltops and mountain tops in this area that are outside of these major ranges have class 3 or 4 wind power. At the highest elevations this wind power increases to class 6 and 7 in the winter. Average wind speeds may vary significantly from one ridge crest to another and are primarily influenced by the height and slope of the ridge, orientation to the prevailing winds, and the proximity of other mountains and ridges. For example, the White Mountains are indicated to have class 6 wind power, but Mount Washington, at 1,917 m (6,288 ft) elevation, is known to have considerably greater wind power as a result of terrain-induced acceleration as the air passes over the mountain.*

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[1] *Washington Post*, August 20, 2002: "Windmills on the Water Create Storm on Cape Cod," page A3.
[2] *Technology Review*, July/August 2002, pp. 42-45.

Also from the Wind Energy Atlas is a map of the wind energy resource in New Hampshire and Vermont.

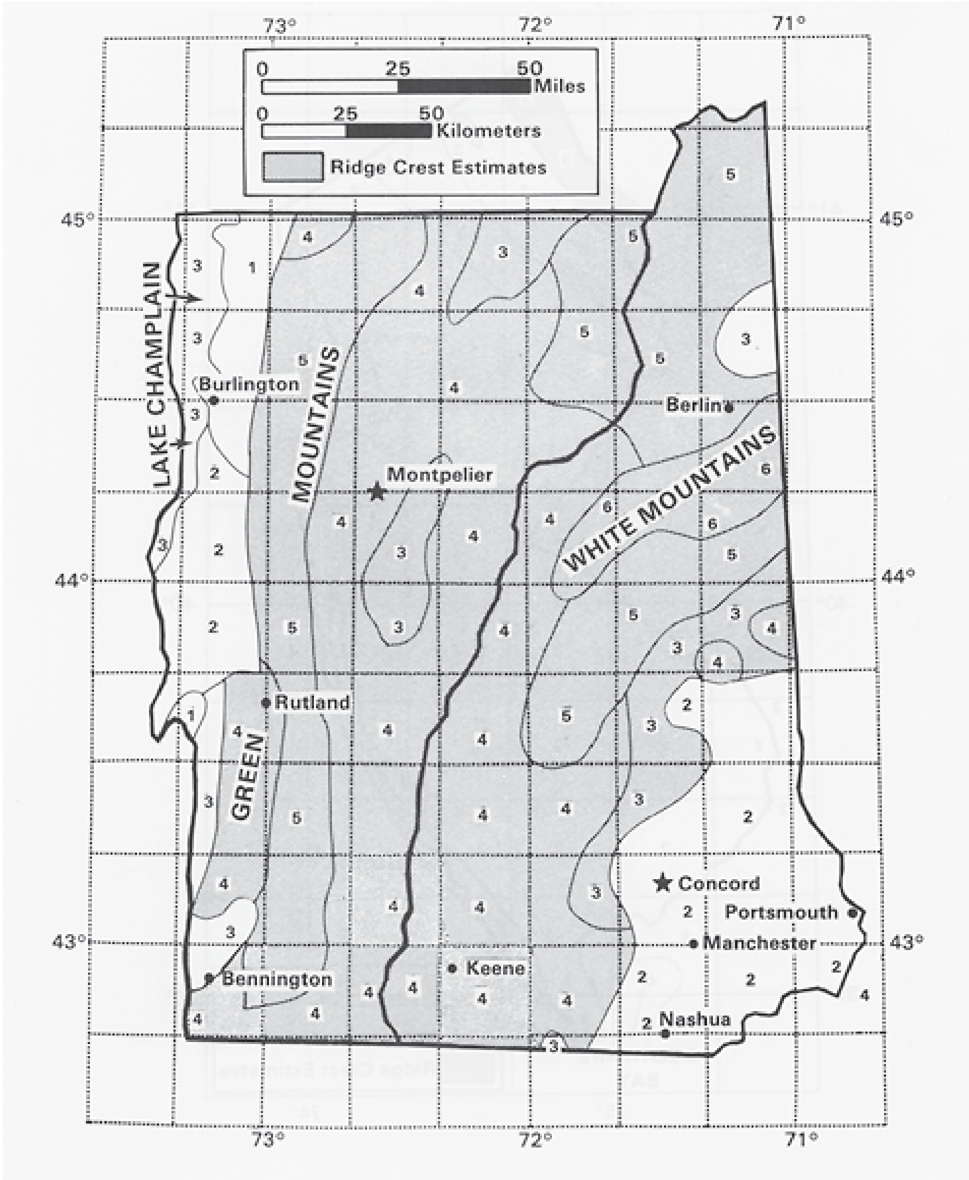

Figure 8.10. Wind Energy Resource Map for New Hampshire and Vermont

While there is strong potential for siting wind farms in the state, they also raise numerous concerns. It is likely that areas that could support wind power may face the following obstacles:

• Distance to the electricity grid:

Many of the sites potentially available for wind generation are remote, and would require investments in new infrastructure to make certain that power produced could reach the electricity power grid in an efficient manner.

• Ownership:

Many of the ridgelines with the altitude and aspect necessary to generate reliable wind power are on public land, most notably the White Mountain National Forest. Current forest policies do not allow siting of wind farms in the National Forest, and any effort to change this may encounter significant resistance.

• Aesthetics:

New Hampshire is known for its open space and views. While many find wind farms visually attractive, many others do not. Recent opposition from citizen groups to the siting of cell towers suggest that a company wishing to establish a wind farm in New Hampshire would need to work closely with the State, local communitites and other interested parties to address these concerns.

• Habitat concerns:

Many of the areas in New Hampshire most likely to have suitable wind are high-elevation ridge lines. High elevation sites often have the least human impact, are distant from roads and buildings, and have relatively undisturbed ecosystems. These issues would clearly need to be considered prior to establishment of a wind farm.

However, it is important to note that many projects have addressed all of these issues. One example is the wind farm in nearby Searsburg, Vermont, owned by Green Mountain Power and managed by Vermont Environmental Research Associates.[3] The project includes 11 turbines that produce 6 megawatts of power for the New England grid.

In this section we describe a basic simulation that has been performed to characterize the energy, environmental, and economic impacts of wind energy development in New Hampshire. We test the impacts of the construction of three moderate-scale wind farms in New Hampshire at 5-year intervals, so that in 2005, 2010, and 2015, wind farms of 25 MW capacity each are constructed. We model the timing of generation from these wind farms to be random and evenly distributed within days and seasons, with an availability factor of 29.05 percent based upon wind resource feasibility studies completed for Massachusetts.[4] As a result, total annual generation from a 25 MW wind farm is calculated as availability **x** capacity **x** time **=** annual generation, or:

*0.2905(availability)*25(MW)*365(days/yr)*24(hrs/day) = 63,619 MWh/yr or 63.6 GWh/yr*

3 See www.northeastwind.com/Searsburg_Project for more information on the Searsburg wind farm.
4 “Massachusetts Renewable Portfolio Standard, Cost Analysis Report,” Prepared for Massachusetts Division of Energy Resources, December 2000.

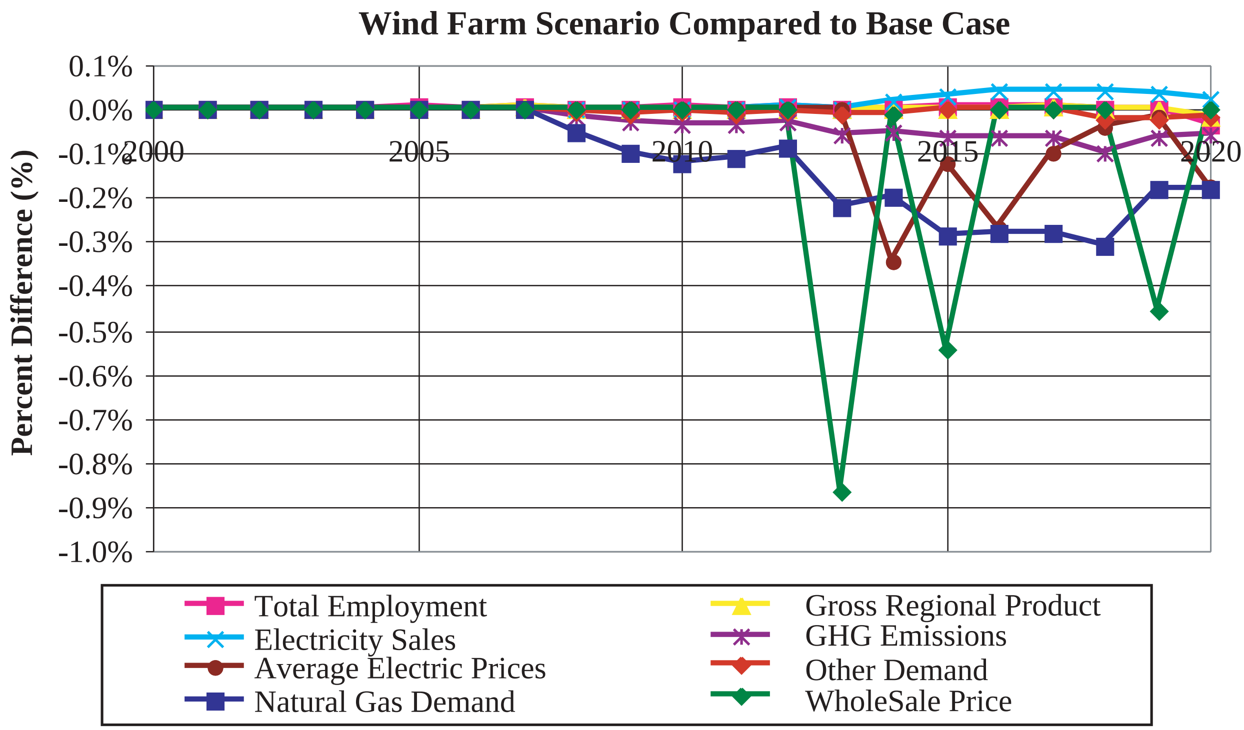

Figure 8.11 Impacts of Wind Farm Relative to Base Case

For purposes of this analysis, we assume that the wind energy units sell all power that they generate, at the average wholesale price for a given year.

The results of the wind farm scenario, relative to the Base Case, are shown in Figure 8.12. Overall, the presence of wind power lowers the wholesale electricity price by an average of 2-3 tenths of a percent between 2012 and 2020. This also has the effect of lowering the retail price of electricity by a lesser amount. The slight retail price reduction leads to a very slight increase in electricity demand in the out-years, as residences and businesses tend to invest less in efficiency at the time of new purchase, and possibly to do a bit of fuel switching to electricity.

Table 8.8 Greenhouse Gas Impacts of Wind Farms

Greenhouse Gas Emissions (Million Tons CO2e/Year)	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	36.37	40.48	46.16	51.63	56.07	**46.94**
Wind Farm	36.37	40.48	46.14	51.60	56.04	**46.93**
Difference	0.00	0.00	-0.02	-0.03	-0.03	**-0.02**
Percent Change	0.00%	0.00%	-0.03%	-0.07%	-0.06%	**-0.03%**
High Price Scenario Comparison						
High Price	36.37	40.48	45.12	48.03	52.73	**45.17**
Wind Farm HP	36.37	40.48	45.10	47.99	52.65	**45.15**
Difference	0.00	0.00	-0.02	-0.04	-0.07	**-0.02**
Percent Change	0.00%	0.00%	-0.04%	-0.09%	-0.14%	**-0.04%**

The hypothetical wind power additions would reduce total annual greenhouse gas emissions in 2020 by 30 thousand tons of CO_2. As a share of the total emissions from the state, this reflects approximately 0.06%. Note that if the high price fuel scenario came to pass, the emissions gains would be considerably higher, because wind would likely displace fossil fuels such as coal which have significant air emissions.

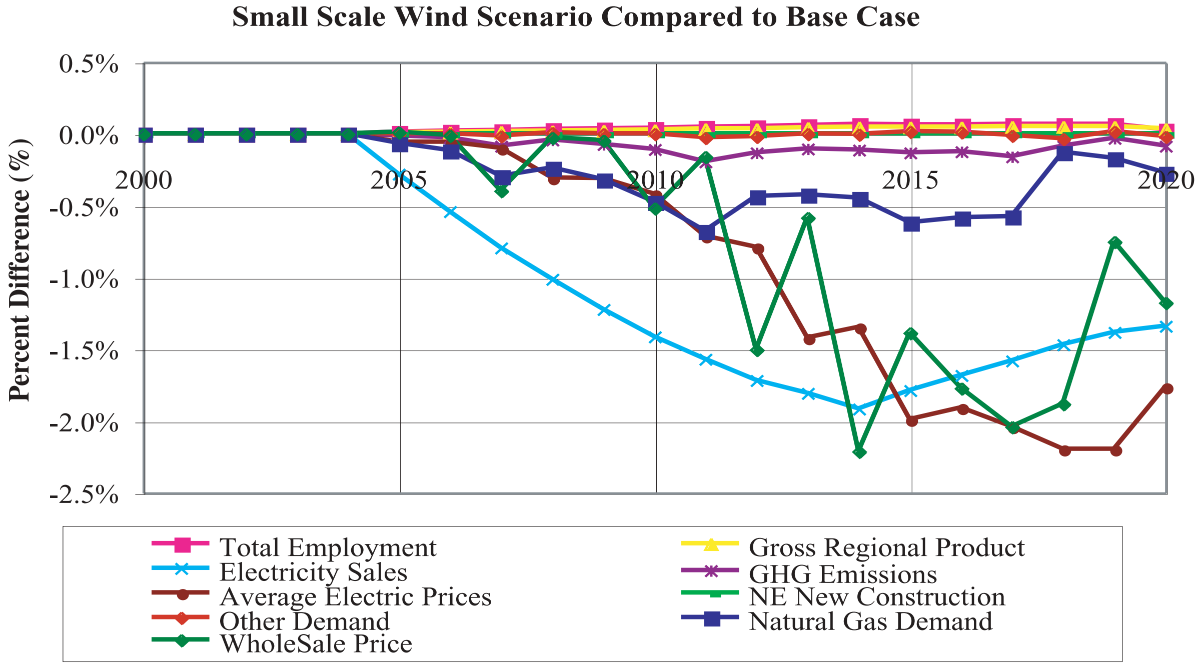

Figure 8.12. Impacts of Wind Farms on Selected Variables, Relative to Base Case

The employment impacts of wind power capacity additions are quite mixed in our modeling results. Construction of the plants generates a modest level of employment (roughly 30 full-time equivalents per year). However, because wind power additions lower the wholesale price of electricity slightly, this has the effect of delaying major plant construction that in the Base Case occurs in 2019; this delay of major new plant construction causes a very slight reduction in employment in 2020 relative to the Base Case.

Table 8.9 Employment Impacts of Wind Farms

Total Employment (Thousands)						
	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	699.797	741.202	777.134	813.023	842.421	**779.501**
Wind Farm	699.797	741.228	777.166	813.058	842.111	**779.501**
Difference	0.000	0.026	0.032	0.035	-0.310	**0.000**
Percent Change	0.00%	0.00%	0.00%	0.00%	-0.04%	**0.00%**
High Price Scenario Comparison						
High Price	699.797	741.202	773.287	806.896	846.290	**776.937**
Wind Farm HP	699.797	741.228	773.319	806.931	845.841	**776.928**
Difference	0.000	0.026	0.032	0.035	-0.449	**-0.008**
Percent Change	0.00%	0.00%	0.00%	0.00%	-0.05%	**0.00%**

While the establishment of wind farms in New Hampshire offers potential economic and environmental benefits for the state, there are a number of issues that will need to be addressed. A starting point is to continue to refine our understanding of what parts of the state – based upon prevailing winds, elevation, aspect, ownership, distance to transmission lines, and other relevant factors included in a recent Northeast Utilities/ECS study – offer the greatest promise for wind power. With this information, the State, wind investors, environmental organizations, landowners and municipalities can engage in constructive dialogue about what sites are most appropriate for potential wind farms. By engaging in this discussion, all parties would have an opportunity to address issues of concern, and potential wind projects could be focused on the most appropriate sites.

8.4 Distributed Generation

Distributed generation refers to the production of electricity by numerous small units located at or near the sources of demand. This stands in contrast to traditional electricity generation systems, where electricity production is centralized at large installations some distance from demand, and the power must be transmitted significant distances through distributions systems such as pipelines and electric transmission wires.

There are a number of benefits associated with distributed generation, including:

• Reduced energy costs for the generator and user of electricity;

• Fewer, or even zero, transmission losses as a result of generation being sited closer to demand;

• Reduced costs associated with upgrades to transmissions and distribution systems otherwise required to handle increased load;

• Protection from major disruptions from weather or other events (ice storms, terrorism, etc.); and

• When the distributed generation uses an indigenous fuel source (e.g. wood-fired boilers at a sawmill), there are benefits to the local economy and environment.

There are concerns about the use of distributed generation, which must be carefully considered. Some forms of distributed generation generate relatively high levels of pollutants, when measured on a per KWh basis. For example, New Hampshire regulates NOx emissions from distributed generation using diesel fuel.

In the ENERGY 2020 system, all energy used for heating is a candidate for cogeneration. The cost of cogeneration is the fixed capital cost of the investment plus the variable fuel costs (net of efficiency gains). This cogeneration cost is estimated for all fuels and technologies and compared to the price of electricity. The marginal market share for each cogeneration technology is based on this comparison. Figure 8.13 shows a simplified overview of the cogeneration structure.[5]

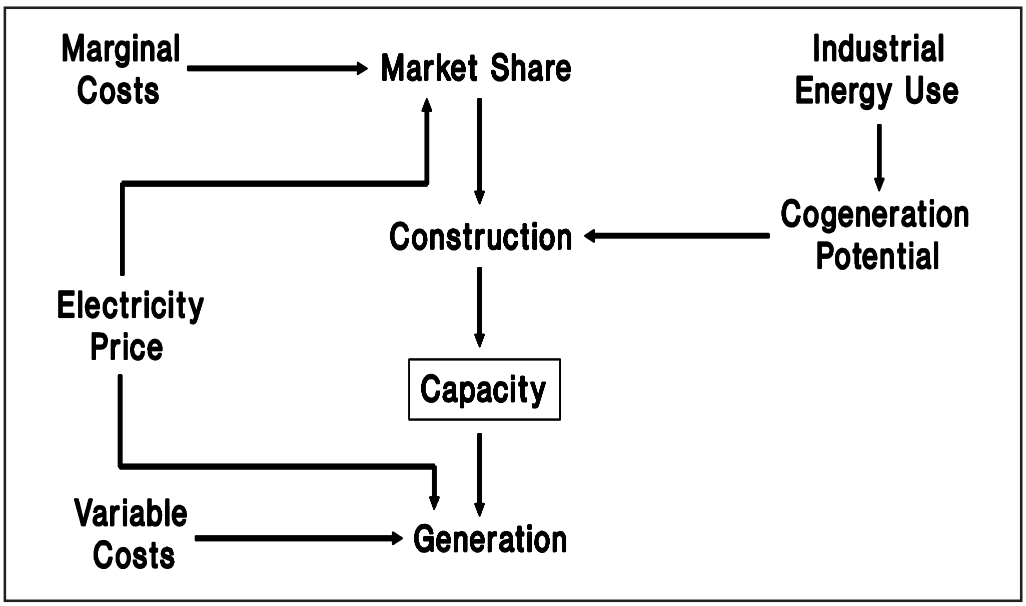

Figure 8.13. Cogeneration Concepts

As discussed above in Chapter 5, distributed energy resources have been identified as in important part of efforts to ensure that our energy infrastructure is secure and not vulnerable to attack.

5 Cogeneration is restricted to consumers who directly produce part of their own electricity requirement. Qualifying Facilities (QFs) under PURPA and LEEPA (such as NH's wood plants), which generate power for resale to the utility, are considered independently by ENERGY2020.

8.5 New Energy Technologies

The biomass, wind and solar policy scenarios were tested in an effort to better understand the role that power produced using renewable resources play in New Hampshire's energy, economic and environmental policy. Of course, there are countless scenarios using alternative energy production that could have been considered, but time and resource constraints forced the review of a representative sample. These policy scenarios are intended to help policymakers, utilities, environmental organizations and others understand the important role that renewable energy sources can have in New Hampshire.

In addition to wood energy, solar energy and wind, there are a number of alternative energy technologies – many of them using renewable resources – that could play a role in New Hampshire's future. The information below is meant to provide a brief introduction to some of these technologies, many of them expected to be commercialized in coming years.

8.5.1 Fuel cells

A fuel cell is an electrochemical system that consumes fuel, often hydrogen, to produce an electrical current. A chemical reaction converts the hydrogen to electric power, with heat and water as byproducts. Since the fuel converts directly to electricity, without combustion, it can operate at greater efficiencies than internal combustion engines. A fuel cell has no moving parts and operates like a battery that does not require recharging (but does require refueling), making it a quiet and reliable power source.

Fuel cells have been used in a variety of settings, including remote applications where self-generation of power is critical and high tech and financial institutions that require reliable, uninterruptible power. Based upon this experience, it is expected that fuel cells will become more and more widespread, with eventual use in vehicles and homes. A number of for-profit companies are actively involved in developing fuel cells for general use.

Fuel cells hold great promise for New Hampshire because they have significant efficiencies over current power production technologies; the emissions from fuel cells are lower per unit of power; fuel cells can be designed to run on renewable fuels – thus reducing our dependence on foreign oil; and they can be used for distributed generation.

8.5.2 Geothermal Energy

The earth contains a great deal of heat, mainly from processes deep under the earth's surface. This heat eventually finds its way to the surface. The temperature of near-surface heat sources determines the ways in which the heat may be used. The use of geothermal (also referred to as "ground source") heat pumps for space heating and cooling is practical throughout New Hampshire. In these systems, energy – typically electricity – is used to move heat out of the Earth into living space during cold weather and from living space into the Earth in warm weather. The technology is the same as that used in refrigerators and air conditioners, though ground source heat pumps are designed to move heat in either direction, depending on the heating or cooling requirements in the living space.

Geothermal heat pumps offer a number of benefits for New Hampshire. First and foremost, they offer a renewable, free, carbon-neutral source for heat and cooling. From a building management point of view, they help reduce space needs by combining heating and cooling systems, have no visual impact upon architecture, and are located indoors – away from the elements and vandalism. As New Hampshire gains experience with this type of heating and cooling system, it is expected that the infrastructure of installers necessary to allow widespread use will develop.

8.5.3 Bio-fuels

In addition to using wood and municipal solid waste to produce electricity, there are a number of other ways that plant material can be used to generate energy. These include growing energy crops for either electricity production or fuel production, the use of landfill or sewer gas to produce power, and the use of plant material to manufacture bio-oil.

Energy Crops

Energy crops are plants grown specifically for use in energy production. These are differentiated from forest-derived wood or agricultural residue in that they are specifically grown for use in energy production. In New Hampshire, abandoned land eventually reverts to forest in most cases, and trees, as a fuel "crop," are largely maintenance free. In contrast, non-forest croplands require inputs of energy and materials to prevent reversion to forest, eliminate unwanted "weed" species and to feed and irrigate the desired plant species. Energy crops include hybrid willow and poplar, switch grass, and hemp.

Energy crops are to varying degrees amenable to pyrolysis (see bio-oil discussion below), gasification, co-firing with fossil fuels or to being burned alone for energy. However, the costs of harvesting and transporting energy crops from New Hampshire's relatively small and widely dispersed fields, coupled with a short growing season, may be a significant commercial barrier to widespread use of energy crops.

At present, it does not appear the energy crops have a strong place in New Hampshire's future. However, use of such crops could provide some benefits to the state and its citizens, including:

- Preservation of "traditional" visual landscapes that include non-forested farmlands;
- Preservation of habitat for grassland animal species that are currently in decline;
- Maintenance and enhancement of overall biodiversity; and
- Economic support for the state's agricultural community.

Because of these benefits, policy makers should continually monitor the evolving potential for energy crops to play a role in New Hampshire's energy diversity.

Hemp as an Energy Crop

At a number of public hearings and work sessions on the development of the energy plan, individuals and organizations advocated growing and processing hemp as a renewable energy source in New Hampshire. The New England Hemp Foundation presented a significant volume of information to the Governor's Office of Energy and Community Services on hemp. This information primarily concentrated on the potential to use hemp as a feedstock in pyrolisis, for the production of "bio-oil." The potential to produce bio-oil using other biomass feedstocks is currently being researched in New Hampshire. Federal law currently prohibits the growing of hemp.

Bio-Oil

Bio-oil is the product of fast pyrolysis, where biomass material is rapidly heated in a controlled setting. This process produces a liquid (often referred to as "bio-oil"), char, and gasses. Proponents of bio-oil suggest that this technology has a number of advantages over traditional combustion of biomass for electricity, including the ability to store and transport bio-oil and the ability to produce "green" chemicals. According to the USDOE National Renewable Energy Laboratory, bio-oil is in a "relatively early stage of development," with a number of issues to be addressed prior to widespread acceptance and use.

The Governor's Office of Energy and Community Services has begun an 18-month feasibility study to determine the potential for the production and use of bio-oil in New Hampshire. This study, conducted in partnership with numerous economic development, forestry and academic institutions throughout New Hampshire, will evaluate the environmental, economic and energy feasibility of manufacturing bio-oil in New Hampshire. This study is expected to look at "waste" wood from forestry and sawmill operations as the primary feedstock for bio-oil. It is hoped that this initial analysis will identify ways to bring increased production of bio-based fuels to New Hampshire.

Farm Waste (Manure Digestion Gas)

Farm waste refers to crop residues and animal manures. In New Hampshire, crop residues such as corn are not available for energy use without competing with existing uses. Animal wastes, which emit gasses that can be burned to generate electricity, present a variety of problems, including:

- odor nuisance;
- organic and bacterial pollution of streams by runoff;
- nutrient loading of soils and waters;
- costly measures to meet increasing stringency of waste management requirements.

At the same time, animal wastes are a potential source of energy and should continually be considered as a possible fuel source. In addition to the challenges above, the dispersed nature of New Hampshire agriculture presents challenges, in that there are likely few farms with enough farm waste to make energy production an economically attractive use of waste. This gas can be and is being burned in other states to generate electricity.

Landfill Gas

This gas is produced by the action of microbes on organic matter in the oxygen-free environments of capped landfills. There are currently three sites in New Hampshire where landfill gas is being burned to generate electricity – taking advantage of a free fuel source. Gas is present in landfills and not utilizing it only adds more methane, a potent greenhouse gas, to the atmosphere as the gas leaks out of the landfill. As landfill gas utilization technology develops, it may become economically feasible for smaller landfills to beneficially manage their landfill gas.

Sewer Gas

As with landfill gas and manure digestion gas (farm waste), this gas is produced by the action of microbes in oxygen-free portions of sewage treatment facilities. It has the same advantages and disadvantages as landfill gas, but there is an additional advantage: it can provide at least some of the heat and/or power required to operate the sewage treatment facility. As this is a developing technology, it may not yet be commercially practical to use sewer gas for electricity production at facilities that serve less than 50,000.

8.5.4 Small-scale Wind Power

In addition to utility scale "wind farms" as discussed earlier, another application for wind power in New Hampshire is small-scale distributed wind generation. In contrast to the large turbines of today's most economical wind farm technology — which can range 1 MW or more per turbine — small-scale wind turbines are much smaller, with a capacity of 10-50 kW andblade diameters of 20-30 feet. Individual residential and small commercial customers with 1 acre or more of land and a minimum wind resource of Class 2 (which includes the entire state) will in many cases find small-scale wind to be economically viable.

As with large-scale wind power, the current pace of technological change is rapid, and is bringing wind energy costs down considerably. The market for small-scale wind turbines (defined as units up to 100 kW capacity and up to 60-foot rotor diameter) has recently been growing at the rate of 40% per year.

The use of small-scale wind power is one way that an individual family or business can make direct use of clean, renewable energy. By taking advantage of the state's net metering law, which allows unused power from small power generators to be sold into the electricity grid, owners of small-scale wind generators may be able to help offset the capital cost of a wind turbine with energy cost savings. In addition to the benefits a family or business may enjoy from generating their own electricity, the use of small scale wind is emission free and adds diversity to the state's energy system.

8.5.5 Residential Solar Hot Water Heating

Solar hot water heating is a cost effective technology that has been commercially available for decades. With a solar hot water system, sunlight heats a working fluid (propylene glycol, a common form of anti-freeze) within a set of panels that are usually installed on a roof. The fluid is then circulated to pre-heat water entering the domestic hot water system, and this pre-heated water is held in an insulated tank, ready to be called upon as input to the standard (e.g., electricity or fuel-fired) hot water system. By pre-heating this input water, the requirements for electricity or fuel input are significantly reduced.

As with small-scale wind power, solar hot water is an excellent opportunity for individuals to use clean, renewable energy in their daily lives. In the Northeast, domestic hot water heating is typically the second-highest energy cost in a household. Using solar energy to pre-heat water can reduce energy associated with heating water by up to 65 percent. Using a solar hot water heater can significantly reduce an individual's footprint on the environment. According to the U.S. Environmental Protection Agency, using one 120 gallon solar hot water heater in New Hampshire helps avoid 21 pounds of NOx, 61 pounds of SO_2, and 10,966 pounds of CO_2 emissions annually. For carbon emissions alone, the EPA estimates that the avoided emissions are equivalent to driving an average car almost 14,000 miles. As a result, the installation of these small systems can have great environmental and energy benefits to the state.

8.6 Bringing New Fuels and Technogies to New Hampshire

Renewable energy and emerging energy technologies hold significant promise for New Hampshire economy, environment, and energy infrastructure. The technologies discussed above, as well as manyothers, should be continually monitored to facilitate their use in the state. New Hampshire has long used renewable energy and innovative technology to help secure the state's energy diversity, and should continue to do so. Working with others in government and the private sector, the Governor's Office of Energy & Community Services has worked to bring innovative technologies to New Hampshire through demonstration projects, feasibility studies, and technical assistance. In addition, as we move into a fully restructured electricity market, ECS should continue to work toward policies that allow renewable energy and emerging technologies access to the electricity market in a way that adds to our current energy mix, while providing economic and environmental benefits to the citizens of New Hampshire.

8.7 A Renewable Portfolio Standard for New Hampshire

A Renewable Portfolio Standard, or RPS, is a regulatory requirement that any supplier of electricity must derive a portion of that electricity from renewable resources. What qualifies as renewable is typically set through legislation or administrative rules, and may change as the standard is phased in to encourage development of new technologies. A renewable portfolio standard assures that all consumers

Table 8.10 Status of States Relative to Renewable Energy Portfolio

State	Qualifying Generation	% Required	Notes
Maine	Solar, Wind, Biomass, Hydro, Waste, "efficient resources" (including some coal)	30%	Prior to enactment of the RPS, roughly 45% of Maine's generation came from renewables
Massachusetts	New generation, including solar, wind, biomass, fuel cells, wave and tidal	1% in 2003, increasing to 4% in 2009	Companies unable to secure sufficient renewable power contribute to the state's Renewable Trust Fund, which helps finance new renewable projects
Connecticut	Solar, landfill gas, wind, hydro, fuel cells, biomass, waste	6% in 2000, increasing to 13% in 2009	Has two classes of renewable in order to encourage new, low emission generation
Arizona	Solar, wind, biomass, hydro, geothermal, waste	0.2% in 2001, increasing to 1.1% in 2007	Requires 50-60% of generation come from solar
Nevada	Solar, wind, biomass, geothermal	5% in 2003, increasing to 15% in 2013	Requires 5% of generation to come from solar
California	Solar, Landfill Gas, Wind, Biomass, Hydro, Waste	1% in 2002, increasing to 20% by 2017	
Iowa	Solar, wind, biomass, hydro, waste	105 MW for two utilities	
Texas	Solar, landfill gas, wind, biomass, hydro, geothermal, wave, tidal	400 MW in 2002, increasing to 2,000 MW in 2009	
Wisconsin	Solar, wind, biomass, hydro, geothermal, fuel cells	0.5% in 2001, increasing to 2.2% in 2010	
Pennsylvania	Solar, wind, biomass, low-head hydro, geothermal, wave, tidal	2.0% in 2000, increasing 0.5% annually	Required to participate in competitive default service
New Jersey	Solar, landfill gas, wind, biomass, hydro, geothermal, fuel cells, waste, wave, tidal	2.5% in 2000, increasing annually	Has two classes of renewables, with different percentage requirements

of electricity contribute to the environmental and economic benefits provided by renewable energy generation, while providing a system that delivers renewable energy to consumers in a cost-efficient manner.

The establishment of an RPS guarantees some market for the generation of renewable power, and spreads the burden of "above-market" costs associated with renewable power to all ratepayers, based upon their energy consumption. By allowing different renewable generators and technologies to compete against one another, consumers have access to least-cost renewable power, encouraging renewable power generators to be as efficient as possible.

At least eleven states, including three in New England, have established a Renewable Portfolio Standard. States have taken a variety of approaches to how renewable power is defined and how much renewable power is required to meet the portfolio standard; see table 8.10 for details.

The establishment of a Renewable Portfolio Standard was considered in New Hampshire in 2001, when House Bill 718 was heard. The legislature eventually opted instead to enact a voluntary "green transition service" option that can be offered by New Hampshire's deregulated electric distribution utilities.

Since the RPS was rejected in New Hampshire, the regional Generation Information System (known as "GIS"), a system that allows tracking of attributes of electricity generation, has been completed and is now being used. The GIS tracks emissions, fuel source, and eligibility for the RPS requirements in states in our region that have an RPS in place. The PUC is drafting Environmental Disclosure Rules, which will provide information to customers on the sources of the power that we use in our homes and businesses. Several of our electric utilities are considering taking advantage of the "green transition service" option, which would utilize the GIS system and allow customers to choose a portion of their electric bill that will go to clean, renewable sources of power. While these steps are important, they are not enough to allow New Hampshire to fully realize the many important benefits of renewable energy sources.

It is now appropriate for the Legislature to reconsider the RPS, and to create a standard that meets our state's renewable energy goals: to help support existing indigenous renewable generation such as wood and hydro; to encourage investments in new renewable power generation in the state; and allow us to benefit from the diversity, reliability and economic benefits of clean power. Creating mechanisms to support renewable power also increases our energy security and reduces our dependence on foreign oil.

By enacting an RPS now, New Hampshire can reap the benefits of renewable power, as other states in the region have already done. Before this is accomplished, however, a number of issues must be considered that will impact the implementation and success of such a program. These issues include:

- What is the appropriate definition of renewable power for purposes of an RPS, and how can this impact existing renewable generators and construction of new generation?
- What percentage of renewable power will each provider be required to purchase, and will this increase over time?
- What legal issues exist regarding electrical generation outside of New Hampshire participating in the state's RPS?
- What are the anticipated impacts on the retail price of electricity?

While these issues need to be addressed, we can learn from the experiences of other New England states like Massachusetts and Maine that already have an RPS in place. For example, the newly developed Generation Information System (GIS) used by ISO New England would help overcome some administrative obstacles, including tracking of energy sources, which have served as challenges in other areas that use an RPS.

In a restructured electricity market, an RPS is the most efficient way to assure that existing renewable generation has the ability to compete, and that new renewable generation can be built. Allowing renewable generators the opportunity to compete against one another, with a guaranteed market for some fixed level of renewable generation, protects ratepayers while promoting environmental stewardship and energy security.

9. Energy Efficiency and Conservation

Energy efficiency has been widely recognized as the most cost effective way to increase the reliability, safety, and security of our energy infrastructure. Lowering demand is the cheapest way to avoid congestion problems, maintain stable prices, and minimize the environmental impacts of our energy use. It has been estimated that "as much as 40-50% of the nation's anticipated load growth over the next two decades could be displaced through energy efficiency, pricing reforms, and load management programs."[1] As a result, states around the country are investing in policies and programs to realize the energy, economic, and environmental benefits of energy efficiency.[2]

9.1 Role of Energy Efficiency in New Hampshire

New Hampshire, like most other states that have restructured its electric industry, has recognized the value of energy efficiency and the role that it should play in a restructured marketplace. In RSA 374-F, the electric restructuring statute, the Legislature highlighted the important role that energy efficiency programs can play in a competitive electric market:

> Restructuring should be designed to reduce market barriers to investments in energy efficiency and provide incentives for appropriate demand-side management and not reduce cost-effective customer conservation. Utility sponsored energy efficiency programs should target cost-effective opportunities that may otherwise be lost to market barriers.
>
> RSA 374-F, Electric Industry Restructuring Act

In response to the passage of RSA 374-F, the Public Utilities Commission issued a Restructuring Plan for the state on February 28, 1997.[3] In the Plan, the Commission planned to phase out existing energy efficiency programs offered by electric utilities and funded by ratepayers two years after the implementation of retail choice. In response to motions for rehearing, reconsideration and clarification, the

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[1]Richard Cowart, Regulatory Assistance Project, "Efficient Reliability: The Critical Role of Demand-Side Resources in Power Systems and Markets," prepared for the National Association of Regulatory Utility Commissioners, June 2001, p. 24.
[2] See www.aceee.org/briefs/mktabl for a listing of state efficiency programs.
[3] All Orders, Plans and Reports referenced in this section are available on the PUC website at www.puc.state.nh.us.

Commission issued Order No. 22,875 on March 20, 1998, which affirmed in part and vacated in part its position with respect to utility sponsored efficiency programs. In the Order, the Commission recognized that efficiency programs may be appropriate beyond two years after restructuring to be concurrent with transition service, stating:

> the transition to market based programs may take longer than the two year period we mandated in the Plan, though we continue to believe that such a transition period is an appropriate policy objective. We also recognized that there may be a place for utility sponsored energy efficiency programs beyond the transition period, but these programs should be limited to 'cost-effective opportunities that may otherwise be lost due to market barriers.' We believe that efforts during the transition toward market-based DSM programs should focus on creating an environment for energy efficiency programs and services that will survive without subsidies in the future.
>
> Order No. 22,875

The Commission's Order directed interested parties to form a working group to explore several issues regarding ratepayer-funded efficiency programs, including:

- Standards for evaluating programs;
- How best to measure cost-effectiveness of programs;
- What market barriers exist;
- Market transformation initiatives;
- Appropriate funding levels for low-income efficiency programs;
- Cost recovery mechanisms for the programs;
- Impacts on rates; and
- The contribution to these programs by large commercial and industrial customer who may no longer receive transition service.

The Energy Efficiency Working Group (EEWG) included representatives of electric and gas utilities, state agencies, environmental groups, consumers, and energy service providers. It held its first meeting in May of 1998, and continued to meet for the next year in facilitated meetings. In July of 1999, the EEWG filed its final report with the Commission,[4] and a hearing on the Report was held in September of that year. The Report, which represented the consensus of the diverse stakeholders, contained recommendations on the following issues:

[4] Report to the New Hampshire Public Utilities Commission on Ratepayer-Funded Energy Efficiency Issues in New Hampshire, July 6, 1999, http://www.puc.state.nh.us/eewkgrp/eewgpg.htm.

- Cost-effectiveness test with an environmental "adder;"
- Recommendation for an energy efficiency committee to develop statewide programs;
- Funding of efficiency programs;
- Adoption of a shareholder incentive rather than lost fixed cost recovery;
- Frameworks for assessing the eligibility of technologies or programs for funding;
- Program design; and
- Low income efficiency programs.

On November 1, 2000, the Commission issued an Order adopting portions of the recommendations in the Report, and setting forth guidelines for statewide energy efficiency programs to be designed, implemented, and administered by the state's electric utilities.[5] The Commission rejected a recommendation to create a stakeholder efficiency committee to assist utilities with the programs, and instead required the utilities to work together to create a set of "core" statewide programs available to all customers.

On October 31, 2000, the Commission issued a companion Order setting forth the allocation of the System Benefits Charge that funds both the energy efficiency and the low income bill assistance programs that are administered by the state's electric distribution companies.

9.2 Current Energy Efficiency Programs in New Hampshire

Electric Energy Efficiency Programs

As a result of the process described above, since June 1, 2002 New Hampshire electric utility customers can take advantage of new statewide energy efficiency products and services. These "core" energy efficiency programs were established consistent with Public Utilities Commission (PUC) Order 23,574, Order 23,850, and Order 23,982 which require the utilities to develop a consistent set of innovative, statewide core programs available to all New Hampshire ratepayers. The core programs will increase the availability of cost-effective energy efficient measures and services, while providing economic and environmental benefits to the State.[6]

The PUC also approved a unique pilot program for two electric utilities called "Pay-As-You-Save™" or "*PAYS*.™"[7] *PAYS*™ is designed to be a market-based system that allows consumers to purchase energy efficiency products for their homes, businesses and institutions. *PAYS*™ is designed to

[5] Order No. 23,574. See Docket DE 01-080 at www.puc.state.nh.us.
[6] More information on the core efficiency programs is available at www.nhsaves.com.
[7] The PAYS concept is a trademark of the Energy Efficiency Institute of Colchester, VT.

operate without the use of subsidies to enable consumers to buy products they would not otherwise purchase. However, the NH pilot program does utilize funds from the system benefits charge to fund the program over the pilot period.

In *PAYS*™, a customer pays for efficient products through payments on their electric bill. The payments are designed to be lower than the estimated savings from the measure, and the costs for the infrastructure, financing, and marketing are included in the price of the product.

PAYS™ is intended to eliminate the market barriers that currently inhibit consumers from purchasing energy saving products. *PAYS*™ requires no up-front payment, capital, or debt from the customer. *PAYS*™ measures "stay with the meter," and as a result there is also no need for customers to know that they will remain in a location for any period of time, or even for the potential purchaser to own the premises in which the *PAYS*™ product will be installed. The NH *PAYS*™ pilot will run through the end of 2003.

Natural Gas Energy Efficiency

Providers of natural gas, working with the Governor's Office of Energy & Community Services and other stakeholders, are finalizing programs to improve energy efficiency for residential, commercial and industrial natural gas users. The New Hampshire Public Utilities Commission is considering a proposal containing recommendations to offer a variety of programs including energy audits, incentive rebates for the installation of energy efficient products and technologies, and training programs.[8] The goal of these programs is to encourage the most efficient use of natural gas, and to help reduce market barriers so that energy efficient products and practices become the industry standard.

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[8] See Docket DG 02-106 at the Public Utilities Commission website, www.puc.state.nh.us.

9.3 Results of Energy Efficiency Policy Simulations

9.3.1 Impacts of Maintaining or Increasing Efficiency Funding

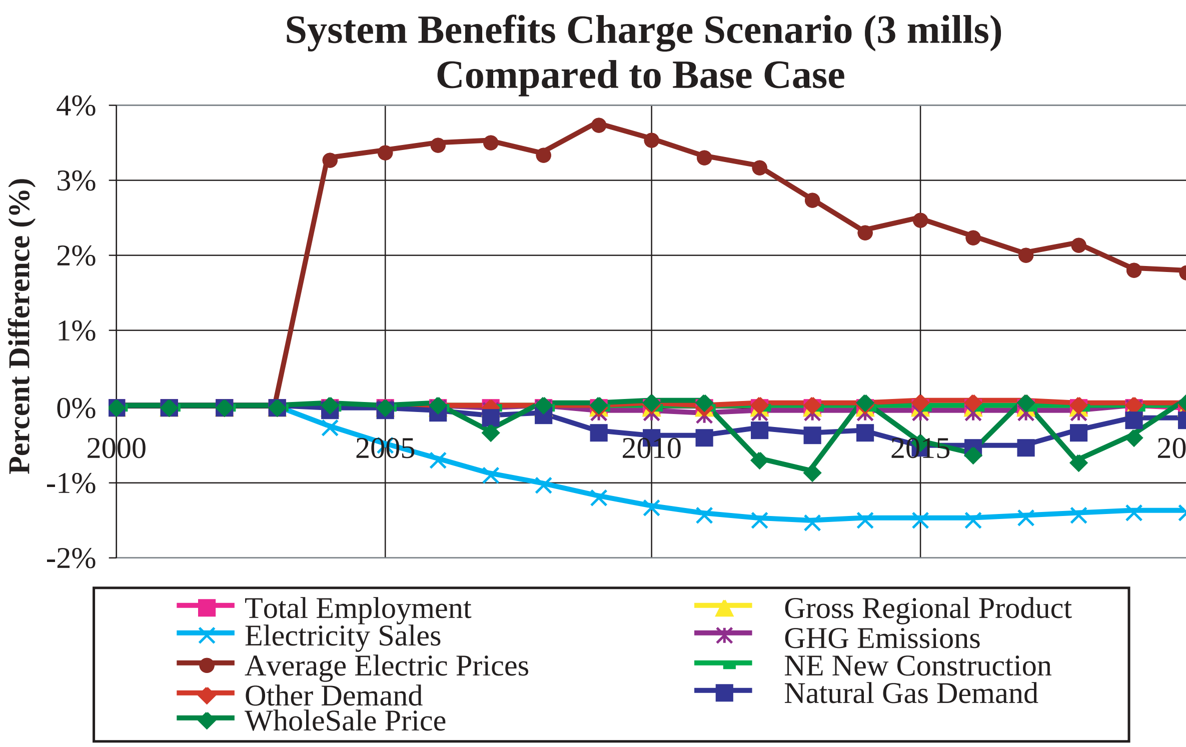

Figure 9.1 Impacts of 3 mill SBC Relative to Base Case

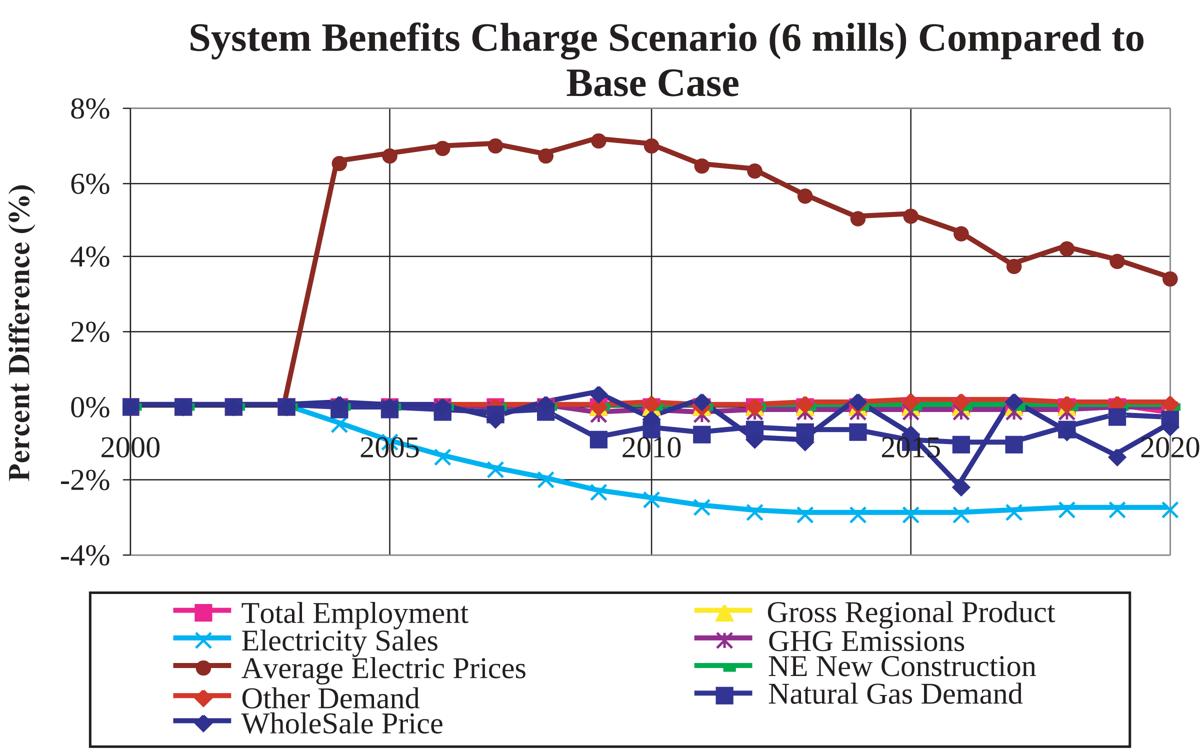

Figure 9.2. Impacts of 6 mill SBC Relative to Base Case

For many reasons, it is useful to study the economic and energy impacts of a modest rise in the cost of electricity, whether from higher fuel prices, transmission and distribution costs, or other price changes. The results of such a simulation provide insight into the impacts of changes in electricity prices in general, and also can inform deliberations of policy makers who consider using a system benefits charge (SBC) or similar mechanism for raising revenues that are then utilized to provide benefits to all ratepayers in the state. The figures below show the impacts of a system benefits charge, but the many important benefits from the investment of those funds from energy efficiency, renewable energy, or other programs are not captured.

The energy and economic systems are highly "nonlinear" – that is, there are feedback loops in the system so that the response to a doubling of investments in energy efficiency may not be double overall efficiency. For example, when electricity costs rise, consumers use less electricity over time by investing in higher efficiency devices, and in some cases even switching to cheaper fuels. As the demand for electricity decreases, this takes higher price generation off line, which in turn reduces the price of electricity.

Another example is when technology (such as high-efficiency light bulbs) makes it more affordable for customers to receive an energy service (such as lighting), they may decide to purchase more of that service. As a third example, when output from a regional economy is increased, this tightens the regional labor market, which raises wages, which in turn reduces the profitability in the region's businesses and partially compensates, over time, for the original increase in output. Because of the possible influence of such non-linearities and feedbacks in the energy and economic systems, in order to characterize the system responses and the magnitude of these responses, we tested the impacts of two levels of SBC: 3 mills and 6 mills (a mill is a surcharge of one-tenth of a cent per kWh).

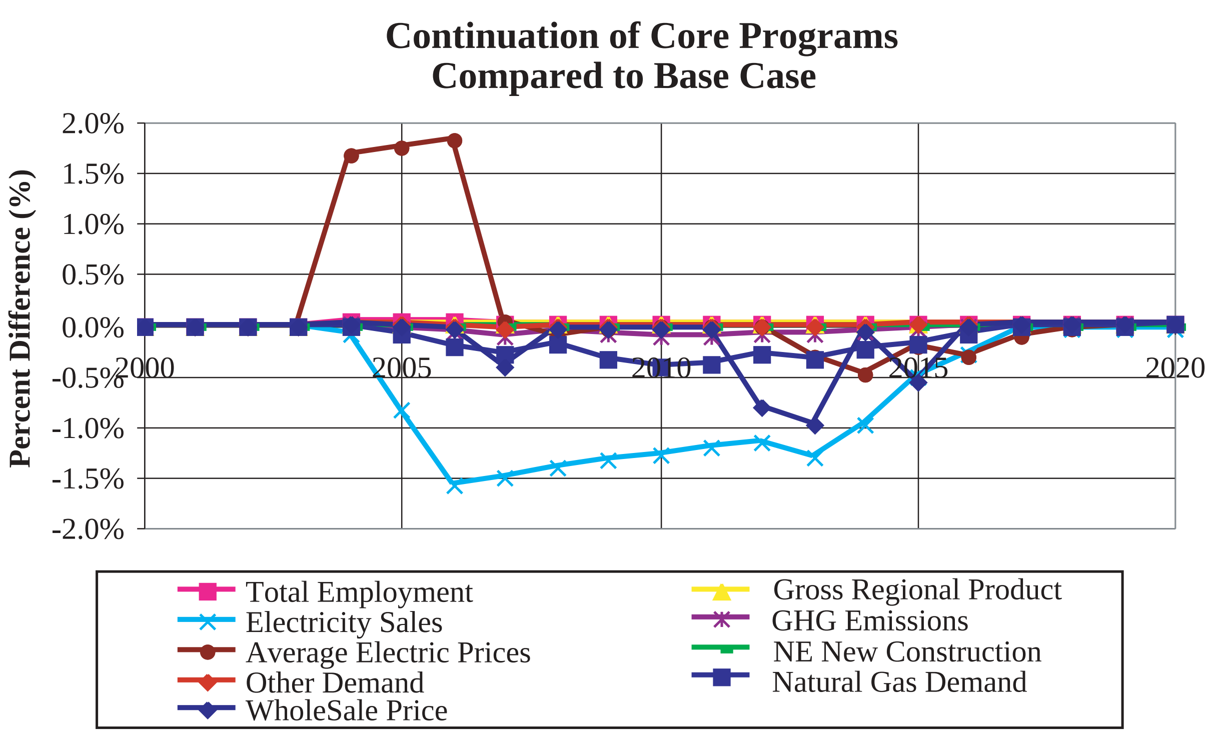

Figure 9.3. Smaller Percentage Impacts of Core Program Extension

The responses for a number of variables relative to the Base Case are shown in Figures 9.1 and 9.2. In these figures we see that electricity sales drop by 1.5% after 10 years for a 3 mill SBC, and by roughly twice that (just under 3%) after 10 years for a 6 mill SBC. The wholesale price paid for electricity is reduced by nearly 1% for some of the years in the 3 mill case, and by 1-2% in some years of the 6 mill case. Natural gas demand is reduced slightly due to the reductions in electricity generation. As the figures indicate, in percentage terms the economic impacts are close to zero, as compared with the impacts on electricity price and electricity.

The economic impacts are also shown in Tables 9.1 and 9.2, where we can also see some evidence of non-linearity in economic response to the SBC levels. For example, the 3 mill SBC would lead to an average loss of approximately 6.5 jobs annually over the 20 year period, whether the base case or high price fuel scenarios hold true. The 6 mill SBC, on the other hand, would lead to an average loss of 15.5 jobs annually over 20 years relative to the base case, or 12.2 jobs annually relative to the high fuel

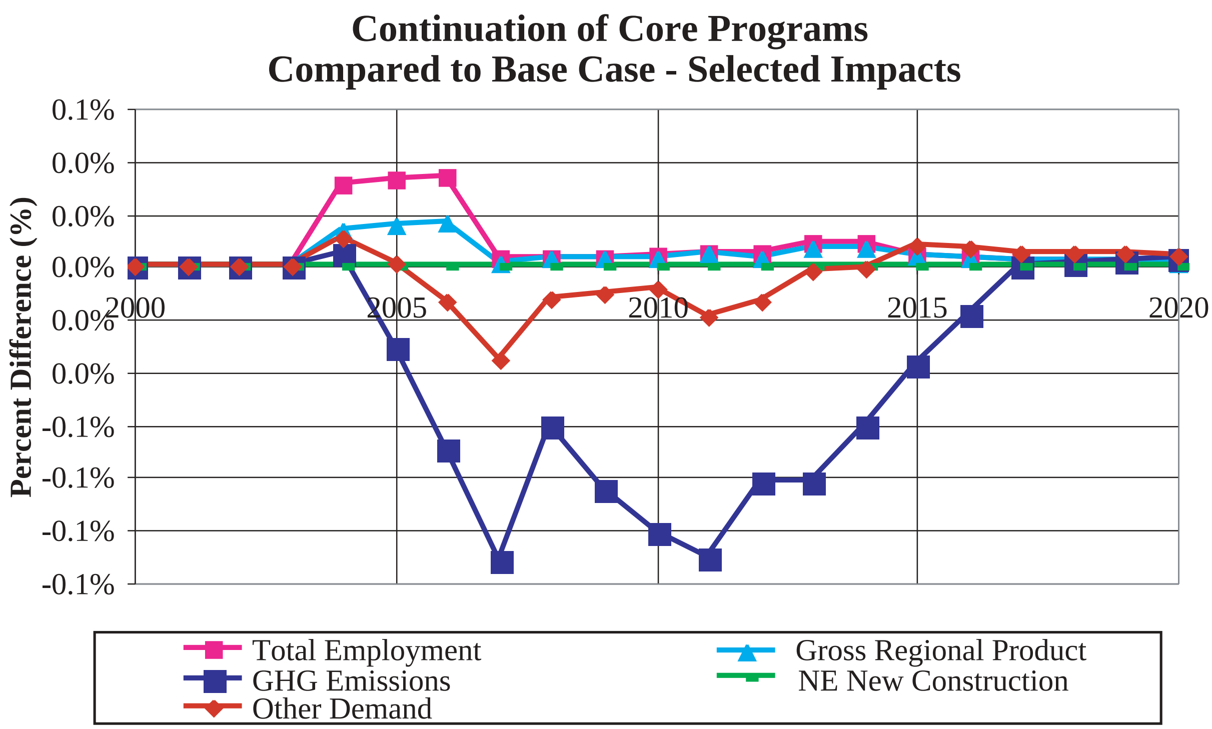

Figure 9.4. Impacts of the Core Program Continuation Relative to Base Case

price scenario. The main difference comes in the 6 mill SBC in the year 2020 for the Base Case fuel price scenario. In this case, the lower wholesale electricity price delays new construction of power plants to beyond the forecast horizon, so that the jobs associated with plant construction are also delayed beyond the forecast horizon. Again, the benefits to the economy of the SBC-funded efficiency programs are significant, and are not captured here.

Table 9.1. Employment Impacts of 3 mill SBC

Total Employment (Thousands)	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	699.797	741.202	777.134	813.023	842.421	**779.501**
EE SBC 6	699.797	740.878	776.845	812.804	840.504	**779.191**
Difference	0.000	-0.324	-0.289	-0.219	-1.917	**-0.310**
Percent Change	0.00%	-0.04%	-0.04%	-0.03%	-0.23%	**-0.04%**
High Price Scenario Comparison						
High Price	699.797	741.202	773.287	806.896	846.290	**776.937**
EE SBC 6 HP	699.797	740.878	773.041	806.709	845.447	**776.692**
Difference	0.000	-0.324	-0.246	-0.187	-0.843	**-0.244**
Percent Change	0.00%	-0.04%	-0.03%	-0.02%	-0.10%	**-0.03%**

Table 9.2. Employment Impacts of 6 mill SBC

Total Employment (Thousands)	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	699.797	741.202	777.134	813.023	842.421	**779.501**
EE SBC 3	699.797	741.043	776.986	812.902	842.005	**779.373**
Difference	0.000	-0.159	-0.148	-0.121	-0.416	**-0.128**
Percent Change	0.00%	-0.02%	-0.02%	-0.01%	-0.05%	**-0.02%**
High Price Scenario Comparison						
High Price	699.797	741.202	773.287	806.896	846.290	**776.937**
EE SBC 3 HP	699.797	741.043	773.164	806.778	845.717	**776.803**
Difference	0.000	-0.159	-0.123	-0.118	-0.573	**-0.134**
Percent Change	0.00%	-0.02%	-0.02%	-0.01%	-0.07%	**-0.02%**

9.3.2 Continuation of Core Energy Efficiency Programs

The current electric energy efficiency "core" programs administered by the electric utilities have been approved by the Public Utilities Commission through December 31, 2003 (a total of 19 months). The total program costs are just over $25 million, and will be used to perform audits, provide technical assistance, and install electric efficiency measures that together are projected to save over 820 GWh of electricity over the lifetimes of the measures. The programs are funded by a system benefits charge (SBC) supported by all ratepayers.

Figure 9.4 makes clear the dynamics of the economic impacts of the Core program extension, which tells an interesting story. From 2004 through 2006 we see the direct and indirect effects of the energy conservation measure installation activity. These effects more than offset reductions in economic activity tied to the 1.6% SBC increase in electricity costs. Then, from 2007 through 2020, the state's economy reaps the benefits of these 3 years of energy efficiency gains in two main ways. First, the state's businesses are more efficient and therefore more profitable and competitive than in the Base Case.

Secondly, the state's residents have higher disposable income due to the residential energy savings, and so they are able to spend more money in the state economy. Note that in every year we see positive economic impacts of the core program extension. It is only as the energy efficiency measures retire after 2015 that the economic advantages of energy efficiency begin to subside back towards parity with the Base Case. Table 9.3 summarizes the employment impacts in absolute terms at five year intervals. This table also shows that the benefits of core program extension are expected in the context of the high fossil fuel price scenario as well as the base fuel price scenario.

Table 9.3 Employment Impacts of Core Program Extension

Total Employment (Thousands)	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	699.797	741.202	777.134	813.023	842.421	**779.501**
Core Cont	699.797	741.445	777.164	813.060	842.439	**779.560**
Difference	0.000	0.243	0.030	0.037	0.018	**0.059**
Percent Change	0.00%	0.03%	0.00%	0.00%	0.00%	**0.01%**
High Price Scenario Comparison						
High Price	699.797	741.202	773.287	806.896	846.290	**776.937**
Core Cont HP	699.797	741.445	773.305	806.929	846.311	**776.990**
Difference	0.000	0.243	0.018	0.033	0.021	**0.053**
Percent Change	0.00%	0.03%	0.00%	0.00%	0.00%	**0.01%**

In this policy simulation we considered the potential effects of extending both the core programs and the SBC that currently funds them. We tested a 3-year extension of the core programs funded by a 3-year SBC at an average rate of 1.543 mils. We assumed a 10-year lifetime for all measures, and distributed the measures across end-uses and sectors in a fashion that matched the sector and end-use breakdown of the original core programs. Measure installation is distributed evenly across the 3 years of the program.

The impacts of the core program extension relative to the Base Case are illustrated in Figure 9.3. This figure shows that the initial three year SBC raises retail electricity prices by approximately 1.6%. However, we also see more than a 1% reduction in electricity demand, which lasts for ten years, after which time the measures begin to retire. As a result, the reduction in electricity demand brings the benefit of reduced electricity prices even after the SBC expires. In addition to the impacts on electricity prices and generation, and on the demand for electricity and for natural gas, the remaining effects (such as employment, gross regional product, and greenhouse gas emissions) of the core program extension are smaller in percentage terms than a tenth of a percent; therefore, we display the response of just these other variables in a separate graph, Figure 9.4.

In conclusion, operating cost-effective energy efficiency programs provides significant lasting benefits to New Hampshire's energy security, reliability, and economy, and environmental improvements for the state's residents and businesses. The economic benefits start immediately, as New Hampshire businesses ramp up to deliver efficiency programs, and last for the lifetimes of the measures. These measures also reduce the risk to residents and businesses posed by the possibility of a fuel price shock.

9.4 The Role of Energy Codes

9.4.1 New Hampshire's Energy Codes

Energy Codes in New Hampshire have existed since 1979, with several updates occurring since then. In February of 1999, the state mandated adoption of the national standard "Model Energy Code – 1995" as New Hampshire's Residential/Small Commercial Energy Code. Similarly, for construction projects that are equal to or greater than 4,000 square feet, the Public Utilities Commission and the NH legislature adopted the national standard "ASHRAE/IES [American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. & the Illuminating Engineering Society of North America] Standard 90.1-1989" in July of 1993.

Legislation passed in March 2002 by the New Hampshire Legislature (House Bill 285) unifies all building codes into one family of codes established by the International Code Council, which developed the "International Energy Conservation Code 2000" (IECC 2000) as its energy component. This new standard will apply to all new construction, with specific chapters outlining requirements for the residential and the commercial / industrial sectors. Under the provisions of HB 285, enforcement of the energy code remains a responsibility of the individual municipalities where building code officials exist and is to be fully implemented by September of 2003, 18 months after enactment. In municipalities without building code officials, residential contractors are required to send their permits to the Public Utilities Commission for approval. For commercial and industrial construction, an architect's signature stating that a building meets the energy code requirements is mandated.

There is some discussion that the Codes Review Board may change the energy code section to reference "ASHRAE 90.1 – 1999" instead of the existing standard. This newer energy code provides more stringent requirements for the building envelope, providing for greater energy efficiency. This simple reference to the updated code will achieve much larger energy savings than the current language, which incorporates the 1989 version of "ASHRAE 90.1." By establishing rules that reference the updated ASHRAE code, New Hampshire will establish compliance with a recent U.S. Department of Energy (DOE) ruling that requires states to adopt "ASHRAE 90.1 – 1999" or a comparable code by 2004. Failure to implement a stricter code would put New Hampshire in jeopardy of losing DOE funding for energy code related projects.

Compliance with Building Codes

In 2000, the Northeast Energy Efficiency Partnerships, Inc. (NEEP), conducted a study for the Governor's Office of Energy & Community Services and the Public Utilities Commission to gauge local building code officials' knowledge of the residential and commercial and industrial energy codes and assess efforts undertaken by code officials to determine compliance. The study revealed that 136 of New Hampshire's 234 towns and cities, or 59%, have local building officials responsible for compliance with the energy code. Of the 91 New Hampshire officials surveyed, 39% identified themselves as "part-time officials." Part-time officials generally believe they are less knowledgeable than their full-time counterparts. They said they find fewer and less severe barriers to compliance, have held their positions a shorter amount of time, are less likely to consult state officials for assistance, and are significantly less likely to attend additional trainings than full-time code officials. When asked to indicate "substantial barriers" in residential code compliance, a number of officials identified two major barriers: the complexity of residential codes and a lack of resources for compliance; and the increased workload for towns to ensure compliance.

Energy codes produce few benefits if they are not being enforced in the field. Except in 25 larger communities clustered in the more urban, southern part of the state, local code officers – if they exist at all – tend to be part-time officials who have significant demands placed on their time and resources to regulate construction for the basic elements of health and fire safety, let alone energy efficiency. Local code officials often must balance their time inspecting construction with other town responsibilities. These officials, even in the state's larger communities, have sometimes viewed energy codes as too complex and time consuming to enforce, particularly given the demands on their time to simply keep up with "core" health and safety compliance. As a result, energy code compliance in New Hampshire tends to be a lower priority in some municipalities.

9.5 Energy Efficiency Recommendations

The energy efficiency programs funded by the Systems Benefit Charge (SBC) provide significant and ongoing energy, economic, and environmental benefits to the state. Investments in energy efficiency help reduce overall generation and associated emissions, reduce the state's reliance on imported fuel, reduce long-term electricity prices, and buffer the state from the effects of a fuel "price shock." The SBC is necessary to fund energy efficiency programs, and it fairly allocates expenses to ratepayers based upon energy use.

However, in order to assure cost-effective use of money generated through the SBC, the state, utilities, consumers and other stakeholders should regularly evaluate the programs funded to ensure that they provide the necessary services to customers, as required by RSA 374-F:4, VIII. While there may be ways to more efficiently deliver energy efficiency programs through a change in programmatic offerings or program administrators, continuation of the SBC to fund energy efficiency is a wise investment, and should be continued in the future.

Building Codes Recommendations

As the State Building Codes Review Board moves forward, serious consideration should be given to adopting ASHRAE 90.1 – 1999 as the referenced energy code for commercial and industrial buildings. This change would improve energy efficiency in new commercial and industrial construction, bring New Hampshire into compliance with pending changes to federal Department of Energy rules, and improve code enforcement due to clearer language in the new standard.

The State should also continue to pursue ways to help municipalities understand, value and enforce energy codes as part of building codes. Great strides are being made through training offered by the Governor's Office of Energy & Community Services and the Public Utilities Commission statewide, which provide code officials an opportunity to learn about and discuss the energy code.

10. The State as Energy User

10.1 The State's Energy Needs

The government agencies of the State of New Hampshire are the largest energy user in the state. The State, through its three branches of government, occupies roughly 1,250 structures, ranging from small transportation sheds to large office buildings. These structures total almost 9.2 million square feet.

These State facilities and the thousands of employees who work in them consume significant amounts of energy. In fiscal year 2000, the State of New Hampshire spent the following on energy:

Table 10.1 Energy Type & Expense

Energy Type	Expense
Diesel (generators)	$ 81,228
Electricity	$11,427,402
Fuel Oil	$ 2,438,059
Natural Gas	$ 722,248
Propane	$ 347,876
Steam	$ 1,530,338
Total	**$16,547,151**

While the State spent over $16.5 million on energy for buildings, including over $11 million on electricity, there is insufficient information available on the specifics of how the State uses this energy. Many State agencies do not specifically track energy use, and agencies that do track use are not reporting it in a manner that would allow for systematic analysis. Because of this, the State does not know some basic facts about its energy consumption. For example, the State knows how much money was spent on electricity for FY 2000, but does not know how many kilowatt-hours this use represents. Similar problems with insufficient baseline information exist for other types of energy use. Development of a system of standardized and consistent energy use tracking is critical to future State efforts to manage its energy use.

10.2 Energy Use at State Facilities

Efficient use of energy at State facilities, both today and in the future, is an energy priority of state government. There are a variety of ways this goal is being achieved, primarily through institution of a State Energy Manager and the Building Energy Conservation Initiative, detailed below.

10.2.1 State Energy Manager

In recognition of the need for state government to manage its energy use, the position of State Energy Manager was created in 2001. The State modeled this position on the private sector, as most large corporate organizations have one individual that oversees energy use throughout a company.

The primary responsibility of the State Energy Manager is to serve as a "change agent" within state government, changing how the State plans for, purchases, and consumes energy. The State Energy Manager works with all State agencies to develop policies and procedures that increase the efficiency, reduce the cost, and account for environmental impacts of State energy use, including:

- Working with the Department of Administrative Services, the Department of Environmental Services, and Department of Transportation to ensure that all State buildings incorporate energy efficiency, and that "life cycle costing" is implemented to reduce long-term ownership costs;
- Developing operating and maintenance guidelines that ensure that State facilities will be operated and maintained in an energy efficient manner;
- Following the development of emerging energy technologies that can reduce energy costs at State facilities, and keeping others in state government aware of opportunities to use these emerging technologies;
- As utility restructuring proceeds, aiding in the development of contracts that assure reliable energy supplies while keeping costs low; and
- Serving as the "focal point" for an ongoing energy awareness program for all State agencies and their personnel, including outreach and workshops targeted at agency personnel that are responsible for the operation and maintenance of State facilities.

As a large energy user, the State has the opportunity to achieve significant savings in energy costs. Based on experience in the private sector, a mature and well-managed energy program can generate savings of between 5% and 10%. With energy bills totaling $16.5 million for fiscal year 2000, the State could realize savings of $825,000 to $1.6 million annually if we implement new policies, procedures and methodologies to manage our energy use.

The State Energy Manager has already enjoyed some significant successes in helping the State manage its energy needs, with more anticipated in the near future. The State is now in the process of fundamental changes in the way new buildings are designed, including accounting for all costs and savings over the lifetime of a building instead of designing for lowest initial cost only. Once fully implemented this will help reduce State energy costs for decades to come. Personal computers, which are used at all levels of state government, will soon be managed by a power management system, ensuring that computers conserve power when not in active use. As the State Energy Manager becomes more known and accepted in state government, this position will continue to identify and propose policies that will responsibly manage the State's energy consumption.

10.2.2 Building Energy Conservation Initiative (BECI)

The Building Energy Conservation Initiative (BECI) is a program designed to cut energy and water costs in more than 500 State buildings, resulting in savings of up to $4 million annually through building upgrades and retrofits. Established in 1997 by Governor Shaheen and authorized by NH RSA 21:I-19, BECI analyzes existing State buildings for energy and resource conservation opportunities. BECI utilizes a "paid from savings" procedure known as "performance contracting" that allows current energy efficiency upgrades to be financed with future utility savings. This allows State agencies to perform energy retrofits and building upgrades that would otherwise not be funded through the capital appropriations process, using energy savings to pay back the cost.

BECI is designed specifically for energy improvement, including but not limited to lighting upgrades, heating / ventilation / air conditioning (HVAC) upgrades, hot water systems, energy management controls, water conservation measures and building envelope improvements. Under this program, a private Energy Service Company (ESCO) is selected through a competitive process to design and implement energy saving improvements to selected State buildings. Energy savings are guaranteed by the ESCO, and costs are repaid over time with money the State otherwise would have paid in utility and other energy costs.

BECI requires that energy savings pay for a project within ten years. To date, two projects encompassing five buildings have already resulted in over $250,000 in annual energy savings to the State. BECI has been recognized by the U.S Environmental Protection Agency as a model for other states.

10.2.3 Energy Information System

Twenty-six separate units of State government, including agencies, bureaus, commissions and boards, are individually responsible for managing their own energy use. Facility operating expense invoices are received by each of the managing agencies at multiple processing offices around the state. Utility companies generally do not distinguish State facilities from other customers because account numbers are designed to facilitate response to outages or interruptions in service, not aggregate usage information. The State's ability to assemble utility account numbers is also limited by the shear volume of the accounts. Without an understanding of the numbers, types, ages, locations or operating characteristics of State buildings, our ability to plan for energy efficiency improvements is hampered.

As the electric and natural gas markets continue to restructure, opportunities for large energy users like the State to acquire energy supply cost savings will increase. Our ability to take advantage of these opportunities requires the development of new managerial skill sets and a consolidation of energy information. Understanding our needs, usage levels and timing is essential to managing a reasonably stable energy consumption profile within a competitive market.

The State is in the process of developing an "Energy Information System" (EIS) that will help address some of these upcoming opportunities. An EIS is a systematic approach to energy accounting, where data collected is used to manage energy consumption and associated costs at State facilities. In essence, an EIS is a database that will place all State energy consumption in one centralized database. Developing and implementing an EIS will allow the State to budget for energy consumption more accurately, identify any problems with energy use in State buildings, take advantage of market opportunities to lower energy costs, prioritize energy-efficiency investments, and evaluate energy use over time.

10.3 Energy Use in Transportation

As noted in Chapter 3, energy use in transportation is a significant portion of New Hampshire's energy consumption. While the New Hampshire Energy Plan does not focus on energy use in transportation, the opportunities to find efficiencies or pollution reductions in this sector cannot be ignored. Because state government relies heavily upon transportation to conduct its business, there are opportunities to evaluate and improve upon the State's use of energy in transportation.

10.3.1 Transportation in Energy Planning

The New Hampshire Department of Transportation (NHDOT) has the statutory responsibility to plan for the State's transportation needs (NHRSA 228:99). This planning deals primarily with the infrastructure necessary to support improvements to New Hampshire's intermodal transportation system. In

December of 2001, NHDOT completed a ten-year transportation plan, covering the years 2003 through 2012. The New Hampshire Legislature approved this transportation plan during the 2002 Session (HB2002). While the transportation plan is not designed to focus on energy issues, it does provide a blueprint for some changes to our current transportation system that would improve energy efficiency, including an increased focus on the importance of public transit, a discussion of the role that "Park and Ride" lots play in encouraging carpooling, and a recognition of the importance of rail for only passengers and for freight service in some parts of the state. The transportation plan is updated on a biannual basis, allowing it to consistently address the transportation needs of the state.

10.3.2 Alternative Fuel Vehicles in the State Transportation Fleet

One area where the State has enjoyed success is in the use of alternative fuel vehicles (AFVs) to provide for State transportation needs. In addition to use by State officials, some municipalities, educational institutions, corporate fleets and individuals are using AFVs to meet transportation needs. The primary alternative fuels used in New Hampshire include natural gas, liquefied petroleum gas (propane), biodiesel, and electricity.

Federal laws mandate states incorporate Alternative Fuel Vehicles (AFVs) into their existing fleets to reduce the negative impact transportation has on air quality. The passage of the Energy Policy Act (EPAct) in 1992 established a timeline as well as targets that state fleets must meet.

The requirements outlined in EPAct were designed to promote the use of non-petroleum fuels, such as ethanol, methanol, natural gas, propane, hydrogen, and electricity in order to reduce U.S. dependence on foreign oil. Aside from the substantial clean air benefits of these fuels, they are also produced domestically, strengthening America's energy independence.

Table 10.2. EPA Fleet Requirements

EPAct Requirements for State Fleet*

Light Duty (8,500 lbs. or less) Only

Model Year	Compliance (% new purchases)
1999	25%
2000	50%
2001	75%
2002	75%

** "State Fleet" is defined as more than 50 vehicles, or 20 vehicles located within a metropolitan area of 500,000 or more people.*

10.3.1.1 State Alternative Fuel Vehicle Project

In June of 1996, the New Hampshire Governor's Office of Energy and Community Services (ECS) received a Congestion Mitigation and Air Quality Improvement (CMAQ) grant to establish a State fleet of alternative fueled vehicles and develop a network of refueling stations. The Alternative Fuel Vehicle Project (AFVP) was established to facilitate this grant. The AFVP managing group consists of participants from ECS, the New Hampshire Department of Environmental Services (DES) and the New Hampshire Department of Transportation (DOT). Through this group's efforts, a fleet of vehicles powered by electricity (EV), propane (LPG) and compressed natural gas (CNG) was procured for various State agencies. These vehicles are used as standard, State fleet vehicles while serving as educational tools that highlight and demonstrate clean transportation technology. To date, the number of State-owned vehicles that have displaced those running on conventional fossil fuels are 16 EVs, 1 van running on LPG and 17 CNG vehicles.

The State has also purchased 42 flexible fuel vehicles, which can run on a combination of fuels. These vehicles can run on conventional gasoline or a blend of ethanol and gasoline mixed at a rate of 85:15 (E85). Currently, there is no ethanol refueling capability in all of New England so these vehicles have been running on gasoline. The nearest E85 refueling stations are in New York, Ohio and Virginia.

As part of the AFVP, a fast fill CNG refueling station was built and placed into operation at a NH DOT facility in the city of Concord, and three slow fill CNG stations have been installed in other locations around the state. In addition, 13 Electric Charging stations/outlets have been installed at various State agencies to support the fleet of EVs. In February 2000, the AFVP requested and received additional CMAQ grant money to purchase more dedicated AFVs within the State fleet while maintaining the existing infrastructure.

10.3.1.2 Granite State Clean Cities Coalition

Clean Cities is a national program sponsored by the U.S. Department of Energy designed to encourage the use of Alternative Fuel Vehicles (AFVs) and to build the supporting infrastructure throughout the country. By encouraging AFV use, the Clean Cities program will help achieve energy security and environmental quality goals at both the national and local levels. Unlike traditional regulatory programs, the Clean Cities program takes a unique voluntary approach to AFV development, working with coalitions of local stakeholders to help develop the AFV industry and integrate this development into larger planning processes.

The Granite State Clean Cities Coalition plans and implements projects that promote the use of alternative fuel vehicles to improve air quality, increase our energy security by decreasing dependence on foreign oil, and foster sustainable economic development in this emerging industry. Diverse stakeholders include DES, ECS, DOT, the cities of Durham, Keene, Manchester, Nashua, Portsmouth, colleges and universities, energy companies, environmental organizations, auto manufacturers, transit systems, and private transportation companies such as limousine services. The Coalition has been recognized as a model for other states, and is a critical component of New Hampshire's ability to decrease and diversify our use transportation fuels, which is one of our fastest growing uses of energy. More information is available at the Coalition's website, www.granitestatecleancities.org.

10.4 Opportunities for Improving the State's Energy Use

As a large energy user in its own right, and as a source of funding for municipalities and organizations around New Hampshire, the State has an opportunity and obligation to serve as a leader in the efficient use of energy. While a number of programs and activities have been developed to manage energy use by the State, there are opportunities to build upon these efforts and increase the effectiveness of this work. In addition to saving taxpayer money through better use of energy, the State can play a leadership role that will impact energy use by others. By piloting programs and sharing the results with others, the State is in a unique position to demonstrate the effectiveness of energy management on financial savings and environmental impact. By helping build infrastructure that others may use, the State can provide the building blocks necessary for increased private sector and municipal sector investments in responsible energy use.

10.4.1 Renewable Power Purchasing by the State

The State of New Hampshire has the ability to significantly impact the electricity market through its purchasing decisions. In a restructured marketplace with customer choice, one way the State can encourage environmentally responsible power is to purchase electricity generated from renewable sources. By insisting that some percentage of the electricity that the State uses comes from renewable sources, the State can help create a market for renewable power.

Around the country, states and local governments have used their market power to purchase renewable power. The table below shows the steps state governments in areas with a restructured electricity market are taking to purchase renewable power.

Table 10.2. Renewable Power Purchasing Policies in Restructured States

State or City	% Renewable Power	Date Effective	Notes
Illinois	5%	2010	Increases to 15% of electricity purchases by 2020
Maryland	6%	2001	
New Jersey	12%	2002	Purchase of roughly 113 million kwh
New York	10%	2005	Increases to 20% by 2010
Tennessee	720,000 kwh/yr	2002	Purchase of renewable power for State facilities in Nashville only

New Hampshire should consider purchasing a fixed percentage of its power from renewable generation. Doing so will not only demonstrate the commitment of State government to using its market power to encourage environmentally responsible electricity generation, it will serve as an example for others. By assuring a market for some baseline level of renewable power, the State will encourage electricity suppliers to develop renewable power options available to other customers as well. The State could leverage its power in the marketplace through this method, and help create a market for renewable power at levels above what is generally offered.

It is expected that the purchase of renewable electricity will cost more than the purchase of fossil fuel power, and the State should obviously consider this increased cost when weighing what percentage of power to purchase from renewable generation. However, as a leader in environmental responsibility and a major consumer of electricity, the State should not miss this opportunity to use market-based, non-regulatory power to help shape New Hampshire's competitive electricity market.

10.3.2 Improvements in New Construction to Increase Energy Efficiency

As the State constructs new buildings or conducts substantial renovation of existing buildings to meet the needs of government, every effort should be made to fully account for the "life-cycle" cost of the building, and not simply the initial cost. Instead of considering only the cost of design and construction when costing a building, life-cycle accounting considers the long-term energy, maintenance, and other costs that are traditionally considered "operating expenses." It is often true that failure to make modest investments at the time of construction in order to keep a building's construction budget low results in inflated long-term expenses. This is particularly true of investments in energy efficiency, which may carry a higher initial cost but quickly pay for themselves through energy savings. By considering the “life-cycle” approach to building design, the State will position itself to reduce overall expenses associated with its new construction and reduce long-term energy use.

The State should also consider incorporating “performance contracting” (see BECI information, section 10.2.2) into new building construction. Performance contracting is a mechanism through which an Energy Service Company (ESCO) implements cost-saving building improvements. Unlike the traditional contracting process, the performance contractor assumes project performance risk to guarantee to the building owner (State) that energy savings will be sufficient to pay for the project costs. In basic terms, this is a “paid from a savings” program, so that no increase in up-front capital costs is required to implement energy cost saving measures in State buildings.

10.4.3 State Purchases of Energy Star® Office Equipment

In order to reduce energy costs and promote the importance of individual and corporate actions to reduce energy use, the State should commit to purchasing office equipment that achieves an Energy Star® rating. Energy Star® is a program that identifies products that meet or exceed premium levels of energy efficiency, making it easier for consumers to identify the most energy-efficient products in the marketplace. By purchasing and using products that meet the Energy Star® standard, and assuring that the energy efficient features are utilized, the State can achieve meaningful energy savings. According to estimates prepared for the New England Governor’s Conference (NEGC), upgrading computers, copiers, printers, fax machines and scanners used by New Hampshire State agencies would result in annual energy savings of almost $70,000 and an annual reduction in carbon emissions of 1.2 million tons. This recommendation supports actions being taken by New England Governors and Eastern Canadian Premiers, coordinated by the New England Governor’s Conference. At its August 2002 meeting, the NEGC/ECP approved a resolution that included implementing Energy Star® purchasing programs in the member states and provinces in order to achieve emission reductions and climate change policies and agreements.[1]

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[1] More information on the NEGC/ECP intiatives is available at www.negc.org.

[2] The Sustainable Buildings Industry Council (SBIC) is a SBIC is a nonprofit organization whose mission is to advance the design, affordability, energy performance, and environmental soundness of residential, institutional, and commercial buildings nationwide. Resources are available at www.sbicouncil.org.

[3] See www.h-m-g.com for information on the Heschong Mahone study on the impacts of daylighting on classroom performance.

10.4.4 State Purchases of "Green Cars"

In addition to the use of alternative fuels to power the State's fleet of vehicles, (see 10.2.3 above), New Hampshire should strive for the most efficient use of fuel in vehicles that use traditional fuel, primarily gasoline. One way to encourage this is to have State purchases passenger vehicles that qualify for the New Hampshire Department of Environmental Service's "Green Label" designation. This designation, reserved for passenger vehicles that achieve 30 miles per gallon or better and meet a low-emission vehicle (LEV) standard, was developed in partnership with the New Hampshire Auto Dealers Association to provide information to consumers. When such vehicles meet the needs of the agency purchasing the vehicle, the State should direct purchases toward these clean and efficient vehicles. The State should also expand its efforts to purchase "hybrid" vehicles, which combine traditional internal combustion engines with electric car technology to achieve great fuel efficiency. The purchase of passenger vehicles meeting the "green label" requirements will not only produce fuel cost savings over time, it will also reduce emissions and help support the market for efficient vehicles.

This recommendation also supports the recent actions being taken by New England Governors and Eastern Canadian Premiers, coordinated by the New England Governor's Conference. At its August 2002 meeting, the NEGC/ECP approved a resolution that included implementing policies that promote the use of clean, energy efficient state fleet vehicles in the member states and provinces in order to achieve emission reductions and climate change policies and agreements.

10.4.5 Increasing Biodiesel Use by the State of New Hampshire

The State of New Hampshire owns roughly 1,500 trucks, many of them diesel. These diesel trucks are used by the State for a variety of functions, primarily public works and transportation. These State vehicles use roughly 2.2 million gallons of diesel fuel annually.

Biodiesel is a diesel replacement fuel made from virgin vegetable oils such as soybeans, rapeseed, or recycled restaurant oils. Biodiesel has some significant advantages over diesel when it comes to emissions. Because it is 11% oxygen by weight and contains no sulfur, sulfur emissions, the chief cause of acid rain, are eliminated. According to EPA, biodiesel lowers emissions of toxins and particulate matter by 30%, although it has been demonstrated to have NOx emissions roughly 10% higher than conventional diesel. Derived from renewable resources such as crops, pure biodiesel is carbon-neutral, making it an attractive option for lowering emissions of carbon dioxide.

One of the great benefits of biodiesel is that it can be used in existing diesel vehicles, without any modifications to the diesel engine. This is in contrast to other emerging diesel technologies (often referred to as "clean diesel"), which require costly modifications to engines and emissions treatment systems, but yield even better emissions reductions.

The City of Keene, Keene State College, and the City of Nashua are currently implementing biodiesel trials, where the fuel will be used in some heavy-duty vehicles. This will help determine the fuel's ability to be used successfully in New Hampshire, and should help provide valuable information on fuel storage and handling, cold weather operations, and fuel efficiency.

Other states and regions have taken steps to decrease diesel emissions from their state fleets or vehicles working on their behalf, including:

- Starting in 2005, Minnesota requires that all diesel fuel sold in the state, whether for State or private use, contain at least 2% biodiesel. State agencies are required to use "clean fuels", including biodiesel blends of 20% or greater by volume, in their vehicles when available at similar costs to diesel.
- In Nebraska, the Transportation Services Bureau has established a goal of having 50% of its fleet run on alternative fuels, including biodiesel, by 2010, and it is anticipated that 100% of the fleet, including heavy construction vehicles, shall run on alternative fuels by 2025.
- Regulators in New York State have required retrofits to diesel vehicles working on the reconstruction of Lower Manhattan following the terrorist attacks of September 11. Because of the heavy influx of diesel vehicles involved in the reconstruction, State regulators took this step to help reduce air pollution in this heavily populated area.

New Hampshire can take a leadership role in the use of biodiesel in State vehicles. By doing so, the State will be helping to reduce emissions of sulfur, particulate matter and other harmful pollutants. Increased use of biodiesel will also reduce dependency on imported fossil fuels, and support a market for agricultural products. If the pilot projects in Keene and Nashua provide positive results, the State should seriously consider transitioning to biodiesel in all of its diesel fleet, including passenger vehicles, trucks, and mobile generators.

Eventually, the State may wish to consider requiring contractors working on State projects using State funds to use some level of biodiesel in vehicles, mobile generators and other diesel-powered devices. These requirements should be carefully considered to allow contractors a choice of fuels when not working on State projects, and biodiesel provides this opportunity – something other alternative fuels may not. The State may also wish to set a high threshold for project size before requiring use of biodiesel, initially targeting only those projects with the greatest opportunity for emissions reduction or that are located in sensitive air quality areas.

10.4.6 College/University Partners in Energy Efficiency and Renewables

New Hampshire is home to some of the top secondary educational institutions in the country, and the State university system is one of the largest users of energy in the State system. ECS currently works with the state universities to encourage investments in energy efficiency and renewable energy to allow these institutions to realize the economic, energy, environmental and educational benefits of these technologies.

For example, the University of New Hampshire campus in Durham was recognized by the U.S. Department of Energy in 2002 for being among the top 5% of research universities nationally for its efficient use of energy. UNH is eager to share its successes and strategies with others seeking to reduce energy use, save money, and improve environmental quality.

In support of the recent resolution approved by the New England Governors and Eastern Canadian Premiers, coordinated by the New England Governor's Conference, the State should take a leadership role in working with colleges and universities to promote energy efficiency and renewable energy technologies. The project approved by the NEGC/ECP encourages the region's colleges and universities to help states and provinces to meet climate change reduction goals, working within their own institutions to reduce greenhouse gas emissions to 10% below 1990 levels by 2012. This effort would serve three purposes: it would expand the number of entities starting to reduce their pollution through energy efficiency and renewables, it would serve as an educational tool for educating students about climate issues; and it could focus student research on finding innovative and creative solutions for making these reductions.

10.4.7 Using School Building Aid to Increase Energy Efficiency

The State of New Hampshire invests between $25 and $30 million dollars each year in new school construction through direct aid to school districts. At present, school building aid requires that new construction or renovation comply with the State's energy code. Districts meet this standard by having their architect self-certify that the building meets the State's energy code. This code, while providing a minimum baseline for energy efficiency, does not incorporate some of the best practices and new design ideas that encourage truly energy efficient building design.

State aid for school construction provides an opportunity for the State to be a partner in new construction of schools, and to help school districts go beyond the code and realize the benefits of high performance schools, including lower operating costs, higher test scores, and better land use practices. "High performance school buildings" are schools that integrate healthy and productive learning space with energy efficiency, lower operating costs, and result in lower environmental impacts.[2] High performance

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[4] The GGGC has developed a High Performance Green Building Guidelines book, and provides resources and guidance on how to build green buildings in the state. More information on Pennsylvania's Governor's Green Government Council may be found at www.gggc.state.pa.us.

schools benefit students, teachers and taxpayers by providing an integrated approach to school design.

Recent studies have shown a correlation between building design, learning success, and health. For example, in a study of three western states, students in environments with increased daylighting (natural light) performed better on standardized tests than students with the least amount of daylight in their classrooms. By providing students and teachers with superior indoor air quality, students and teachers take fewer sick days. Through design features and ventilation and building materials, schools can reduce sources of health problems and limit the spread of infections. With a healthy work environment, school districts can see tangible improvements in attracting and retaining teaching staff.[3]

High performance school buildings are less expensive to maintain, which means a reduction in the life-cycle costs of the facilities, providing taxpayers with the most efficient use of their money. Several states are already seeing the benefits of saving limited state resources by building green schools. In Pennsylvania, the Governor's Green Government Council (GGGC) is working with the real estate, architecture and building industries and school districts to help make school buildings better places to learn with lower operating costs.[4] California, through the Collaborative for High Performance Schools, is working to increase the energy efficiency of schools in California by providing information, services, and incentive programs directly to school districts and designers.[5]

In order to ensure that New Hampshire students and taxpayers realize the many economic and environmental benefits of high performance schools, the State should continue to work with schools and municipalities to provide information on the benefits, both educational and financial, of high performance building design. Part of this effort should focus on conducting and evaluating demonstration projects in New Hampshire, and sharing the results of these demonstration projects. In addition, the State should explore ways to use funding mechanisms available to it, including school building aid,to encourage the construction of high performance schools in New Hampshire. By utilizing this approach, the State can have more schools that are energy efficient, less expensive to operate, better places to learn, and have less impact on the environment.

ECS actively works with schools and municipalities to accomplish these goals through Rebuild NH, but more resources and coordination with other State agencies should be devoted to this effort. Rebuild is a federal Department of Energy program that provides technical assistance on energy efficiency and energy management directly to municipalities and school districts. The Rebuild NH network of municipal, school, and building professionals provides a solid foundation to advance green schools initiatives, and serve as the foundation for a high performance school building program in New Hampshire.

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[5] The Collaborative's goal is to facilitate the design of high performance schools, which are more cost-effective, energy efficient, and a healthier environment to provide a quality education. For more information see www.eley.com/chps.

10.4.8 LED Traffic Light Project

It is now widely recognized that simply changing traffic lights from incandescent bulbs to light emitting diode (LED) technology results in significant energy savings and pollution reductions, using 85% less energy than conventional traffic lights. As a result, the State should work to implement the project approved by the the New England Governors and Eastern Canadian Premiers, coordinated by the New England Governor's Conference, to replace these lights throughout the region by 2007. NEGC/ECP has found that making these changes will result in reductions totaling 1120.9 pounds of CO2/yr. per light and would save roughly $58.40[6] per light, each year. In addition, this project will also reduce labor costs associated with the current lights that require more frequent replacement. Further, the new lights tend to enhance public safety because they are more reliable, reducing the problems that occur when incandescent lights burn out prematurely and signal systems fail.

New Hampshire should continue to work with the NEGC and our neighboring states in the region to implement this and the other initiatives approved by the NEGC/ECP in August 2002.[7]

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[6] Based upon 15-20 watts per light versus 100, .36-.48 kWh vs. 2.4 kWh, roughly $.08 per kWh, $14.016/year vs. $70.08/year.

[7] More information on these initiatives is available at www.negc.org

Appendix 2: Overview of Energy 2020

The Basic Version of ENERGY 2020

ENERGY 2020 is a multi-sector energy analysis system that simulates the supply, price and demand for all fuels. It can be interactively configured to any level of detail with regard to the energy system by changing the structure of the model. Additional sectors or modules from other non-ENERGY 2020 related models (such as a macroeconomic model) can be incorporated directly into the ENERGY 2020 framework. This flexibility allows the model to evolve over time in response to the changing objectives of the decision maker.

ENERGY 2020 OVERVIEW

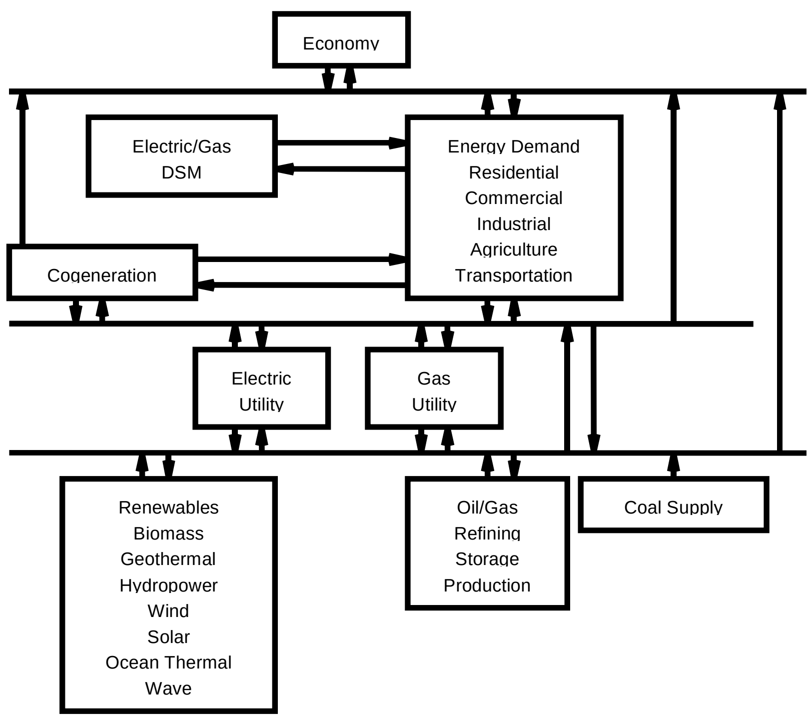

Figure A2.1

ENERGY 2020 differs from many of the utility models in use today. ENERGY 2020 does not contain elasticities and obscurely specified parameters. To make model results understandable and realistic, a one-to-one relationship always exists between the model and the real world. For example, customer responses to relative price changes are not modeled using price and income elasticities. Instead, all the factors that determine the choices one makes when a purchase is made, such as the amount of money you have, what your preferences are, and how well informed you are about other prices, are all explicitly modeled in ENERGY 2020.

ENERGY 2020 is made up of model sectors that can be modified, expanded or deleted to suit individual client needs. Figure A2.1illustrates the current model configuration. Common to all versions of ENERGY 2020 is an economy sector where economic growth rates are determined. The economy sector can be run either interactively with the Regional Economic Models, Inc. (REMI) economic model or with any accurate twenty-year economic forecast. The ENERGY 2020 model runs under the PROMULA simulation system. PROMULA allows mainframe models to run on microcomputers. It also allows programs written in any other language to run simultaneously with it. PROMULA provides sophisticated, but easy-to-use and fast database manager, program editor, decision tree, simulation, statistical/regression, graphics, and report generator capabilities. Programs written for any other computer can be automatically converted to run quickly on a microcomputer. With minimal additional effort sophisticated menus and database capabilities can be added.

Energy demand itself is created from five model sectors: Residential, Commercial, Industrial, Agriculture and Transportation. Most versions of ENERGY 2020 have at least the first three sectors operating; it is not uncommon to use all five. In addition to these basic demand model sectors, two more sectors - electric and gas DSM and the Cogeneration sectors, modify the demand sectors. All sector demands are influenced by DSM and most, especially industrial, are modified by cogeneration capability. Demand is dynamically simulated by end-use and economic sector for all fuels (electric, gas, oil, LPG, coal, biomass and solar).

The disaggregation of end-use and economic sectors can be detailed in many ways. A "typical" model has a few residential and commercial classes, industrial demand divided into two digit SIC code subclasses, transportation demand modeled by class and mode, and about six to eight end-uses for each class. Gas-refrigeration and air-conditioning are standard end-uses. Marginal and average energy intensity at both the process and device level are determined. ENERGY 2020's unique capability to model how consumers make fuel and efficiency choices in the face of personal preference, price, and utility incentives is critical to DSM and competitive analysis.

Independent power producer and cogenerator behavior (across ten technologies) as well as pollution generation (across eight pollutants) both at the end-use and supply level are dynamically calculated. Additional pollutant types and technologies to represent land and water pollution can be added as desired. The other half of the energy demand market, the supply sector, is modeled in several parts as well, depending on client needs. The two most common are the electric and gas utility sectors which generate energy used to meet energy demands. The renewable resources sector usually impacts the electric utility sector but also affects the demand sectors as well through such things as solar water heat and biomass process heat. Less used, but also available, are a complete oil and gas refining sector which tracks the exploration, refining, production and storage of oil and gas as well as a similar sector for coal supply. Any supply sectors not specifically modeled are captured in a generic supply sector that generates fuel prices and availability. For example, a common supply sector configuration would be an electric utility sector, a gas utility sector and a generic supply sector for oil and coal supplies. For electric and gas utilities (separate or combined), ENERGY 2020 internally and self-consistently simulates sales, load (by end-use, time-of-use, and class), production (across thirty-six dispatch types), demand-side management (by technology), forecasting, capacity expansion (new generation, independent-power-producers, purchases, and DSM), finance, and rates (by class, end-use, and time-of-use). Utility bypass and transportation are internally estimated. Supply dispatch order can be pre-specified, based on variable costs, or based on attributes (as in the case of pollution minimization). The dispatch process can be modeled by fast advanced derating, chronological-probabilistic, or linear programming methods. Multiple service areas are simply linked together. Firm contract and spot market interactions can be specified, and ENERGY 2020 can analyze utility deregulation dynamics.

ENERGY 2020 addresses both demand-side and (conventional and renewable-fuel) supply option impacts on financial health, rates, and the customer. Peak and off-peak avoided, marginal, and incremental costs are calculated. Transmission, distribution, and cogeneration issues are also addressed. ENERGY 2020 provides a complete, realistic description of supply and demand processes, options, and issues that must be considered for adequate IRP and LCP assessment. Over 250 pre-specified scenarios/options can be combined and easily modified to test almost any scenario imaginable. A summary of the possible output generated by ENERGY 2020 is shown in Table A2.1. ENERGY 2020 is automatically calibrated to a specific service area or region with minimal data requirements - much of the data are on default databases specified by state. Model input routines provide automatic error checking and input screen display templates of standard utility reporting forms (for example, FERC Form 1, EIA Form 412, and/or Annual Financial Reports). Model output can be displayed in the same standard report formats or with high resolution color graphics. Model results can be sent to a printer or plotter.

Table A2.1. ENERGY 2020 Outputs

Basic Data
Balance Sheet
Sources and Uses of Funds
Income Statement
Capacity
Generation
Sales
End-Use Loads
Comparison Studies
Service-Area/Employment Impacts
DSM Market Dynamics
Pollution Emissions
Rate Schedule Effects
Gas versus Electric Market Dynamics
Alternative Regulatory Treatment
Standard Studies
Cost Benefit Analysis with Externalities
Uncertainty/confidence Analysis
Dynamic Impact Analysis
Perspective Analysis
Special Studies
Mergers
Acquisitions
Deregulation
Decentralization

Data files can be read and manipulated using standard spreadsheets such as EXCEL and Lotus 1-2-3. ENERGY 2020 has an uncertainty package called HYPERSENS to aid the user in policy testing.

HYPERSENS quantifies the impacts of conservation technology uncertainty on utility/consumer cost/benefits where the components of the cost/benefit measure may be the price of electricity, revenue requirements, capacity requirements, and energy costs per consumer unit. Other measures can be calculated as determined by the user. The uncertainty analysis uses the efficient Latin-Hypercube Sampling approach developed at Los Alamos National Laboratory. Uncertain parameters can be described by any arbitrary distribution. Input parameters are varied simultaneously to capture the more realistic “all-else-not-equal” conditions. ENERGY 2020 also has attribute and post-processing capabilities.

Although ENERGY 2020 is not an optimizing model, users can define their “objective function” for model results - stable rates, reduced peak demand, maximum return on investment, etc. Combinations of attributes can be weighted to obtain composite measures for ranking scenarios. These multi-attribute functions can be used with HYPERSENS to find the optimally robust strategy to achieve the desired objectives, in effect, determining the “optimal” path. Added post processing capabilities allow the user to manipulate model-generated data to automatically perform unique analyses. ENERGY 2020 calculates the market penetration, sales/load impacts, program costs, reliability impacts, revenue impacts, cost/benefit figures of merit, etc. of DSM options. Peak and off-peak avoided, marginal, and incremental costs can be calculated. Cogeneration issues are also addressed. Peak clipping, valley filling, load shifting, strategic conservation, and strategic load growth (by day and season) options can be specified. Consideration of focus (small versus large customer) and level (aggressive versus limited implementation) are part of the DSM option selection process. ENERGY 2020 provides a complete, realistic description of the demand processes, options, and issues that organizations must consider for adequate demand-side option assessment.

In summary, ENERGY 2020’s integrated planning framework simulates the dynamic interactions within the energy sector under various plans and uncertainties (scenarios). The ENERGY 2020 framework can be automatically calibrated, using generally available data, and modified to represent any particular energy source, utility company, or geographical area. It then becomes a descriptive tool that dynamically simulates current and future conditions. It provides a laboratory in which planners can examine the long-range implications of programs and policies. Table A2.2 provides an overview of ENERGY 2020’s features.

ENERGY2020 is an End-Use (Disaggregate) Model

Historically, energy use has been forecast either by customer class or rate class. Further delineation based on energy use was not considered. But many models, including ENERGY 2020, now forecast energy use by customer-designated end-uses such as space heating and lighting.

Although both types of modeling have strengths and weaknesses, end-use models are gaining in popularity for several reasons. First, they are often required in many states. Utilities see them as a way to get to know their customers better in an increasingly more competitive and customer-centered energy market. Regulators often prefer them for their ease of policy testing, particularly DSM policies that are difficult to handle with econometric models.

Their clear advantage in policy testing is the second reason causal models are gaining popularity. For example, to determine the impact of a rebate on high efficiency electric hot water heaters it is necessary to know the energy use of existing hot water heaters (is it large or small relative to total load), to estimate the impact of the policy. If electric hot water heaters contribute only minutely to total load, then DSM programs designed to minimize this already small load will not have a significant effect on utility sales.

The third reason for the gaining popularity of end-use models is the availability of structural enhancements that allow model changes in the causes of energy demand, and not simply changes in demand itself. For example, if you have a residential electric econometric forecast and you are implementing a policy encouraging fuel switching, all you can do is reduce electric load by some estimated amount.

Table A2.2. General ENERGY 2020 Model Features

• *Integrates energy supply, price, demand, economy, and regulation. Includes all fuel demand and supply model with detailed electric and gas utility capability. Has detailed Cogeneration and Qualified Facility sectors. Simulates all decision or strategy points of energy supplier and consumer (both short and long-term). Captures the feedback dynamics between Utility, Demand, Economy and Regulation sectors.*
• *Analyzes Mid to Long-Term Planning. Simulates continuous dynamics of supply, price, load, pollution emissions and end use demand from 1975 - 2020 time frame. Includes critical feedback shown by NERC as most important to forecasting.*
• *Performs cost-benefit analysis of DSM programs and any scenario with externality pollution costs, and uncertainty.*
• *Provides both least cost and consumer preference decision criteria.-Performs historical validation and automatically calibrates to unique utility service area conditions. Uses publicly available data.*
• *Automatic uncertainty and sensitivity analysis produces actual confidence intervals rather than high and low cases.*
• *Provides scenario database for user specified definition and initiation of scenario packages. Calculates decision-maker preference-function for each scenario.*
• *Simulates pollution generation from both consumer and utility end-use (Typically eight pollutants with impact-weighted indices.)-Allows interactive modification of model structure to include additional or alternative sector representations. Model is designed to ease modification, extension and scenario additions.*
• *Allows easy execution and comparison of multiple runs/scenarios. Provides interactive input editing, output review, report generation, and mathematical transformations.*
• *Can integrate with a client's existing analysis tools written in other languages.*
• *Over 250 experience years of model usage/development at federal, state, energy company, and utility level. (Early version still used for all U.S. DOE National Energy Plans.) Model used for energy policy and planning by other 27 states and Canadian provinces. Over $15 Million spent on model development and testing.*
• *Reviewed favorably in studies by the California Energy Commission, Barakat and Chamberlin, Inc., Southern Company Services, Inc., and the National Academy of Sciences (FOSSIL2/IDEAS).*
• *Model can be freely given to others for review and critique (or cooperative policy development between adversarial groups). Code is machine independent(runs on personal computer or mainframe).*

With ENERGY 2020, there is the gas forecast, the percentage of demand that is substitutable as well as prices, and previous energy decision behavior. It is possible to directly model the change in the system and have the energy sales change in response to the policy.

Using the water heating example above, other effects that would be captured by ENERGY 2020 include fuel switching from natural gas to electric hot water as the price of the electric hot water heater is made more economic by the rebate. Not only is the change in energy demand simulated with a causal model, but the composition of the change is simulated as well. Also, with an integrated end-use model,

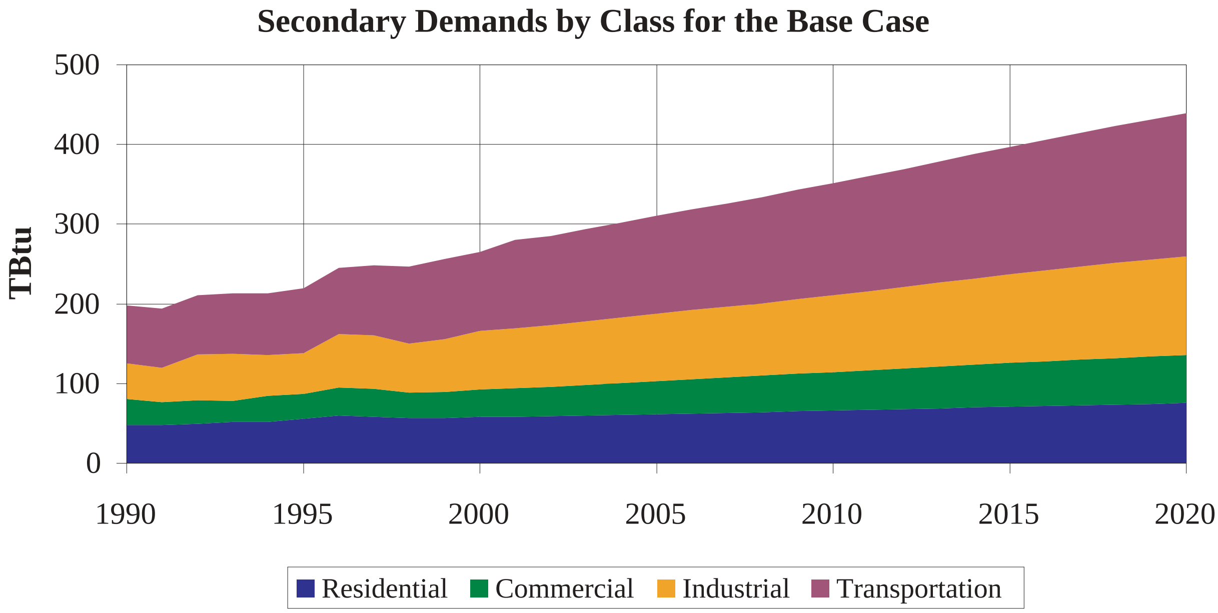

Figure A2.2. Energy Demand as a Function of Capital Stock

there would be consistency between the natural gas and electric assumptions, difficult to achieve with separate forecasts.

Finally, the analyst can feel comfortable with the simulation results of a causal model because there is an understanding of why demand changes occurred. If residential energy demand is projected to grow by two percent per year, an econometric model usually provides only two variables - number of customers and use per customer. With an end-use model, the analyst can see, for example, that the residential energy growth is determined by a growth in space heating demand (a fuel switch from natural gas to electric), a decrease in lighting and refrigeration demand (due to increased efficiencies) and an increase in miscellaneous electricity use.

ENERGY 2020 is a Causal Model

Causal models are made up of variables that allow the user to directly relate changes in the real system to changes in the model. Causal models model cause and effect relationships. This is significantly different from models that look at variable correlation, with no implied causality. For example, weather and energy use are correlated. Given temperature we can make some determination about demand. This is true of both causal and correlation models. If temperatures rise in the summer, demand should rise as well. The causal model has structure that causes the temperature rise to increase the demand for energy, the econometric model determines only that there exists a relationship between the two variables. With a correlation, direction does not matter. It is just as true to say that the increase in demand correlates with an increase in temperatures as it is to say an increase in temperature correlates with an increase in demand. However, it would be ludicrous to imply that changing demand causes changing weather - causality has direction.

This causal model has structure that mimics the real world allowing the analyst to describe how energy use changes. For example, energy use in ENERGY 2020 depends upon device and process efficiencies and market share among other variables. Each of these variables has a real world counterpart and can be modified to reflect changes, either naturally occurring or through policy implementation. With econometric models, these changes are all captured with an elasticity - a catch-all term that is hard to modify to reflect structural or policy changes.

Changes in a causal model "work through" the model and the analyst can see exactly what effects these changes have. This transparency becomes particularly important when policies are being tested. Secondary and tertiary effects are picked up with a causal model that might be overlooked in other modeling endeavors. For example, a policy increasing the efficiency of electric air conditioning can lower peak demand and prices. However, these lower prices have effects of their own, including fuel switching into electric and possibly lower device and process efficiencies in the non-policy end-uses. These effects are not captured in models with incomplete market structure.

Finally, using a causal model helps the analyst provide justifications for adjustments to the model or forecast. Instead of simply lowering the forecast because it is "too high," the analyst can identify specific variables which may be highly uncertain - fuel prices, technology constraints, behavior variables - and adjust accordingly.

ENERGY2020 Replicates History

It is the structure of the ENERGY2020 model, representing how decision makers act, rather than exogenous data that primarily determines the model results. The ENERGY2020 structure allows the model to reproduce history. If a model cannot reproduce history there can be no confidence that it can properly simulate the future. Without historical tests it is impossible to determine whether feedback is properly incorporated, what is missing, or what is improperly specified. Other models cannot reproduce history because real-world systems (e.g. energy consumers and suppliers) fail to follow the models' idealized, optimal, and generic rules. Each real-world case study shows that "exceptions-to-the-rules" affected the past and will determine the future.

Because ENERGY2020 simulates how participants in an energy system make decisions, it is able not only to reproduce (and explain) history, it can simulate how decision makers will act when they are faced with policies/conditions for which there is no historical precedent. Most scenarios conceived today fall in to the "no-precedent" category. ENERGY2020 can be calibrated to any service area or region with publicly-available data. Its internal national and state databases contain historical economic, price, and demand data by economic sector, fuel, and end-use. Utility data can be entered via templates of standard utility reports or, if available, electronically transferred. Further, any data the user does not enter or is not already on the database will be provided "synthetically."

The default databases contain not only generic data, but also regional data that is modified to be compatible with the data provided by the user. For example, if the user only knows the system peak and annual customer class sales, the input routines will generate estimated end-use load shapes by class by appropriately scaling detailed state or regional data. As the user adds more data, less "default" data is synthetically created. The data set evolves as better data is added to it. ENERGY 2020 is often used for analyses where the user-specific data is limited but answers are critically needed.

Overview of the ENERGY2020 Demand Model

The demand sector of ENERGY2020 represents the service area by disaggregating the four economic sectors: residential, commercial, industrial and transportation into subsectors based on energy end-use. As many or as few subsectors can be supported as desired. The Commercial sector may be divided into subsectors that include offices, restaurants, retail establishments, groceries, warehouses, elementary and secondary schools, colleges, health fields and hospitals, hotels and motels, and a miscellaneous buildings category. The industrial sector often is divided into subsectors by two-digit SIC code. The transportation sector models the transportation demands for each of the sectors; residential, commercial, and industrial. The residential sector may be divided into single family, multi-family and mobile homes. Multiple end-uses (including transportation and feed stocks) and multiple fuels are detailed. Currently, the commercial sector is configured to have eight end-uses: Primary Heat, Refrigeration, Lighting, Water Heating, Cooking, Ventilation, Air Conditioning and Miscellaneous Demands. The industrial sector has four end-uses: Process Heat, Motors, Lighting, and Miscellaneous Demands. Fuel choices include natural gas, oil, coal biomass, solar, electric and LPG. Cogeneration, fungible demands (fuel switching), municipal resale demands, and power pool resale demands are also determined by the. A few basic concepts are crucial to an understanding of how ENERGY 2020 models the energy system. The capital stock driver, the modeling of energy efficiency through trade-off curves, the fuel market share

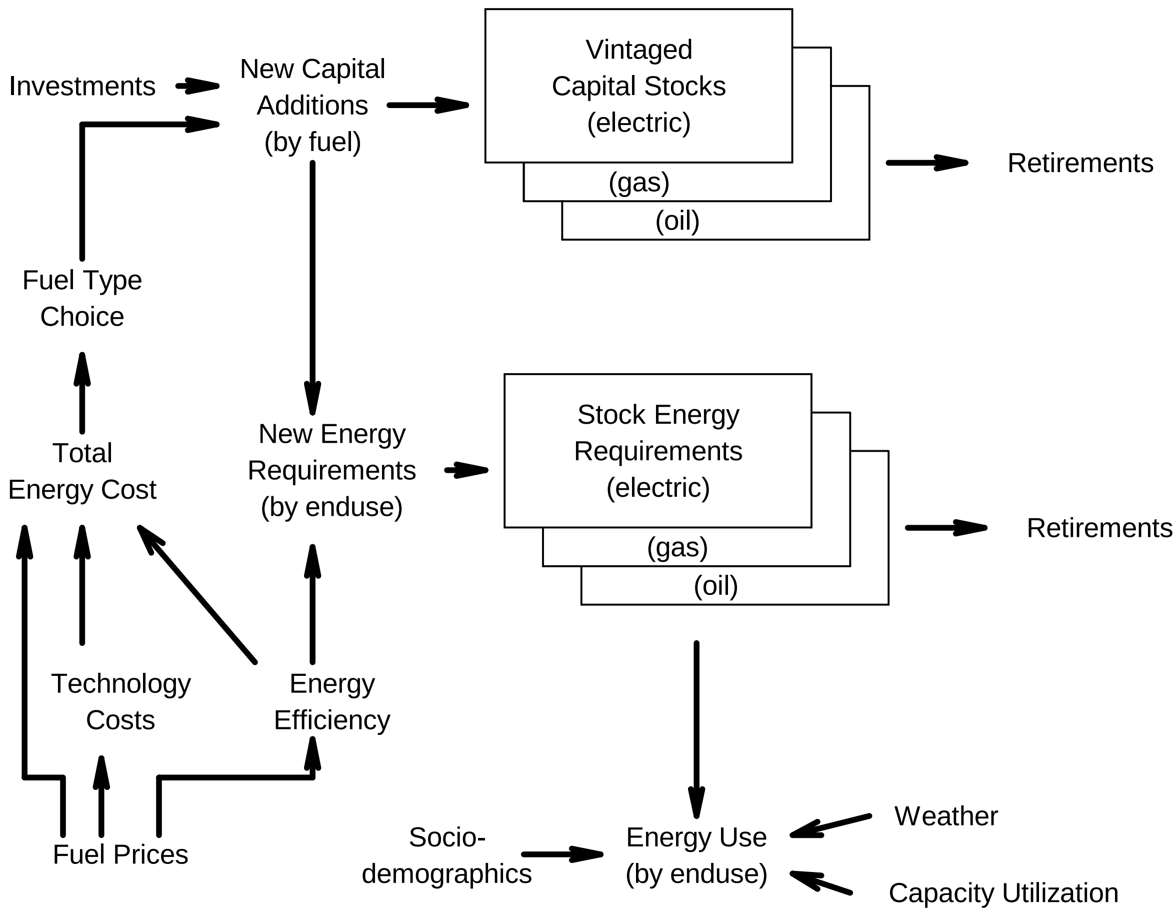

Figure A2.3. Demand Sector Interactions

calculation, utilization multipliers and the cogeneration module are discussed below in abbreviated form. Figure A2.3 illustrates the demand sector interactions. Table A2.3 shows the typical features of the demand sector.

Energy Demand as a Function of Capital Stock

ENERGY2020 assumes that energy demand is a consequence of using capital stock in the production of output. For example, the industrial sector produces goods in factories which require energy for production; the commercial sector requires buildings to provide services; and the residential sector needs housing to provide sustained labor services. The occupants of these buildings require energy for heating, cooling, and electromechanical (appliance) uses. The amount of energy used in any end-use is based on the concept of energy efficiencies. For example, the energy efficiency of a house along with the conversion efficiency of the furnace determine how much energy the house uses to provide the desired warmth. The energy efficiency of the house is called the capital stock energy or process efficiency. This efficiency is primarily technological (e.g. insulation levels) but can also be associated with control or life-style changes (e.g. less household energy use because both spouses work outside the home.) The furnace efficiency is called the device or thermal efficiency. Thermal efficiency is associated with air conditioning, electromotive devices, furnaces and appliances. The model simulates investment in energy using capital (buildings and equipment) from installation to retirement through three age classes or vintages. This capital represents embodied energy requirements that will result in a specified energy demand as the capital is utilized, until it is retired or modified.

Table A2.3. Demand Sector Features

• *Simulates process and device side decisions.*
• *Trades off capital and efficiency with fuel prices dynamically. Incorporates both least cost and consumer preference energy efficiency curves.*
• *Allows testing of any major scenario (e.g., efficiency standards, subsidies, low interest loans ,energy taxes, cost sharing, tax credits, risks, indirect costs, expending or capitalization of conservation costs, technological advances, environmental regulations, energy shortages).*
• *Simulates short term effects such as budget constraints and temperature sensitive loads.*
• *Includes socio economic change (female labor participation, multi family housing) and other non energy price effects.*
• *Simulates marginal investments, fuel switching, and fuel conversions.*
• *Allows arbitrary number of end uses (Example: primary/process heat, cooking, drying, hot water, lighting, air conditioning, refrigeration, miscellaneous electromotive, feedstock, etc.)*
• *Allows arbitrary number of energy consuming sectors*
• *Simulates energy demands for all fuels (standard: gas, oil, high sulfur coal, low sulfur coal, biomass, solar, electric).*
• *Simulates cogeneration investment, construction, and usage.*
• *Simulates inter/intra regional energy demands.*

The size and efficiency of the capital stock, and hence energy demand, change over time as consumers make new investments and retire old equipment. Consumers determine which fuel and technology to use for new investments based on perceptions of cost and utility. Marginal trade-offs between changing fuel costs and efficiency determine the capital cost of the chosen technology. These trade-offs are dependent on perceived energy prices, capital costs, operating costs, risk, access to capital, regulations and other imperfect information.

ENERGY 2020 formulates the energy demand equation causally. Rather than using price elasticities to determine how demand reacts to changes in price, ENERGY 2020 explicitly identifies the multiple ways price changes influence the relative economics of alternative technologies and behaviors, which in turn determine consumers' demand. In this sense, price elasticities are outputs, not inputs, of ENERGY 2020. The model accurately recognizes that price responses vary over time, and depend upon factors such as the rate of investment, age and efficiency of the capital stock, and the relative prices of alternative technologies.

Device and Process Energy Efficiency

The energy requirement embodied in the capital stock can be changed by new investments, retirements, or retrofitting. The efficiency of capital uses has is limited by technological or physical constraints. The trade-off between efficiency and other factors (such as capital costs) is depicted in Figure A2.4. The efficiency of new capital depends on the consumer's perception of this trade-off. For example, as fuel prices increase, the efficiency consumers choose for a new furnace is increased despite higher capital costs. The amount of the increase in efficiency depends on the perceived price increase and its relevance to the consumer's cash flow.

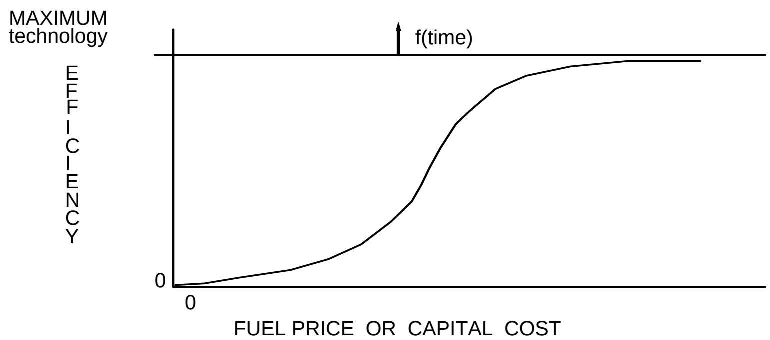

Figure A2.4. Efficiency/Capital Cost Trade-Off

The standard ENERGY 2020 efficiency trade-off curves are called consumer-preference curves because they are estimated using cross-sectional (historical) data showing the decisions made based on their perception of value. Many planners are interested in measure-by-measure or least-cost curves which use engineering calculations and discount rates to show how consumers should respond to changing prices. Another analysis focuses on the technical/price differences in alternative technologies and the incentives needed to increase the market-share or market penetration of a specific technology. This perspective on the choice process uses market share curves.

ENERGY 2020 allows the user to select any of these three types of curves to represent the way consumers make their choices. Shared savings, rebate, subsidy programs, etc. can be tested using any of the curves. Cumulative investments determine the average "embodied" efficiency. The efficiency of new investments versus the average efficiency of existing equipment is one measure of the gap between realized and potential conservation savings.

ENERGY 2020 uses saturation rates for devices to represent the amount of energy services necessary to produce a given level of output. Saturation rates may change over time to reflect changes in standard of living or technological improvements. For example, air conditioning has historically increased with rising disposable incomes. These rates can be specified exogenously or can be defined in relation to other variables within the model (such as disposable income).

The Market Share Calculation

Not all investment funds are allocated to the least expensive energy option. Uncertainty, regional variations, and limited knowledge make the perceived price a distribution. The investments allocated to any fuel type are then proportional to the fraction of times one fuel is perceived as less expensive (has a higher perceived value) than all others. This process is shown graphically in Figure A2.4.

A short-term, temporary response to budget constraints is included in ENERGY 2020. Customers reduce usage of energy if they notice a significant increase in their energy bills. The customers' budgets are limited and energy use must be reduced to keep expenditures within those limits. These cutbacks are temporary behavioral reactions to changes in price, and will phase out as budgets adjust and efficiency improvements are implemented. This causes the initial response to changing prices to be more exaggerated than the long-term response, a phenomenon called “take-back.”

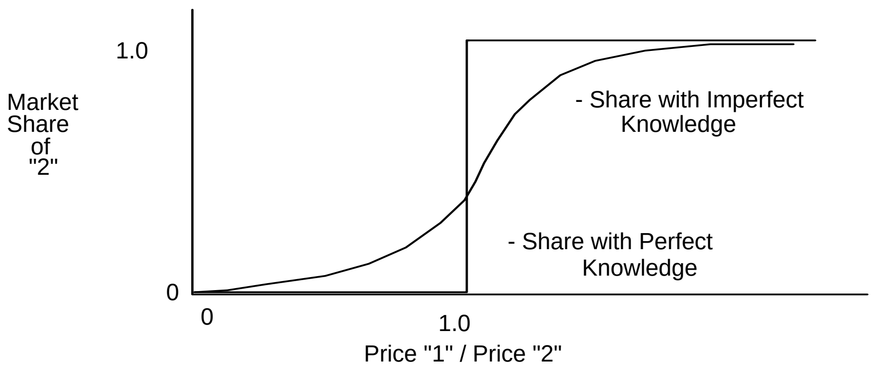

Figure A2.5. Market Share Dynamics Short Term Budget Responses

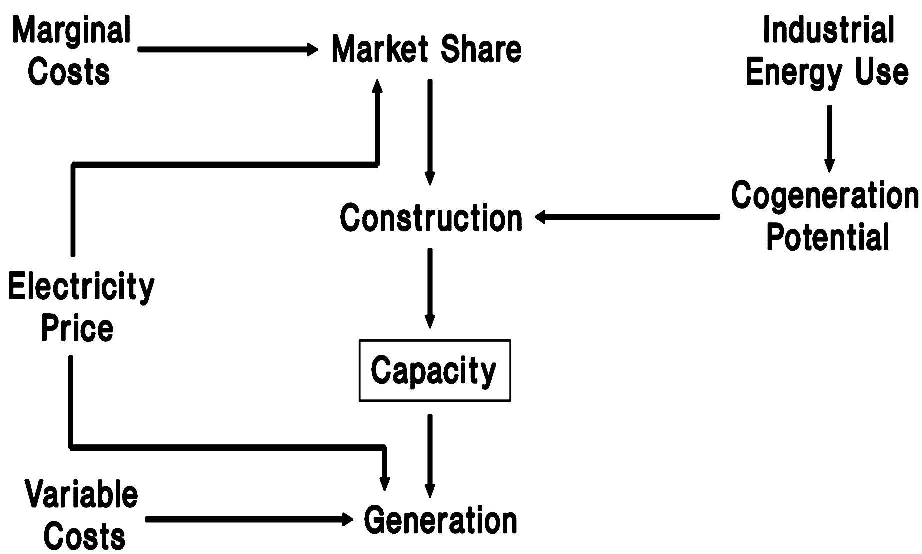

Figure A2.6 Cogeneration Concepts

Modeling Cogeneration

Most energy users purchase their electricity requirements from a utility. Some large users can convert some of their waste heat into electricity when economics warrant it. Other users (residential and commercial) can purchase self-generation energy sources such as gas turbines and diesel-generators.

In the ENERGY2020 system, all energy used for heating is a candidate for cogeneration. The cost of cogeneration is the fixed capital cost of the investment plus the variable fuel costs (net of efficiency gains). This cogeneration cost is estimated for all fuels/technologies and compared to the price of electricity. The marginal market share for each cogeneration technology is based on this comparison. Figure A2.6 shows a simplified overview of the cogeneration structure. Cogeneration is restricted to consumers who directly produce part of their own electricity requirement. Qualifying Facilities (QFs), which generate power for resale to the utility, are considered independently by ENERGY 2020.

Appendix 3: REMI Policy Insight

REMI stands for Regional Economic Models, Inc. REMI Policy Insight includes a REMI model that has been built especially for the geographic area(s) in New Hampshire's customized version of the model. REMI's model-building system uses hundreds of programs developed over the past two decades to build customized models for each area using data from the Bureau of Economic Analysis, the Bureau of Labor Statistics, the Department of Energy, the Census Bureau and other public sources. Information provided by the New Hampshire Department of Employment Security specific to the state's economy was used to help develop the New Hampshire Energy Plan.

Founded in 1980, Regional Economic Models, Inc. (REMI) constructs models that reveal the economic and demographic effects that policy initiatives or external events may cause on a local economy. The REMI model is a structural model, meaning that it clearly includes cause-and-effect relationships. The model shares two key underlying assumptions with mainstream economic theory: households maximize utility and producers maximize profits.

In the model, businesses produce goods to sell to other firms, consumers, investors, governments and purchasers outside the region. The output is produced using labor, capital, fuel and intermediate inputs. The demand for labor, capital and fuel per unit of output depends on their relative costs, since an increase in the price of any one of these inputs leads to substitution away from that input to other inputs. The supply of labor in the model depends on the number of people in the population and the proportion of those people who participate in the labor force. Economic migration affects the population size. People will move into an area if the real after-tax wage rates or the likelihood of being employed increases in a region.

Supply and demand for labor in the model determine the wage rates. These wage rates, along with other prices and productivity, determine the cost of doing business for every industry in the model. An increase in the cost of doing business causes either an increase in price or a cut in profits, depending on the market for the product. In either case, an increase in cost would decrease the share of the local and U.S. market supplied by local firms. This market share combined with the demand determines the amount of local output. The model also has many other feedbacks. For example, changes in wages and employment impact income and consumption, while economic expansion changes investment and population growth impacts government spending.

The structure of REMI models of economies incorporates inter-industry transactions and endogenous final demand feedback. In addition, the model includes: substitution among factors of production in response to changes in relative factor costs, migration in response to changes in expected income, wage responses to changes in labor market conditions, and changes in the share of local and export markets in response to changes in regional profitability and production costs.

The power of the REMI model lies in its use of theoretical structural restrictions instead of individual econometric estimates based on single time-series observations for each region. The explicit structure of the model facilitates the use of policy variables that represent a wide range of policy options and the tracking of the policy effects on all the variables in the model.

REMI models generate forecasts by solving a large number of simultaneous equations, organized in five blocks as shown in Figure A3.1, which describes the underlying structure of the model. Each block contains several components that are shown in rectangular boxes. The lines and arrows represent the interaction of key components both within and between blocks. Most interactions flow both ways indicating a highly simultaneous structure. Block 1, labeled output linkages, forms the core of the model. An input-output structure represents the inter-industry and final demand linkages by industry. The interaction between block 1 and the rest of the model is extensive. Predicted outputs from block 1 drive labor demand in block 2. Labor demand interacts with labor supply from block 3 to determine wages. Combined with other factor costs, wages determine relative production costs and relative profitability in block 4 affecting the market shares in block 5. The market shares are the proportions of local demand in the region in block 1 and exogenous export demand that local production fulfills.

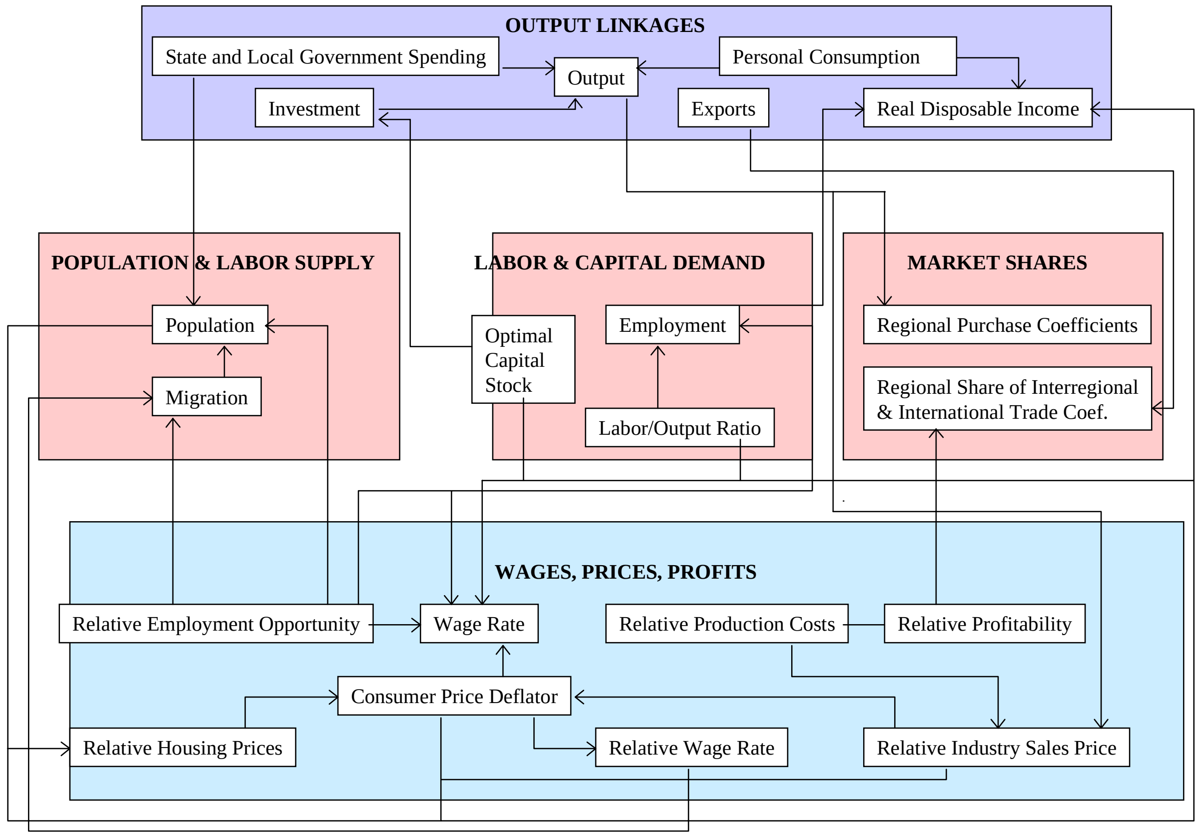

Figure A3.1. REMI Overview

The endogenous final demands include consumption, investment, and state and local government demand. Real disposable income drives consumption demands. An accounting identity defines nominal disposable income as wage income from blocks 2 and 4, plus property income related to population and the cohort distribution of population calculated in block 3, plus transfer income related to population less employment and retirement population, minus taxes. Nominal disposable income deflated by the regional consumer price deflator from block 4 gives real disposable income. Optimal capital stock calculated in block 2 drives stock adjustment investment equations. Population in block 3 drives state and local government final demand. The endogenous final demands combined with exports drive the output block.

Appendix 4: New Hampshire Energy Efficiency Programs

The five electric utilities, along with a diverse group of intervenors including ECS, PUC Staff, the Office of the Consumer Advocate, the Department of Environmental Services Air Resources Division, New Hampshire Legal Assistance, the Society for the Protection of NH Forests, the Conservation Law Foundation, and the Environmental Responsibility Committee of the Episcopal Diocese of NH, worked together to create a common set of statewide core programs. The programs are funded by the energy efficiency portion of the System Benefits Charge (SBC) that appears on customers' electric bills.

A4.1 "Core" Energy Efficiency Programs

A4.1.1Residential Programs

Energy Star® Lighting Program

Residential customers who purchase of Energy Star® rated light bulbs and fixtures can receive rebate coupons redeemable at participating retailers. Other lighting and select energy savings products will also be made available from a mail order catalog. A typical Energy Star® rated Compact Fluorescent Lamp (CFL) lasts up to 10 times longer than an equivalent incandescent bulb and uses 75% less energy. Rebate levels available for energy efficient lights and fixtures are: $3 towards compact fluorescent light bulbs; $10 towards exterior light fixtures; $15 towards interior light fixtures; and $20 towards torchiere lamps.

Energy Star® Appliance Program

Customers will receive a $50 rebate coupon towards the purchase of an Energy Star ® rated washing machine when purchased at a participating retailer. Energy Star® clothes washers use 35% to 50%

less water and 50% less energy per load.

Home Energy Efficiency Program

Customers can receive up to $2,500 in rebates and services for qualified energy efficiency improvements under this program, known as the Residential Retrofit Program. Improvements include insulation, thermostats, lighting upgrades, and efficient refrigerators, and a customized report helping customers analyze their home. This program is targeted first to customers with some permanently installed electric heat, and will then be offered to customers with high electric use.

Income Qualified Energy Efficiency Program

Qualified low-income customers living in an apartment or house, either rented or owned, can receive up to $3,600 in services ($5,900 if customers also qualify for the NH Weatherization Assistance Program), including a customized report analyzing their home, improvements including insulation, thermostats, lighting upgrades, and efficient refrigerators, and recommendations on how to use energy more efficiently.

NH Energy Star® Homes Program

The NH Energy Star® Homes Program encourages customers to take advantage of the benefits of building or renovating a single or multi-family energy efficient home with rebates up to $2,500. Energy Star® construction results in reduced monthly operating costs, improved homeowner comfort and a higher resale value, and environmental benefits.

A4.1.2 Commercial Programs

Small Business Energy Efficiency Program

This program assists small commercial and industrial customers (under 100 kW) by providing 50% of the installed cost of electrical energy efficiency improvements, including lighting; occupancy sensors; electric hot water measures; controls for walk-in coolers; air conditioning; and programmable thermostats.

A similar Large Business Energy Advantage Program assists business customers over 100 kW with financial and technical services for installation of new energy efficient equipment through the replacement of old, inefficient equipment in existing facilities. Rebates are available for lighting conversions and controls, ?energy efficient motors; variable frequency drives (VFDs); energy management systems; LED traffic lights as well as custom projects. The New Construction / Major Renovation Program offers a variety of rebates and technical assistance services to any commercial/industrial customers building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment.

Schools

Specifically designed to help schools access energy efficiency improvements, this program will pay for up to 100 percent of the incremental costs of energy efficiency projects.

More information on these energy efficiency programs can be found at www.nhsaves.com.

A4.2 Programs of the Governor's Office of Energy and Community Services (ECS)

ECS administers several DOE-funded energy programs, serving customers from the most energy-intensive industries, to schools and municipalities, to low income customers. The major energy programs administered by ECS are described at www.nhecs.org.

Federal Weatherization Program

The State of New Hampshire's Weatherization Assistance Program is designed to provide weatherization services to low-income persons throughout the state. The Weatherization Assistance Program reduces household energy use and costs by improving the energy efficiency of a participant's home. The overall goal of the Weatherization Assistance Program is to serve those low-income households that are most vulnerable to high energy costs and who would not otherwise have the means of making cost-effective energy conservation improvements to their homes.

The statewide Weatherization Assistance Program is administered by the Governor's Office of Energy and Community Services (ECS). The Weatherization Assistance Program operates on grants from the U.S. Department of Energy (DOE) and the U.S. Department of Health and Human Services Low Income Home Energy Assistance Program (LIHEAP). ECS subcontracts with the state's Community Action Agencies (CAPs) to operate and deliver weatherization services at the local level.

ECS's working relationship with the CAPs is valuable because it allows for better coordination with other social service programs or organizations that eligible households may not be aware of. Participants in the Weatherization Assistance Program receive a comprehensive home energy audit, including diagnostic testing performed by an ECS-certified energy auditor. Based upon the energy audit findings, a crew of trained workers will return to install the required weatherization measures. The priority order in which these measures are usually performed is:

- measures designed to reduce general heat waste;
- wall and/or attic insulation where appropriate;
- the evaluation of and some repair to heating systems (under certain circumstances, grossly inefficient heating systems may be replaced).

This conserves energy and improves the energy efficiency of the home, reducing energy costs, improving comfort, and positively impacting the health and safety of the occupants.