Ridgewood

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February 20, 2007

Via FedEx and Electronic Mail

Ms. Luly E. Massaro
Commission Clerk
Rhode Island Public Utilities Commission
89 Jefferson Boulevard
Warwick, Rhode Island 02889

Re: Docket 3765 -- National Grid Renewable Energy Standard Procurement Plan

Dear Ms. Massaro:

Enclosed please find ten copies of Surrebuttal Testimony of William P. Short III in the above-referenced docket.

Please contact me at 201.447.9000 if you have any questions.

Very truly yours,

Maria E. Haggerty

Enclosures

Copy: Docket 3765 Service List (via E-Mail only)

SURREBUTTAL TESTIMONY & ATTACHMENTS

OF

WILLIAM P. SHORT III

February 20, 2007

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William P. Short III Surrebuttal Testimony

Attachments

I. Introduction

Q. Please state your name and business address.

A. My name is William P. Short III, 947 Linwood Avenue, Ridgewood, New Jersey 07450.

Q. Please state your position.

A. I am the Vice President of Power Marketing of Ridgewood Power Management, LLC ("Ridgewood").

Q. Have you previously submitted testimony in this proceeding?

A. Yes. On January 17, 2007, I submitted testimony in this proceeding.

Q. What is the purpose of your surrebuttal testimony?

A. The purpose of my surrebuttal testimony in this proceeding is to respond to the issues raised by the testimony filed by National Grid and other intervenors and to the rebuttal testimony filed by National Grid.

II. Comments in Support of /In Opposition to National Grid Procurement Plan

Q. What aspects of National Grid's testimony, rebuttal testimony or Procurement Plan does Ridgewood support?

A. Ridgewood agrees with National Grid's assertions that:

- Long-term contracting at this time is speculative;[1]
- The issues facing any type of procurement plan are complex and that a different

contracting entity other than National Grid might be a better vehicle to resolve these issues;[2]

- The need for a workshop-like series of meetings between the parties is a preferred method and the better way to get all of the issues fully vetted;[3]
- Too many unknowns exist, which means that any conclusions reached today will likely lead to poor decisions once the facts are fully known.[4]

Q. What aspects of National Grid's testimony, rebuttal testimony or Procurement Plan does Ridgewood oppose?

A. Ridgewood believes that the supply of both Existing and New Renewable Certificates for the foreseeable future exceeds the requirements. Consequently, there is no need for long-term procurement contracts at this time. Instead, the Commission should order National Grid to procure its required Certificates via a short-term contract methodology, like the process outlined in Ridgewood's testimony of January 17, 2007.

First, with respect to Existing Renewable Certificates, Ridgewood believes that the supply should be approximately 6.8 million Certificates, once the owners of these facilities have registered with the Commission.[5] Even after discounting the Certificates taken out of this supply for the Connecticut, Massachusetts and Maine RPS programs, there remains a supply

1 R.T. Gerwatowski Rebuttal Testimony at 10, line 1-2.
2 R.T. Gerwatowki Rebuttal Testimony at 28, line 8-10.
3 R.T. Gerwatowki Rebuttal Testimony at 31, line 7-11.
4 M.J. Hager Rebuttal Testimony at 8, line 15.
5 See Attachment WPS-1. For example, during 2005, NEPOOL Generators generated 2.1 TWh of electricity from biomass, 4.3 TWh from hydro 30 MW and less, and 0.4 TWh from landfill gas.

many times the requirement for Existing Renewable Certificates of 2% of Rhode Island's retail load. Based on Ridgewood's review of available generation, the remaining supply should easily exceed the anticipated requirement for Existing Renewable Certificates of approximately 170 thousand Certificates. Accordingly, the traditional purpose for long-term contracts, e.g., to encourage the building of new renewable energy generators, is simply not there. Indeed, the facts suggest that the Commission's bigger problem may be that the eventual price for Existing Renewable Certificates of about $1.00 or less per Certificate may discourage the owners of existing generation from even filing the forms to qualify their facilities for the RES as Existing Renewable Generators.

For similar reasons, Ridgewood believes that the requirement for New Renewable Certificates will also be glutted for the foreseeable future, and, therefore, even New Renewable Certificates will likely be procurable for prices in the range of $1.00 or less per Certificate.

Ridgewood notes that other than a brief passage by National Grid on the number of generators that have submitted forms for qualification for the RES as New Renewable Generators,[6] no other intervenor has made the attempt that Ridgewood has made to determine, based on available generation data, whether the RES requirement for the Existing and/or New Renewable Certificates is short, in-balance or glutted for the near-term. Ridgewood suggests that, if others had undertaken the analysis it undertook, these persons would have reached the same conclusion that Ridgewood has – these markets are glutted, long-term contracts are not in the best interest of the public at this time and perhaps more importantly, this procurement proceeding should be postponed until 2009 at the earliest.

Q. Can you elaborate why Ridgewood believes that, for the near-term, the need for New Renewables requirement is satisfied?

A. First, the RES includes 30 MW and below hydro units, subject to certain conditions. No other high value New England RPS programs include these types of units except certain hydro units of 5 MW or less.[7] Thus, if qualified for the RES as New Renewable Certificates, most, if not all, of this potential supply will automatically gravitate to the RES. Some or all of the generation of these hydro units may become RES eligible based on whether they: (a) increase in their production above their Historical Generation Baselines subject to certain conditions; (b) make capital improvements (which requirement could qualify a substantial percentage of production as New Renewable); and/or (c) repower with new turbine-generators.

Ridgewood's rough estimate is that the first condition could produce annually as much as 1 million New Renewables Certificates and the second one could produce an additional ½ million New Renewables Certificates. Ridgewood notes from its analysis that, 30 MW and below hydro production in 2001 was 2.8 million MWh while for 2005 the production number was 4.3 million MWh. If only 15% of this 1.5 million MWh supply increase qualified as New Renewable Certificates, then the RES requirement for New Renewables

6 M.J. Hager Rebuttal Testimony at 9, line 3-8.
7 See Attachment WPS-2, pages 30-32 for details.

should be satisfied through 2010. Ridgewood further notes that, if only 5% of the total 2005 production from these hydro units qualified under the capital improvement test, then a similar supply of New Renewables Certificates is created and the RES requirement for New Renewables Certificates is satisfied for the near-term.

The impact of repowering of hydro units may be similarly significant. Ridgewood notes that it would not be unusual for a hydro unit to repower at three times its current capacity after an expenditure of only approximately $1 million per MW. These repowerings may be economical in the absence of any RES revenues. Given the large number of 30 MW and under hydro units that could repower (approximately 500 stations, representing nearly 1,000 MW of generation), Ridgewood believes that this development **alone** would more than satisfy the near-term needs for New Renewables Certificates.

In summary, given the current supply of existing hydro units below 30 MW that could produce New Renewable Certificates, the present RES regulations and the near-term requirements for New Renewables Certificates, Ridgewood believes that the owners of these units will qualify sufficient production to satisfy all of the RES requirements for the near-term.

Q. Other than hydro units of 30 MW or less, are there other generation technologies which could supply New Renewable Certificates?

A. Yes, there are several biomass plants with low or no Historical Generation Baselines **which**

presently do not participate in any high value RPS program (either because they do not meet certain requirements or are not currently operating). These are Chester (a 15 MW plant with zero vintage; not operating), Alexandria (a 15 MW plant with zero vintage; not operating), McNeil (a 52 MW plant with a 40% capacity factor during its vintage period; not qualified) and Ashland (a 34 MW plant with a zero vintage; not qualified). All are located in the New England Control Area except for Ashland, which is located in NMISA.

Q. What is your estimate of their annual production levels?

A. Annual production levels above their Historical Generation Baselines for these facilities is as follows:

- Chester and Alexandria, 120 GWh each;
- McNeil, 400 GWh less a vintage of 180 GWh, for net of 220 GWh; and
- Ashland, 270 GWh.

The aggregate annual production levels above their Historical Generation Baselines for these facilities is 730 GWh, approximately 8% of Rhode Island's retail load. All of which should qualify as New Renewable Certificates.

III. Other Issues Affecting Long-Term Contracts at this Time

Q. Did you consider any other issues which makes long-term contracting unnecessary for this procurement plan?

A. Yes, change and the rate of change. We are in a rapidly evolving market. What Ridgewood knew and believed in as little as three years ago about RPS programs and REC markets has dramatically changed. Ridgewood has been in the generation end of this business since 1997 and it has experienced at least three different phases of business – first, the Age of Enron; second, the Over Building & Collapse; and third, the Restructured Market. Each phase produced very different business behavior and created vastly different results.

Ridgewood firmly believes that this industry will be in its fourth phase by 2010. To rush into something as unforgiving as long-term contracts without knowing if there will be a shortage or a glut of New Renewable Certificates is foolish. The better approach is to let the RES evolve somewhat before making any decisions as to the viability of long-term contracting. To that end, Ridgewood concurs with National Grid on the need for a workshop-like series of meetings with the interested parties as the best way to get all of the issues, including using the EDC as a contracting entity for New Renewable Certificates, fully vetted. Ridgewood believes, however, that to hold such meetings during 2007 would not be as productive as starting in no earlier than the spring of 2009.

Q. Does this conclude your testimony?

A. Yes, it does.

ATTACHMENT WPS–1

Ridgewood Analysis of New England Renewables (2000-2005)

ANALYSIS OF NEW ENGLAND ELECTRIC PRODUCTION (GWh)

State	CY 2000		CY 2001		CY 2002		CY 2003		CY 2004		CY 2005	
	Energy	Percentage*	Energy	Percentage*	Energy	Percentage*	Energy	Percentage*	Energy	Percentage*	Energy	Percentage*
NE Retail Load**	125,394		126,485		128,029		130,778		132,520		136,369	
NE Generation**	109,924	87.7%	114,618	90.6%	120,538	94.1%	126,898	97.0%	129,189	97.5%	131,602	96.5%
NE Non-Renewable	96,887	77.3%	103,393	81.7%	108,395	84.7%	113,799	87.0%	116,271	87.7%	117,422	86.1%
NE Renewable	13,037	10.4%	11,225	8.9%	12,143	9.5%	13,099	10.0%	12,917	9.7%	14,180	10.4%
NE Biomass	2,172	1.7%	2,076	1.6%	1,964	1.5%	1,907	1.5%	1,822	1.4%	2,097	1.5%
NE Hydro (all sizes)	6,115	4.9%	4,365	3.5%	6,468	5.1%	6,391	4.9%	6,305	4.8%	7,284	5.3%
NE Hydro (< 5 MW)	667	0.6%	598	0.5%	819	0.6%	933	0.7%	887	0.7%	985	0.7%
NE Hydro (> 5 < 30 MW)	3,048	2.4%	2,164	1.7%	2,590	2.0%	3,053	2.3%	3,061	2.3%	3,348	2.5%
NE Hydro (> 30 MW)	2,401	1.9%	1,603	1.3%	1,959	1.5%	2,406	1.8%	2,357	1.8%	2,951	2.2%
NE Landfill Gas	302	0.2%	361	0.3%	354	0.3%	373	0.3%	377	0.3%	404	0.3%
NE MSW	4,438	3.5%	4,411	3.5%	4,444	3.5%	4,416	3.4%	4,400	3.3%	4,382	3.2%
NE Wind	9	0.0%	12	0.0%	13	0.0%	12	0.0%	13	0.0%	12	0.0%

* Percentage is the percent of New England Retail Load

** Excludes NMISA Generation and Load

ATTACHMENT WPS–2

Economic Impact of a New Hampshire RPS

Economic Impact of a New Hampshire Renewable Portfolio Standard

University of New Hampshire
Ross Gittell, Ph.D.
Matt Magnusson, MBA

February 2007

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1 Executive Summary

Main Findings:

- A NH Renewable Portfolio Standard (RPS) can:
  - help diversify NH's and the region's power generating capacity and reduce dependency on imported sources
  - increase the potential for new renewable energy development within the state and also help to support the continued operations of existing renewable energy resources

- There are costs associated with a RPS, however, the net economic and environmental benefits are expected to be positive for New Hampshire

- The modeled increase in retail costs to New Hampshire ratepayers would be less than 2% per year, or less than $1.25 per month for households

- The modeled economic development benefits would include 1100 full-time jobs and $1 million in new state revenue annually in 2025

- NH RPS demand combined with regional RPS demand is modeled to lead to new development in NH of 960 MW wind, 56 MW biomass, 15 MW landfill gas, & 33 MW solar by 2025

- Natural gas consumption would decrease as a result of a NH RPS reducing total NH electric costs by $300,000 in 2010 and $5.6 million in 2025

- With the regional energy market, a NH RPS does not guarantee in-state development of renewable energy facilities. Consideration should be given to complementing RPS with efforts to support renewable energy and related economic development. This could include long-term contracting for renewable energy and dedicated funding for renewable energy development

Background:

- About half the US states, 23, have RPS requirements
- In New England, New Hampshire is the only state not to have passed RPS legislation
- In New England there is a regional energy market. Any qualifying renewable energy generation in the region can be used to meet the requirements of any state in the region
- Renewable Energy Certificates (RECs) represent 1000 kWh (1 MWh) of renewable energy generation and are used for compliance of New England state RPS
- The Alternative Compliance Payment (ACP) is a "penalty payment" paid by the utility or the competitive electric supplier if they are unable to purchase enough RECs to meet their RPS obligation
- Currently, REC prices in the region for new renewable energy are at or near the Alternative Compliance Payment (ACP), but REC prices for existing renewable energy are significantly lower than the ACP (almost having no value)

Purposes of RPS:

- Reduce dependence on foreign and imported sources of energy
- Reduction of risk and volatility in energy costs
- Reduction of air pollution, including greenhouse gas emissions
- Foster new local employment and business development opportunities

RPS Requirements based on LSR-H-0208:

- A NH RPS would contribute 2% in 2010 and 11% in 2025 to the regional demand for new renewable energy

NH LSR-H-0208 RPS Requirements

Year	Class	% of Retail Load	Generation Required (MWh)
2010	Class I New	1%	122,000
	Class II Solar	0.04%	4,900
	Class III & IV Existing	6.5%	792,000
2025	Class I New	16%	2,340,000
	Class II Solar	0.3%	44,000
	Class III & IV Existing	7.5%	1,097,000

Estimated Regional Renewable Energy Supply and Demand

- There is sufficient potential generation supply to meet the 22 million MWh of projected regional RPS demand for new renewable energy generation by 2025

Modeled increases in retail costs to New Hampshire ratepayers of RPS in the state (Total retail electricity costs to NH ratepayers are currently $1.4 billion):

- $7,140,000 or 0.5% in 2008
- $30,000,000 or 1.8% in 2015
- $23,820,000 or 1.2% in 2025
- $0.33 to $1.24 increase in NH residential household average (580 kWh) monthly utility bill

Maximum retail costs (100% Alternative Compliance Payment or ACP):

- $13,327,000 or 0.9% in 2008
- $72,721,000 or 4.4% in 2015
- $159,877,000 or 8.0% in 2025
- $0.61 to $5.73 increase in NH residential household average monthly utility bill

Under a scenario reducing New England wind development potential by 50%, New Hampshire:

- RPS compliance costs increase from the base case scenario, but overall retail electric rate impact is modest
- $0.33 to $1.54 increase in NH residential household average monthly utility bill
- Employment and state revenue remain the same as the base case scenario
- Wind development decreases by 383 MW, but biomass development increases by 125 MW relative to the base case scenario

Recommendations:

- Utilize long-term contracting for power and RECs to assist in-state development
- Implement a renewable energy development fund financed through a renewable energy Systems Benefit Charge to assist in-state development
- Add an Energy Efficiency Class to RPS to reduce cost of RPS
- Consider the effectiveness and cost of the proposed NH class structure

2 Introduction

New Hampshire is considering implementing a Renewable Portfolio Standard (RPS) to promote increased generation of electricity from renewable energy resources. During the 2006 New Hampshire legislative session, legislation was proposed for the State to implement a RPS. The University of New Hampshire (UNH) was approached by the New Hampshire Department of Environmental Services (NHDES) to address some of the questions raised by the Legislature in regards to the economic costs and benefits of a State RPS.

The UNH research team worked with NHDES, the New Hampshire Public Utility Commission (NHPUC), renewable energy developers, government researchers and private consultants to help determine the economic impact of a RPS on New Hampshire. The majority of work consisted of reviewing other research related to renewable energy and state RPS, with a focus on research in the Northeast region of the United States. Funding for the study was provided through the NHDES.

This report is organized in the following manner. The initial portion of the report, Section 3 and 4, provides general information related to Renewable Portfolio Standards and an overview of relevant New England renewable energy legislation. Starting in Section 4.5 there are detailed demand and supply estimates for both new and existing renewable energy throughout the region. Section 4.7 provides supply and demand estimates specific to New Hampshire. Section 4.8 provides a description of New England RPS market activity for both new and existing renewable energy.

The report provides a detailed explanation of methodology and assumptions in Section 5. This is followed by specific cost analysis starting in Section 5.2. In section 5.3, there is specific discussion of New Hampshire economic development related to a RPS. In Section 6, the cost and development impacts of a scenario where New England wind potential is reduced by 50% is discussed. Section 7 provides some specific recommendations to take into account when drafting the RPS legislation. Findings of the report are presented in Section 8. Section 9 provides the supply curve utilized for analysis in 2010, 2015, 2020 and 2025. Section 10 provides definitions for acronyms used throughout the report.

3 Overview

Renewable energy refers to energy, including electricity, generated from sources that will not be depleted if used in a sustainable manner. Although the specific technologies that are considered renewable vary, they are generally considered to include solar, wind, geothermal, biomass, biogas and hydro. Renewable energy resources provide an alternative to more prevalent means of electrical power generation, including coal, nuclear, natural gas and oil[1]. These sources of energy are nonrenewable and will be depleted at some point in the future.

A Renewable Portfolio Standard (RPS) is a public policy designed to help influence the amount of electricity generated from renewable energy resources. RPS policies are meant to encourage the development of new renewable energy resources and to help maintain existing renewable energy resources. RPS policies influence demand in the marketplace for electricity generated from renewable energy. The expectation is that RPS driven demand will result in the development of new renewable energy facilities and support the continued operation of existing renewable energy facilities.

Federal legislation has been proposed in Congress to institute a national RPS. In the last congressional session, 14 separate bills were proposed to implement a federal RPS. However, federal legislation has yet to be enacted into law. Legislation at the state level has been significant. As of December 2006, 23 states and the District of Columbia had enacted some form of RPS legislation. Almost 6 out of every 10 Americans now live in a state that has enacted RPS legislation.

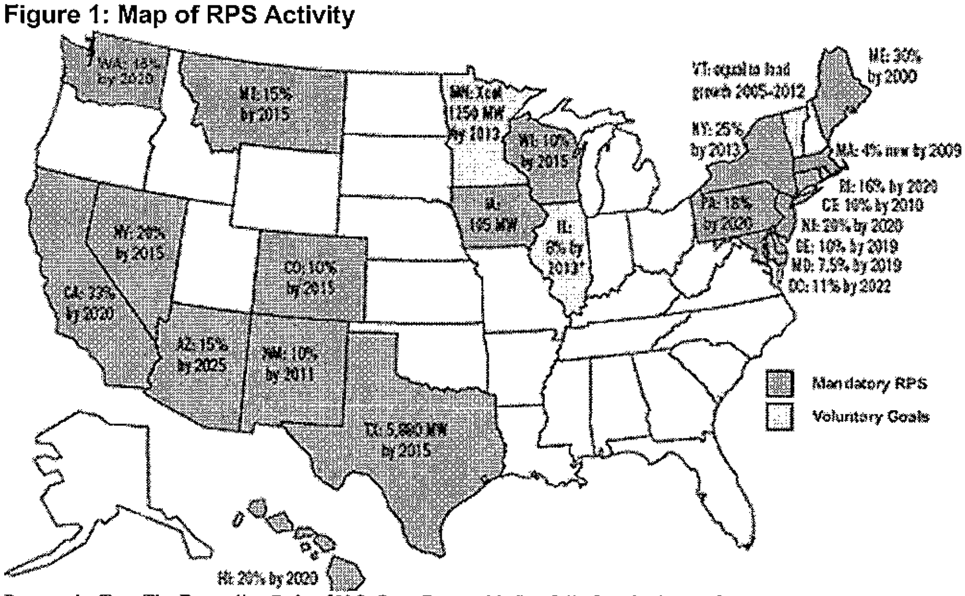
[1] In 2005, 84% of New England generation was from coal, nuclear, natural gas or oil. Data accessed from NEPOOL GIS October, 2006.

Table 1: RPS Legislation by State

State	Year Enacted	Preliminary Target	Final Target	Credit Trading Allowed?
Arizona	2001	0.2% by 2001	15% by 2025	No
California	2002	13% by 2003	33% by 2020	Yes
Colorado	2004	3% by 2007	10% by 2015	Yes
Connecticut	1998	4% by 2004	10% by 2010	Yes
Delaware	2005	1% by 2007	10% by 2019	Yes
Washington, DC	2005	4% by 2007	11% by 2022	Yes
Hawaii	2004	7% by 2003	20% by 2020	No
Illinois†	2005	2% by 2007	8% by 2013	No
Iowa	1991	None	105 MW	No
Maine	1999	None	30% by 2000	Yes
Maryland	2004	3.5% by 2006	7.5% by 2019	Yes
Massachusetts	1997	1% new by 2003	4% new by 2009	Yes
Minnesota	1997	1,125 MW by 2010	1,250 MW by 2013	No
Montana	2005	5% by 2008	15% by 2015	Yes
Nevada	1997	6% by 2005	20% by 2015	Yes
New Jersey	2001	6.5% by 2008	20% by 2020	Yes
New Mexico	2002	5% by 2006	10% by 2011	Yes
New York	2004	None	25% by 2013	Yes
Pennsylvania	2004	1.5% by 2007	18% by 2020	Yes
Rhode Island	2004	3% by 2007	16% by 2020	Yes
Texas	1999	2,280 MW by 2007	5,880 MW by 2015	Yes
Vermont	2005	None	Load growth by 2012	Yes
Washington	2006	3% by 2012	15% by 2020	Yes
Wisconsin	1999	None	10% by 2015	Yes

Source: Race to the Top: The Expanding Role of U.S. State Renewable Portfolio Standard, Pew Center on Global Climate Change, DSIRE State Database

Figure 1: Map of RPS Activity



Race to the Top: The Expanding Role of U.S. State Renewable Portfolio Standard, Pew Center on Global Climate Change, North Carolina Solar Center, DSIRE State Database

In the Northeast, New Hampshire is the only state that has not enacted RPS or "RPS-like" legislation to promote renewable energy resources. All of the other New England states have enacted RPS mandates with the exception of Vermont, which has implemented a voluntary requirement for utilities to meet load growth through renewable energy or energy demand reduction.

States are enacting Renewable Portfolio Standards for many different reasons, including:

- **To increase energy security** - Many states including New Hampshire, must import fuel used in power generation. This increases the risk of having inadequate levels of fuel in the case of geopolitical instability and natural disaster. Renewable energy resources located within the state or region can serve to increase power system reliability[2].

- **To hedge against rising and volatile fossil fuel energy costs-** Renewable energy resources can help diversify the sources of supply of electricity. In recent years, rising global demand for fossil fuels has contributed to increased energy costs[3]. Many renewable technologies, such as wind, solar and hydro, have no associated fuel costs and can therefore act as a hedge against rising and volatile fossil fuel prices.

- **To reduce air pollution including greenhouse gas emissions** -Several different air pollutants including sulfur dioxide, nitrogen oxides, mercury and fine particulate matter are all associated with fossil fuel generation. These pollutants affect public health and degrade environmental quality. In recent years, increased scientific evidence of global warming has heightened the concern and interest in limiting carbon dioxide from fossil fuel sources[4]. Renewable energy offers the benefit of little to no air emissions associated with the power generation.

- **To foster new local employment and economic development opportunities-** Renewable energy development can provide, particularly in states with limited nonrenewable sources, local business development and employment opportunities. Renewable energy helps keep consumer expenditures that would have otherwise been spent on imported fuel, within the state, further helping to boost the local economy[5].

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[2] "American Energy: The Renewable Path to Energy Security," Center for American Progress and Worldwatch Institute, September 2006, Available at http://images1.americanprogress.org/il80web20037/americanenergynow/AmericanEnergy.pdf

[3] Federal Reserve Board Chairman Ben S. Bernanke, Semiannual Monetary Policy Report to the Congress, before the Committee on Financial Services, U.S. House of Representatives February 15, 2006, Available at http://www.federalreserve.gov/boarddocs/hh/2006/february/testimony.htm

[4] "Global Fingerprints of Greenhouse Warming: A Summary of Recent Scientific Research," Pew Center on Global Climate Change, March 2006, Available at http://www.pewclimate.org/docUploads/Pew%20Center%5FGlobal%20Fingerprints%5F3%2E06%2Epdf

[5] "The Work That Goes In Renewable Energy," Renewable Energy Policy Project, November 2001, Available at http://www.crest.org/articles/static/1/binaries/LABOR_FINAL_REV.pdf

4 Background

4.1 Renewable Portfolio Standards

A Renewable Portfolio Standard (RPS) is a public policy designed to increase the use of renewable energy resources. The specifics of RPS policies and legislation vary. A RPS usually requires a specific percentage of electricity sold to retail customers come from renewable energy resources. RPS requirements typically start at relatively low percentages that gradually increase over a period of time to higher percentages.

RPS legislation from state to state varies in terms of required percentage, eligibility, definition of different renewable technologies and the inclusion of existing renewable energy technologies. Often, there will be separate classes for new and existing renewable energy technologies.

In the case of many RPS, including the RPS of the states in the New England region, a Renewable Energy Credit (REC) is utilized to satisfy compliance with the standard. A REC is a tradable entity that represents 1000 kWh (1 MWh) of renewable power generation. RECs can be traded separately from the electricity generated. A renewable energy generator may sell the wholesale electricity to one entity, such as a utility or competitive electric supplier, and the RECs to another entity; the entities can be located in different states.

Because electricity generated from renewable and nonrenewable resources are indistinguishable in the power grid, RECs provide the accounting mechanism to track power generation from renewable energy sources. For RPS compliance, the utility or competitive electric supplier is responsible to purchase RECs to cover the required percentage of their customer electricity load.

Often the price that a renewable energy generator must sell its electricity for (to cover expenses, financing and a reasonable rate of return in its investment) is higher than the current market price for wholesale electricity. RECs provide an additional source of revenue that helps bridge the gap between a generator's revenue requirements and wholesale electricity market prices.

The price of a REC is determined by supply and demand within the RPS markets. If supply and demand are relatively well matched, meaning that the amount of renewable generation is adequate to meet the amount required by the RPS, then the market price of a REC would be expected to equal the marginal cost of the last generator able to fill the RPS demand[6].

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[6] "Massachusetts Renewable Portfolio Standard Cost Analysis Report," La Capra Associates et al., December 2000, Available at http://www.mass.gov/doer/programs/renew/rps-docs/fca.pdf

If the supply of RECs is high, meaning that more electricity from renewable energy is being generated than is required by a RPS, then the price would be expected to decrease below the marginal cost. If the supply of RECs is low, meaning that not enough electricity from renewable energy is being generated to meet RPS demand, then the price would be expected to increase above the marginal cost.

Each state RPS essentially caps the maximum price of a REC through a mechanism called an Alternative Compliance Payment (ACP). An ACP is a "penalty payment" established in the RPS legislation that must be made by either the utility or the competitive electric supplier if they are unable to purchase the required number of RECs to cover their customer load percentage requirement. Typically, these payments go into a fund established to help support the development of renewable energy resources.

REC demand can be met from renewable energy technologies located in other states within the same power pool or even adjacent power pools if electricity is also imported in with the RECs. This consideration is especially relevant in New England where all the New England states share the same power grid. An eligible renewable energy technology for a specific state RPS can be met by a facility developed within any state in the New England power pool.

4.2 New Hampshire Renewable Energy Overview

In 2005, 2.3 million MWh of electricity was generated from 576 MW of renewable energy facilities in New Hampshire. This accounted for 10% of overall New Hampshire generation. In 2006, renewable energy capacity in New Hampshire increased to 693 MW. Renewable energy capacity accounted for 16% of overall NH capacity.

Renewable energy is making significant contributions to New Hampshire's energy consumption. New Hampshire reached a peak usage on August 2, 2006, of 2506 MW. During that peak, New Hampshire generated 471 MW, almost 20% of peak, from hydro and wood based renewable resources.

Two recent examples of new renewable generating capacity that have benefited from regional RPS are the wood fired generating facility in Whitefield and the Northern Wood Power project in Portsmouth.

The 14.4 MW wood-fired generating facility in Whitefield, formerly operating under a rate order with Public Service Co. of New Hampshire (PSNH), was refurbished after having been out of service for several years. The facility generates RECs that are eligible for the Connecticut Class I RPS. The plant went back on line in August 2005.

PSNH's Northern Wood Power project converted a 50 MW coal boiler at the Schiller Station in Portsmouth to generate 50 MW from wood chips. The RECs from this project are eligible to be used in both the Massachusetts and Connecticut Class I RPS. The project went on line in December 2006.

4.3 New England Renewable Portfolio Standards

In New England, the states of Massachusetts, Maine, Rhode Island and Connecticut have Renewable Portfolio Standards that are currently in effect. Vermont does not have a RPS but has implemented a voluntary requirement for renewable energy development that becomes a mandatory RPS in 2013 if certain goals are not reached. New Hampshire is the only state in New England that has not passed RPS or related legislation.

Massachusetts is the only RPS in New England that specifically requires only new renewable energy. All of the other RPS in the region have provisions for both new and existing renewable energy. For the most part, the different New England state RPS agree on the core technologies for new renewable energy facilities. Between the different New England RPS, however, there are greater discrepancies in the handling of existing generation.

Each of the New England RPS have different renewable energy percentage requirements and definitions of renewable energy technologies. However, these definitions overlap and specific renewable energy facilities can be used to satisfy demand in several different RPS. This creates situations where RPS requirements of different states may compete for specific portions of renewable energy supply.

Table 2: Summary of Classes in New England RPS

		Classes					Alternative Compliance Payment*				
	RPS Start Date	New only	Existing only	Mixed (New and Existing)	Solar only	Efficiency	New only	Existing only	Mixed (New and Existing)	Solar only	Efficiency
CT	2004	X		X		X	$55		$55		$55
MA	2003	X					$50 per MWh(in adjusted 2003 $)				
ME	2000			X					Not defined		
NH (LSR-H-0208)		X	X		X		$56 per MWh(in adjusted 2008 $)	$28 per MWh(in adjusted 2008 $)		$150 per MWh(in adjusted 2008 $)	
RI	2007			X					$50 per MWh(in adjusted 2003 $)		
VT											

*As defined in the state RPS legislation

4.3.1 Massachusetts Renewable Portfolio Standard

Massachusetts was the first state in New England to enact a RPS. In 1997, legislation was passed and the RPS began in 2003 with a 1% requirement of renewable energy share of electricity sales. The requirement increases to 4% by 2009 and then increases 1% annually until the Massachusetts Department of Energy Resources ends additional resource requirements. Massachusetts has one class that primarily accepts new renewable energy facilities.

To qualify in Massachusetts as new, the renewable resource must have been installed after December 31, 1997. There is a "Vintage Waiver" provision for resources constructed before December 31, 1997. The portion of generation from qualifying vintage units that is greater than the average historical generation rate from 1995-1997 is eligible.

Qualifying Resources:

- Solar
- Wind
- Hydropower under 30 MW
- Geothermal
- Ocean Thermal/Wave
- Biomass including landfill methane, biogas, and bio-diesel
- Biomass co-firing with fossil fuels
- Fuel cells using renewable fuels

4.3.2 Connecticut Renewable Portfolio Standard

In 1998, Connecticut became the second New England state to legislate a RPS. Connecticut's RPS has two separate classes for renewable energy resources. Class I generally refers to the renewable energy facilities constructed after July 1, 2003, with some older facilities being potentially eligible. Class II includes renewable energy facilities built before July 1, 2003 and also includes some additional types of technologies.

The first compliance year in Connecticut was 2004 where each utility or competitive electric supplier was required to cover 1% of its retail load with Class I and 3% of its retail load with Class I or Class II. The 3% requirement remains the same over time and is expected to be only filled using Class II. The requirement for Class I increases to 7% by 2010.

In 2005, Connecticut established a third class, Class III, for energy efficiency and energy demand reductions. Utilities and competitive electric suppliers are required to meet 1% of their retail load from Class III in 2007, increasing over time to 4%.

Qualifying Resources:

- Class I
  - Solar
  - Wind
  - New sustainable biomass (no Construction and Demolition debris)
  - Landfill gas
  - Fuel cells (using renewable or non-renewable fuels)
  - Ocean thermal power, wave or tidal power
  - New run-of-the-river hydropower facilities with a maximum capacity of 5 MW
- Class II
  - Trash-to-energy facilities
  - Biomass facilities not included in Class I
  - Older hydropower facilities under 5 MW
- Class III
  - Customer-sited combined-heat-and-power (CHP) systems with a minimum operating efficiency of 50% installed at commercial or industrial facilities on or after January 1, 2006
  - Electricity savings created at commercial and industrial facilities from conversion and load-management programs begun on or after January 1, 2006.

4.3.3 Maine Renewable Portfolio Standard

Maine passed legislation in 1999 requiring that 30% of retail customer load come from renewable energy resources. Maine has only one class for both new and existing generation. The RPS does not require an increase in percentage over time. While the 30% requirement is the highest level in the country, it is deemed not to be a significant factor in the regional and prospective NH RPS markets.

Maine has more than sufficient existing renewable energy generation to meet the RPS requirement. In 2004, the generation from renewable resources in Maine was almost 60% of its retail load, far exceeding the 30% requirement.

Qualifying Resources (must be under 100 MW):

- Fuel cells
- Tidal power
- Solar
- Wind
- Geothermal
- Hydroelectric
- Biomass
- Municipal solid waste in conjunction with recycling

4.3.4 New Hampshire Renewable Portfolio Legislation

In 2007, LSR-H-0208 was submitted by prime sponsor Representative Suzanne Harvey. It seeks to establish a Renewable Portfolio Standard for New Hampshire.

LSR-H-0208 proposes four classes of renewable energy, Class I for new renewable energy, Class II for new solar installations, Class III for existing biomass and biogas, and Class IV for existing small hydropower. LSR-H-0208 defines new renewable energy as having commercial operation after January 1, 2006. The percentage requirements used in this analysis are listed below in Table 3.

Table 3: NH RPS Percentages

Category	2008	2009	2010	2011	2012	2013	2014	2015-2025
Class I	0%	0.5%	1%	2%	3%	4%	5%	1% Additional per year
Class II	0%	0%	0.04%	0.08%	0.15%	0.2%	0.3%	0.3%
Class III	3.5%	4.5%	5.5%	6.5%	6.5%	6.5%	6.5%	6.5%
Class IV	0.5%	1%	1%	1%	1%	1%	1%	1%

Qualifying Resources:

- Class I
  - Solar
  - Wind
  - Geothermal
  - Fuel cells utilizing renewable fuels
  - Ocean thermal, wave, or tidal
  - Biogas from anaerobic digestion, including landfill methane
  - Biomass less than or equal to 50 MW
  - Incremental output over the historical generation baseline for an existing renewable energy resource attributable to significant capital investments performed after January 1, 2006
  - Class III or Class IV that has been shut down for at least three years and made significant capital investments
- Class II
  - Solar
- Class III
  - Biogas from anaerobic digestion, including landfill methane
  - Biomass under 25 MW
- Class IV
  - Hydropower facilities less than or equal to 5 MW that have up and down stream fish facilities

4.3.5 Rhode Island Renewable Portfolio Standard

The Rhode Island RPS requirement was passed in 2004 and takes effect in 2007 with a 3% requirement. The overall RPS requirement increases to 16% by 2020 and remains fixed at that percentage thereafter. Rhode Island does not have separate classes for new and existing. Rhode Island allows a maximum of 2% of the RPS to be met with existing resources for any compliance year. Rhode Island requires that for the facility to be considered new, it must be built after December 31, 1997.

Qualifying Resources :

- Solar
- Wind
- Hydropower under 30 MW
- Geothermal
- Ocean Thermal/Wave
- Biomass including landfill methane, biogas, and bio-diesel
- Biomass co-firing with fossil fuels
- Fuel cells using renewable fuels
- Specifically excludes Waste to Energy

4.3.6 Vermont Renewable Portfolio Goal

Vermont does not have a Renewable Portfolio Standard. In 2005, Vermont passed legislation to establish a renewable portfolio goal. The legislation encourages the state electric utilities to use energy efficiency and new renewable energy resources to meet its total incremental energy growth between January 1, 2005, and January 1, 2012. A new renewable resource is defined as being constructed after December 31, 2004.

The amount of renewable energy that each utility is encouraged to supply is capped at 10% of its 2005 total retail electric sales. If this goal is not achieved by 2012, the voluntary goal will become a mandatory RPS in 2013.

The Vermont legislation is expected to have little to no impact on the compliance-driven demand for new renewable energy in New England and New Hampshire. Vermont has the lowest electricity consumption of all the New England states and it is calling only for the incremental energy increase. Furthermore, Vermont has one of the nation's most aggressive energy efficiency efforts and may experience little to no load growth[7].

Of particular note is its allowance of new hydroelectric projects of up to 200 MW as an eligible resource. This is unusual as most RPS tend to be supportive of only smaller size

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[7] New England Wind Forum, Volume 1, Issue 2, December 2006, Available at http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/new_england/newf_newsletter_2006_12.pdf

hydropower. Any new projects of that scale would easily allow Vermont to meet any potential incremental load growth.

Qualifying Resources:

- Hydropower (up to 200 MW)
- Methane from landfill gas
- Anaerobic digesters and sewage-treatment facilities
- Specifically excludes Municipal Solid Waste
- Also allows other unnamed technologies that generate electricity from "a resource that is being consumed at a harvest rate at or below its natural regeneration rate"

4.4 Supporting Economic Programs

Some New England states have implemented programs separate from their respective RPS (or in the case of Vermont, voluntary goals) that complement their RPS programs in promoting renewable energy business development.

An in-depth analysis of all of the different New England state programs implemented to promote renewable energy is beyond the scope of this study. However, there were some programs that would be worthwhile to consider when developing the NH RPS legislation. Specifically, New Hampshire should consider renewable energy investment funds and allowing renewable energy facilities to enter into long-term contracts with utilities.

4.4.1 Renewable Energy Investment funds

All of the New England states except for New Hampshire have enacted legislation establishing a renewable energy investment fund. These funds support the development of renewable energy resources within the respective states. Connecticut and Massachusetts have particularly ambitious programs to develop renewable energy resources. The funds in these states have invested a total of $250 million in promoting the development of renewable energy resources.

Vermont has a program that is just beginning and Maine's program does not appear to be having a significant impact on development. Rhode Island's program is in transition with oversight of the fund being switched over to the state utilities.

The funding mechanisms for the funds vary. Rhode Island, Connecticut and Massachusetts finance their renewable energy funds through a surcharge on electric utility bills. Vermont's fund is financed by one energy company in exchange for permission to store radioactive waste on-site at a nuclear power plant. Maine's fund is financed through a voluntary contribution by retail electricity consumers.

Table 4: Summary of New England State Renewable Energy Funds

	Funding Mechanism	2006 Systems Benefit Charge (mill per kWh)	Estimated 2007 Funds Generated	Receives RPS Alternative Compliance Payments	Management
CT	Systems Benefit Charge	1	$35 million	Yes	Quasi-public
MA	Systems Benefit Charge	0.5	$25 million	Yes	Quasi-public
ME	Customer Donation	Not Applicable	$10,000	No	Quasi-public
RI	Systems Benefit Charge	0.3	$3.5 million	No	State Energy Office
VT	1 Powerplant	Not Applicable	$6 million	Not Applicable	Utility Commission

4.4.1.1 Connecticut Clean Energy Fund

The Connecticut Clean Energy Fund (CCEF) was created in 1998 as part of legislation deregulating the state's electric-utility industry. The fund's purpose is to promote growth of renewable energy sources in the state. Programs under the CCEF are divided into two main categories: community programs and clean energy funding.

Community programs are designed to increase public awareness about renewable energy. The program develops renewable energy exhibits, provides educational materials and assists communities in voluntary purchases of renewable energy.

Clean energy funding in Connecticut consists of many different programs that provide financial and development assistance for renewable energy technologies. These programs include solar rebates, funding for on-site renewable power generation, long-term contracts and startup financing for private companies.

The CCEF is administered by Connecticut Innovations, a quasi-governmental investment organization with guidance from the Clean Energy Advisory Committee. The committee membership includes members of the Legislature and Connecticut's Governor.

The CCEF is financed by a surcharge on ratepayers' electric utility bills. In 2000, the charge was set at $0.0005 per kWh(0.5 mill per kWh), rising to $0.00075 per kWh (0.75 mill per kWh) in 2002 and $0.001 per kWh (1 mill per kWh) in 2004. Through April 2006, the program had collected $117 million and had funded projects, commitments and program allocations in excess of $100 million.

4.4.1.2 Maine Renewable Resource Matching Fund

Maine passed legislation in 1998 with deregulation of their electric utility industry that led to the development of the Renewable Resource Matching Fund (RRMF). This fund provides grants of up to $50,000 for each renewable energy project. This fund has a couple of unique features. It is only available to the University of Maine system, the Maine Maritime Academy, Maine Technical College System and nonprofit organization demonstration projects. Another unique feature is that it is funded solely through voluntary contributions by allowing customers the option of checking off a contribution of $1, $5, $10 or other amount on their monthly electricity bill.

This fund is administered by the Maine Technology Institute (MTI), a state funded, private non-profit organization. Maine's renewable energy fund does not appear to be very effective. As of April 2006, it had only $70,000 in funds and had funded only one $10,000 project in fiscal year 2006.

4.4.1.3 Massachusetts Renewable Energy Trust Fund

The Massachusetts Renewable Energy Trust Fund was established as part of Massachusetts deregulation of the electric utility industry in 1997. The trust programs are divided into four different categories: clean energy program, green buildings, industry and investment, and policy.

The clean energy program works to increase both supply and demand through supporting renewable energy projects and providing public education. This program includes technical and financial resources for site feasibility, promotion of voluntary renewable energy purchases and activities to increase public awareness.

The green buildings program also provides financial and technical resources for increased on-site development including solar rebates. The industry and investment program provides capital financing options for companies in the early stage of development. The policy program seeks to work with stakeholders to reduce market and regulatory barriers to renewable energy.

The fund is administered by the Massachusetts Technology Collaborative (MTC), a quasi-public research and development entity. The Massachusetts Division of Energy Resources (DOER) and an advisory board oversee the MTC.

The fund is financed by a surcharge on ratepayers' electric utility bills. The charge has varied from $0.00075 cents per kWh (0.75 mill per kWh) in 1998, to as high as $0.00125 per kWh(1.25 mill per kWh) in 2000. The charge is currently set at $0.0005 per kWh (0.5 mill per kWh) and is expected to remain at this level. In the first five years of the program, total funding from the charge was $150 million and currently is receiving approximately $25 million per year.

4.4.1.4 New Hampshire System Benefits Charge

New Hampshire does not have an established renewable energy fund. The state does have a System Benefits Charge of $0.003 per kWh (3 mill per kWh) that generates approximately $35 million annually. Funds from this program have been used to finance energy efficiency programs and provide financial assistance for low-income residents. In the 2006 legislative session, House Bill 1690 was introduced to allow funds from the Systems Benefit Charge to be used to fund renewable energy technologies. The bill passed both the House and the Senate with amendment; however the bill never made it out of Conference Committee.

4.4.1.5 Rhode Island Renewable Energy Fund

The Rhode Island Renewable Energy Fund (RIREF) was created in 2002 when legislation was passed to dedicate $0.0003 per kWh (0.3 mill per kWh) to renewable energy from the current systems benefit charge of $0.0023 per kWh (2.3 mills per kWh) on the electric bills of Rhode Island.

These charges are collected by the electric distribution company from electricity consumers and transferred to the Rhode Island State Energy Office (RISEO), which has responsibility for administering the Fund. In July 2007, the administration of the RIREF programs will be transferred to the state's utilities, with oversight from the RISEO.

Programs under the fund are divided into three key areas: education and outreach, support of the voluntary renewable energy markets and renewable energy funding. Programs of note are solar rebate programs, funding of feasibility studies and project development assistance.

Potential alternative compliance payments resulting from the Rhode Island RPS will go into a separate Renewable Energy Development Fund managed by the Rhode Island Economic Development Corporation (EDC). The EDC can use the funds to enter into long-term contracts for renewable energy certificates.

4.4.1.6 Vermont Clean Energy Development Fund

Vermont passed legislation in 2005 that established Vermont's Clean Energy Development Fund (CEDF). This fund can be used for projects other than just renewable energy, including combined heat and power and other energy efficiency resources. The Vermont Department of Public Service (DPS) is in the process of creating a five-year strategic plan for expenditure of the funds.

The most unique feature of the Vermont program is how it is funded. Entergy, owner of the Vermont Yankee nuclear power plant, has entered an agreement with the state of Vermont to pay $6 million to $7.2 million into the fund on an annual basis. In return, Entergy will be permitted to store spent nuclear fuel at the Yankee plant through 2012. There no other sources of funding for the fund.

4.4.2 Long-term contracts

Deregulation of the electric utility industry has prevented utilities from entering into long-term contracts for power delivery. This has presented a problem for renewable energy developers. Developers are concerned that for a project to obtain financing, they need to be able to enter into long-term contracts with creditworthy entities, such as utilities[8].

To address this issue, Connecticut, Maine and Vermont have all passed legislation that allow and encourage renewable energy facilities to enter into long-term power contracts with utility companies. Massachusetts offers a different program which involves a long-term contract option for RECs only.

Table 5: Summary of New England State Long-term Contract Incentives

	Long-Term Contracts	
	Power & RECs	RECs only
CT	X	
MA		X
ME	X	
VT	X	

4.4.2.1 State Summary

In 2003, Connecticut established the Connecticut Clean Energy Fund's (CCEF) Project 100 Initiative requiring state electric utilities to enter into 10-year minimum contracts to obtain at least 100 MW of Class I renewable energy. These contracts can include a renewable premium of up to 5.5¢ per kWh. Projects must be in Connecticut to receive financing. The first round of funding was held in 2005 and financed three projects with a total capacity of 34 MW. A second round of funding is currently in process for 85 MW total.

In 2006, Maine enacted legislation that created a goal of increasing the percentage of new renewable energy capacity by 10% by 2017. To help obtain this goal, the Maine PUC was authorized to direct investor-owned utilities to enter into long-term contracts for new renewable energy facilities in Maine.

[8] " Southern California Edison Signs Largest Wind Energy Contract in U.S. Renewable Industry History February 2005," Edison International, December 2006, Available at http://www.edison.com/pressroom/pr.asp?id=6487

In Vermont, the Sustainably Priced Energy Enterprise Development (SPEED) program encourages Vermont's utilities to secure long-term contracts with Vermont renewable energy sources. Vermont enacted this program at the same time as the renewable portfolio goal and it takes effect in 2007.

In Massachusetts, there is a program called the Massachusetts Green Power Partnership (MGPP) administered by the Massachusetts Technology Collaborative (MTC). This program offers an innovative solution for providing long-term contracts with renewable energy facilities that does not require long-term power contracts between the utilities and renewable energy facilities. The MTC will directly enter into long-term contracts with renewable energy facilities only for their RECs, not their power. It offers three different types of contracts:

1. **Purchase agreements-** the MTC will purchase a specified quantity of RECs at a specified price from a renewable generator.
2. **Put options-**a renewable generator secures the option to sell RECs to MTC at a specified price.
3. **Price collars (combined put and call options)-** a renewable generator secures the option to sell RECs to MTC at a specified price and the MTC has the option to purchase RECs from the generator at a specified higher price.

Another feature of the Massachusetts Green Power Partnership is that renewable energy facilities from other New England states can participate in this program. This is the only state long-term contract program that is available for facilities outside of the state originating the program.

4.4.2.2 Costs Associated with Long-Term Contracts

In a study examining a Vermont State RPS, the analysis included the expected costs of a 2% RPS when filled through RECs versus long-term contracts. The cost of market based procurement of RECs to fill the RPS was calculated in the same manner as this study, using marginal renewable cost. The expected costs when using long-term contracts were calculated using the average renewable cost. In other words, in the case of market-based RECs, the renewable premium for all generating facilities is based on the last generating facility able to meet the RPS. This contrasts with long-term contracts where the renewable premium paid is equal to the renewable premium required for that project.

The Vermont RPS study found projected costs of similar magnitude to this study when utilizing market-based RECs. For example, this study found that in 2015, the modeled renewable premium would be $17.20 per MWh and the Vermont RPS study projected the expected renewable premium to the $19.50 per MWh. The Vermont RPS study found significant reductions in cost associated with using long-term contracts to meet the RPS.

The renewable energy premium was 50% to 65% less when long-term contracts were utilized to meet RPS demand[9].

Table 6: Vermont RPS Study-Cost impacts of 2% Vermont RPS

	RECs	Long-Term Contracts	
	Renewable Premium ($/MWh)	Renewable Premium ($/MWh)	% Difference
2008	19.95	7.13	-64%
2009	23.1	8.46	-63%
2010	22.88	8.92	-61%
2011	22.67	9.39	-59%
2012	22.46	9.85	-56%
2013	21.5	9.76	-55%
2014	20.53	9.67	-53%
2015	19.57	9.58	-51%

Source: Synapse Energy Economics Inc., Potential Cost Impacts of a Vermont Renewable Portfolio Standard

4.4.2.3 Risks Associated with Long-Term Contracts

It is also important to point out the risks associated with long-term contracts. New Hampshire has first-hand experience in the risks of long-term contracts for renewable energy. In response to energy concerns in the late 1970s, the New Hampshire Legislature passed the Limited Electrical Energy Producers Act (LEEPA), to promote the development of renewable energy resources through long-term contracts with the utility companies.

Several biomass plants and small hydroelectric dams were built in New Hampshire as a result of the legislation. As energy prices eased, many of these contracts proved to have rates that far exceeded market rates. In 2001, when Public Service Company of New Hampshire restructured, the most significant stranded cost was the buyout of LEEPA contracts valued at approximately $1 billion[10].

4.5 New England RPS Demand Projections

The current New England state RPS in total will require an estimated 3 million MWh from new renewable energy generation and 5 million MWh from existing renewable energy generation in 2007. By 2025, it is projected that the New England state RPS in total will require 22 million MWh from new renewable energy generation and 5.5 million MWh from existing renewable energy generation.

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[9] "Potential Cost Impacts of a Vermont Renewable Portfolio Standard," Synapse Energy Economics, October 2003, Available at http://www.synapse-energy.com/Downloads/SynapseReport.2003-10.VT-PSB.Cost-Impacts-VT-RPS.03-32.pdf

[10] Commissioner Tom Franz, New Hampshire Public Utility Commission, December 16, 2004

Annual demand for new renewable energy is expected to increase 560% from 2007 to 2025 (annual growth rate of 11%) because of New England RPS requirements. Annual demand for existing renewable energy is expected to increase a modest 10% from 2007 to 2025 (annual growth rate of 0.5%) due to New England RPS requirements.

Table 7: New England State RPS Requirements

	CT			ME	MA	RI	
	I	II	III			New	Existing
2007	3.5%	3%	1%	30%	3%	1%	2%
2008	5%	3%	2%	30%	3.5%	1.5%	2%
2009	6%	3%	3%	30%	4%	2%	2%
2010	7%	3%	4%	30%	5%	2.5%	2%
2015	7%	3%	4%	30%	10%	8%	2%
2020	7%	3%	4%	30%	15%	14%	2%
2025	7%	3%	4%	30%	20%	14%	2%

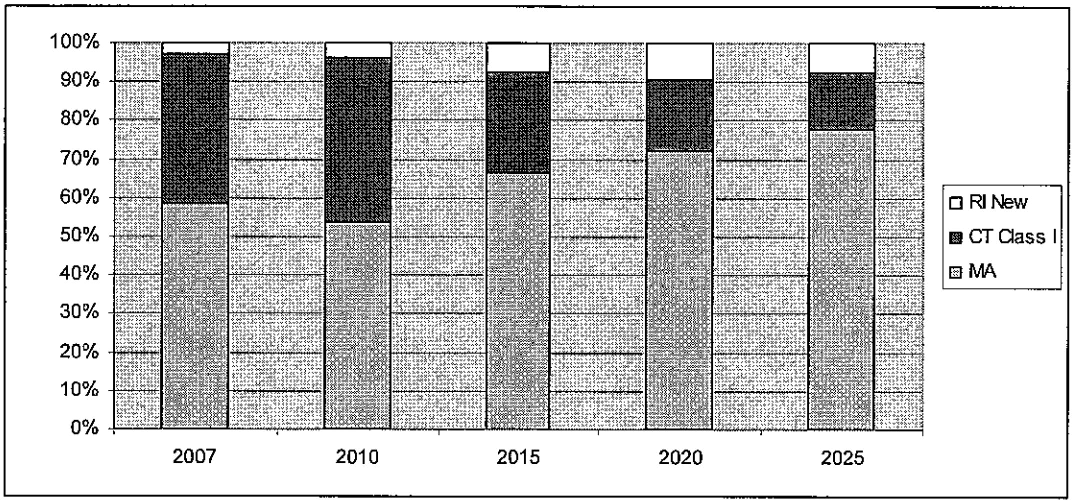
Table 8: Projected Demand from New England RPS (Thousands of MWh)

	CT			ME	MA	RI	
	I	II	III			New	Existing
2007	1,169	1,002	334	3,767	1,762	82	165
2008	1,691	1,014	676	3,786	2,087	125	167
2009	2,054	1,027	1,027	3,805	2,422	170	170
2010	2,425	1,039	1,386	3,824	3,073	215	172
2015	2,577	1,104	1,472	3,921	6,629	742	185
2020	2,738	1,173	1,564	4,021	10,723	1,398	200
2025	2,909	1,247	1,662	4,123	15,419	1,504	215

The Massachusetts RPS currently is and will very likely continue to be the most influential RPS for new renewable energy in New England. In 2007, it is estimated to account for 58% of the demand. By 2010, its percentage of overall demand decreases slightly to 54%. By 2025, Massachusetts is estimated to account for almost 80% of new renewable energy demand.

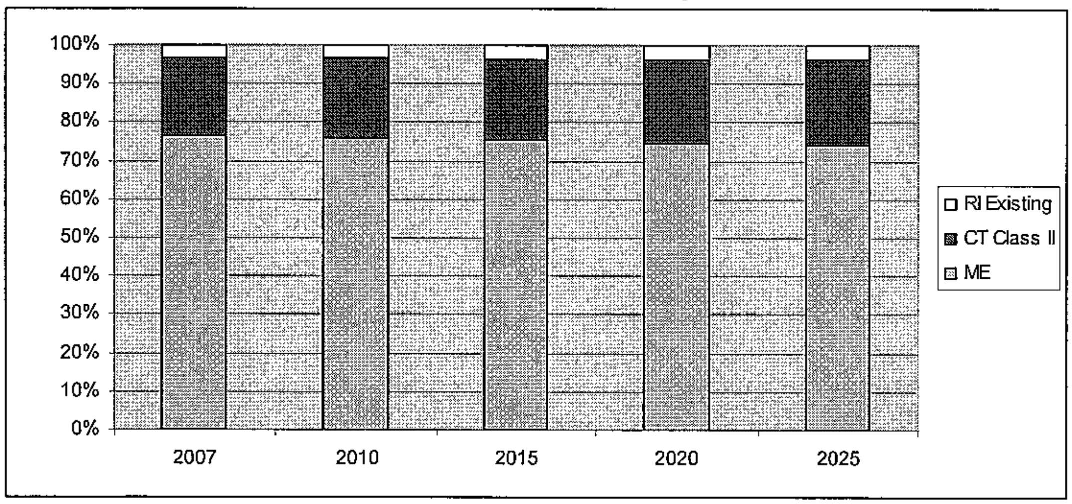
The Rhode Island RPS is expected to account for 3% of new regional renewable energy demand in 2007 growing to 8% by 2025. The Connecticut Class I requirement is expected to be more influential early on at 39% of demand in 2007 and 42% in 2010 though its proportion of overall regional demand decreases to 15% by 2025.

Figure 2: Projected Percentage of New Renewable Regional Demand from State RPS



Over time, the projected proportion of each RPS for existing renewable energy remains relatively the same. The Maine RPS is expected to account for 75% to 85% of demand for existing renewable energy. The Connecticut RPS is expected to account for 20% to 22% of demand for existing renewable energy. The Rhode Island RPS is expected to account for 3% to 4% of demand for existing renewable energy.

Figure 3: Projected Percentage of Existing Renewable Regional Demand from State RPS



4.6 New England New Sources of Renewable Energy Supply

4.6.1 Short-Term Supply

Interconnection requests made to ISO New England for new facilities serve as a useful predictor of short-term supply of new renewable energy facilities. While not all facilities that make these requests will end up as completed facilities, it provides one of the best sources for predicting future development in the region.

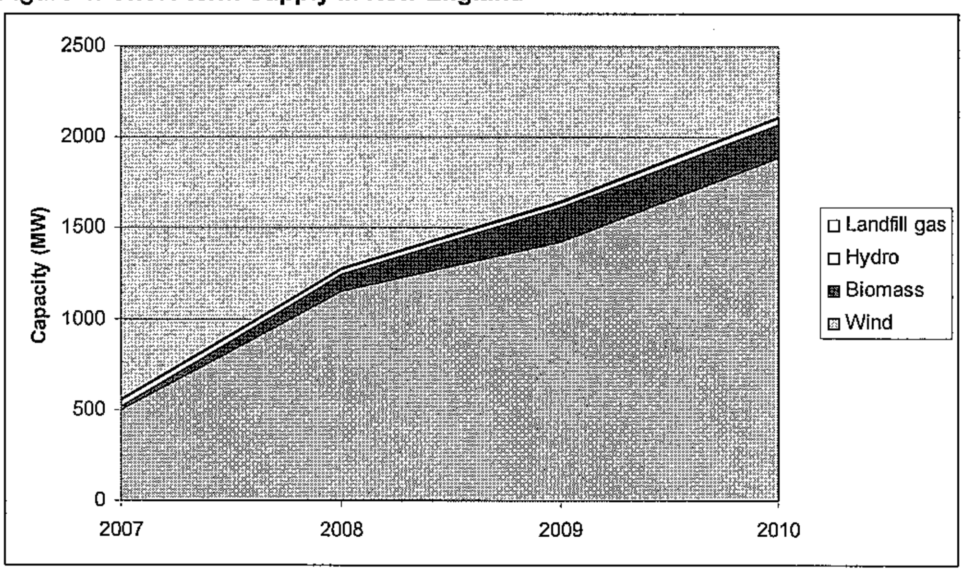
Through 2010, 29 separate projects representing 2100 MW of generation could come online based on current active interconnection requests. Wind generation is the single largest category for new capacity accounting for 90% of all regional requests through 2010. Biomass makes up the next single largest category at 9% of regional requests through 2010. These projects have the potential of about 7 million MWh of generation by 2010. RPS market demand is projected to require a similar level of generation.

Table 9: Active Interconnection Requests for New Projects in New England

		Year of Initial Operation				
Type		2007	2008	2009	2010	Grand Total
Biomass	Count of Type	1	2	2		5
	Capacity (MW)	16	77	89		182
Hydro	Projects	1				1
	Capacity (MW)	32				32
Landfill gas	Projects	2				2
	Capacity (MW)	9				9
Wind	Projects	13	5	2	1	21
	Capacity (MW)	500	650	280	462	1892
Total Count of Type		17	7	4	1	29
Total Sum of Capacity (MW)		557	727	369	462	2114

Source: ISO New England as of January 5, 2007

Figure 4: Short-term Supply in New England



Source: ISO New England as of January 5, 2007

4.6.2 Long Term Supply

Different sources were utilized to develop estimates for the long term supply potential for new renewable energy resources in New England. The majority of the supply estimates are based on research from a New York RPS study performed for the New York State Energy Research and Development Authority (NYSERDA) [11]. These estimates are based on the economic potential for renewable energy development in New England.

The potential economic supply of new renewable resources in New England is approximately 76 million MWh of annual generation by 2025. It is expected that actual development will be below the potential supply. Total New England RPS demand for new renewable energy is projected to be around 22 million MWh. This indicates that there are sufficient economically available natural energy resources in New England to meet the projected total New England RPS demand.

Figure 5: New England Potential Developable Generation by Type by 2025

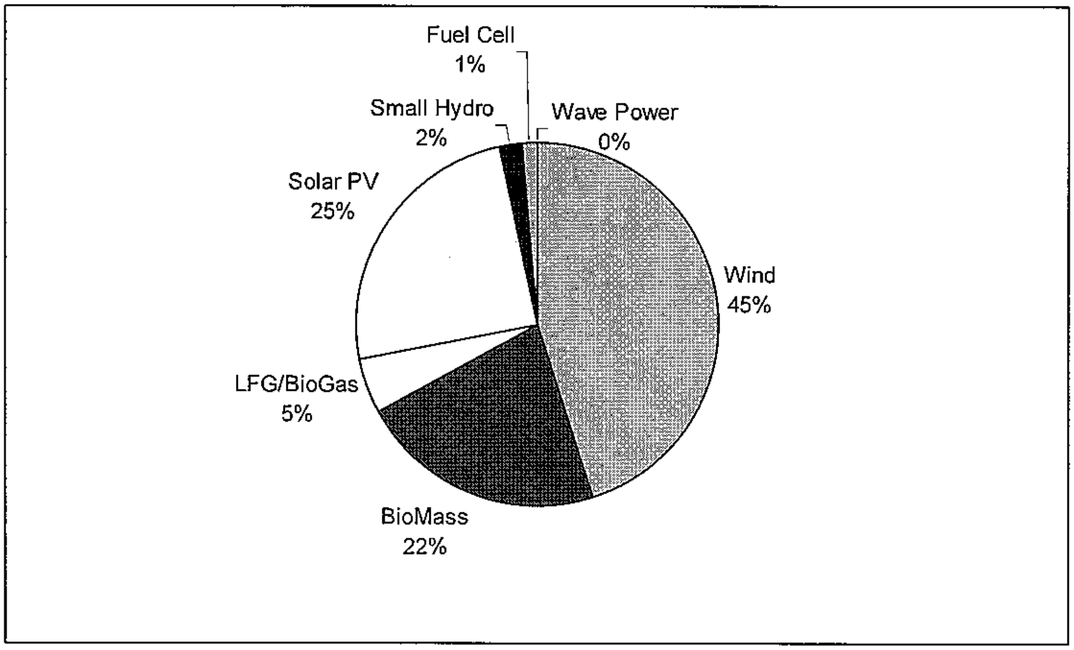


Figure 5 shows the maximum potential economic generation that could be developed in New England by 2025. This figure is not a prediction of the generation that will actually be developed but instead represents all of the generation that could possibly be economically developed.

Generation from wind is the single largest potential source accounting for about 45% of total possible generation. Solar photovoltaic would be the second-largest potential source

[11] Additional information regarding how economic supply estimates were developed is located in the methodology section of this report.

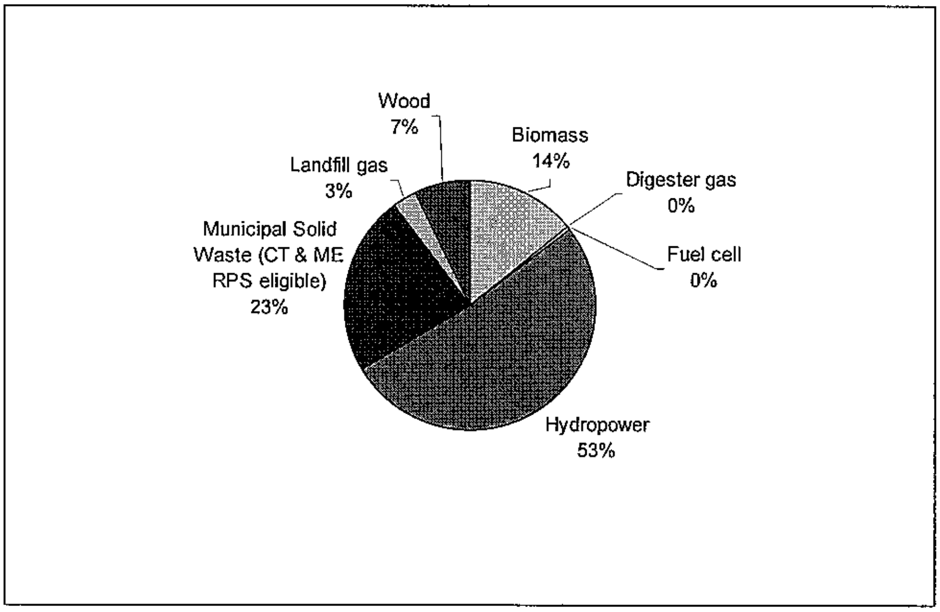
accounting for about 25% of total possible generation. Biomass would be the next largest potential source at around 22% of total possible generation. Hydropower and power generation related to tidal or wave movement are not expected to be significant contributors to generation through 2025.

To help put this projected economic potential in context, total retail electricity load in 2025 is estimated to be 166 million MWh. If all possible economic renewable energy resources were developed by 2025, New England new renewable energy resources would be able to meet 45% of the electricity needs for the region.

4.6.3 New England Existing Supply

Analysis indicates that there is more than sufficient existing supply to meet all of the New England state RPS requirements for existing renewable energy. The overall existing annual supply of renewable energy in 2005 was approximately 14 million MWh of generation. In 2005, the combined demand from the New England states with an existing renewable energy requirement-Connecticut and Maine-was only 4.7 million MWh.

Figure 6: New England Renewable Energy Generation in 2005



Source: REC supply from NEPOOL GIS, 2005 Generation

There is expected to be more than sufficient supply through at least 2025, the future RPS demand for existing renewable energy from Connecticut, Maine and Rhode Island is only expected to require 5.6 million MWh in 2025.

It is important to note that the supply available to different RPS depend on their requirements for eligibility. Maine and Connecticut have different requirements for eligibility and therefore accept RECs from different portions of existing renewable energy supply. The Maine RPS accepts almost all existing New England renewable energy facilities, while the Connecticut Class II is more restrictive and has only about a 25% overlap with the Maine RPS.

Table 10: 2005 Supply and Demand for Existing Renewables

	Projected REC demand (thousands)	Available REC supply (thousands)	Difference (thousands)
Maine	3,729	14,269	10,540
Connecticut Class II	978	3,442	2,464

Source: REC supply from NEPOOL GIS, 2005 Generation

Considering the supply for the existing portion of the Rhode Island RPS- which takes effect in 2007- it is expected that there will be sufficient existing renewable energy to meet demand. One reason is that the Rhode Island RPS accepts RECs from hydropower facilities with capacities up to 30 MW. This allows Rhode Island to satisfy RPS demand from a significant portion of existing renewable energy supply (existing hydropower between 5 and 30 MW) without competing against Connecticut's RPS. The Connecticut Class II accepts existing hydropower only up to 5 MW.

In 2005, there was 3.4 million MWh of generation from hydroelectric facilities between 5 and 30 MW. This exceeds the projected 2025 allowance for existing renewable energy in Rhode Island by a substantial amount. In addition, Rhode Island has no restrictions on existing biomass facilities, meaning that considerable older generation would be available to fulfill its existing allowance. Therefore, the Rhode Island 2% allowance for existing should be easily met and not have any significant impact on the other existing renewable energy requirements of other New England state RPS.

In a RPS study conducted for Massachusetts, it was asserted that there were sufficient existing renewable energy resources in New England to meet the demand of a potential existing requirement for Massachusetts; even when taking into account the RPS of Maine and Connecticut[12].

The RPS study for Massachusetts further stated that substantial portions of the existing renewable energy supply curve are under long-term contracts at favorable rates or have operating costs below wholesale power prices. This suggests that many existing renewable energy facilities throughout New England are financially viable and not likely to disappear from renewable energy supply in the foreseeable future.

[12] "Massachusetts Renewable Portfolio Standard Cost Analysis Report," La Capra Associates et al., December 2000, Available at http://www.mass.gov/doer/programs/renew/rps-docs/fca.pdf

4.6.4 New Hampshire Considerations for Existing Renewable Energy

Analysis was undertaken to determine the regional existing supply of renewable energy that would be available to meet the Class III and Class IV requirements in the New Hampshire RPS proposed through LSR-H-0208.

Class III calls for power generated from existing biogas from anaerobic digestion, including landfill methane, and biomass less than 25 MW. Biogas would be unlikely to be used to fill this RPS requirement, as all landfill gas generation in New England and other biogas facilities qualify for either the Massachusetts or Connecticut Class I requirement. In 2005, there were 13 different facilities throughout New England that were biomass of less than 25 MW.

The New Hampshire RPS requirement for Class III is expected to be 671,000 MWh in 2010 growing to 950,000 MWh by 2025. Regional generation in 2005 from biomass under 25 MW was 1.1 million MWh.

Table 11: Estimates of Class III Eligible Generation by State

State	Type	Facilities	Generation (Thousands MWh)
Connecticut	Biomass <25 MW	0	-
Maine	Biomass <25 MW	4	127
Massachusetts	Biomass <25 MW	3	135
New Hampshire	Biomass <25 MW	5	663
Rhode Island	Biomass <25 MW	0	-
Vermont	Biomass <25 MW	1	167
Total	Biomass <25 MW	13	1,091

Source: NEPOOL GIS, 2005 Generation

Class IV calls for hydropower facilities less than or equal to 5 MW with up and down stream fish facilities. Data for hydropower facilities with fish facilities was not readily accessible, so supply analysis was based on capacity. In 2005, there were 236 different facilities throughout New England with capacities less than or equal to 5 MW. The New Hampshire RPS requirement for Class IV is expected to be 122,000 MWh in 2010 growing to 146,000 MWh by 2025. Regional supply currently exceeds the 2025 requirement by 800%.

In New Hampshire alone, 285,000 MWh were generated in 2005. This exceeds the 2025 requirement by 210%. So even when taking into account the other New England state RPS requirements, supply is expected to far exceed New Hampshire RPS demand. However, is important to note that the fish facility requirement would be expected to reduce qualifying supply.

Table 12: Estimates of Class IV Eligible (Hydropower under or equal to 5MW) Generation by State

State	Facilities	Generation (Thousands MWh)
Connecticut	26	128
Maine	40	222
Massachusetts	46	173
New Hampshire	68	285
Rhode Island	4	13
Vermont	52	290
Total	236	1,113

Source: NEPOOL GIS, 2005 Generation

4.7 New Hampshire Supply

4.7.1 NH New Renewable Energy Short-term

Interconnection requests of ISO New England through 2010 include three separate interconnection requests in New Hampshire. All interconnection requests were wind projects. This indicates a short-term supply potential of 24 MW project planned in 2007 and two large-scale wind projects (295 MW total) with projected commercial operation dates of 2008[13].

Table 13: NH Interconnection Requests

Type	Capacity (MW)	County	State	Projected Commercial Operation Date
Wind	149	Coos	NH	9/30/2008
Wind	145.5	Coos	NH	12/30/2008
Wind	24	Sullivan	NH	11/1/2007

Source: ISO New England as of January 5, 2007

4.7.2 NH New Renewable Energy Long-term

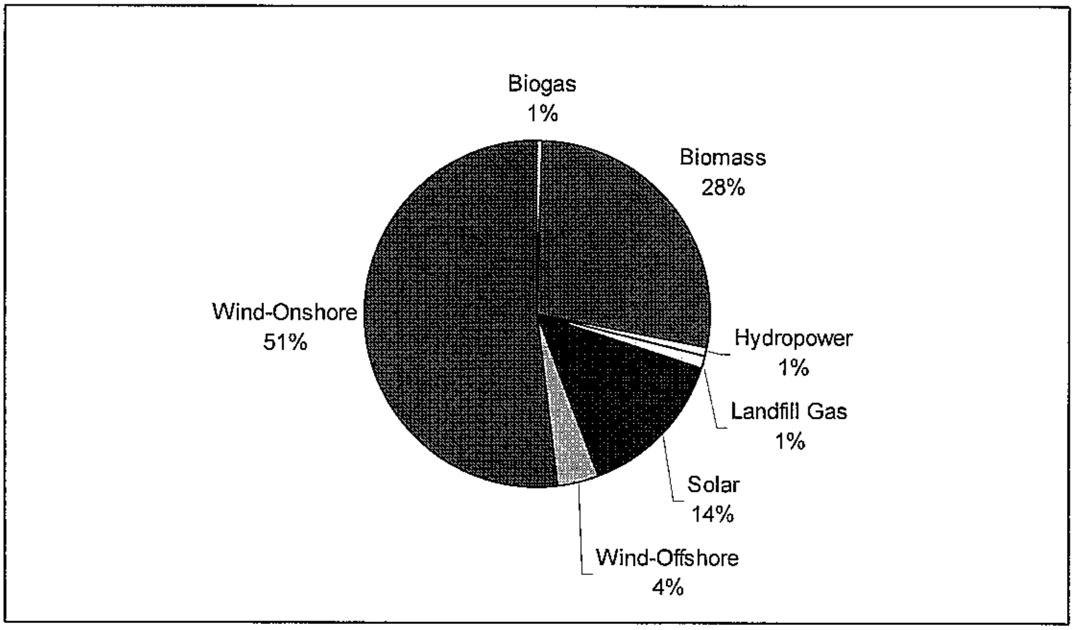
The economic development potential for new renewable resources in New Hampshire is approximately 13 million MWh of annual generation by 2025. Total New England RPS demand for new renewable energy is projected to be around 22 million MWh. New Hampshire has the economic renewable resource potential to meet 60% of total regional RPS demand for new renewable energy.

[13] ISO New England Interconnection requests, January 5, 2007, Available at http://www.iso-ne.com/genrtion_resrcs/nwgen_inter/req/index.html

Table 14: New Hampshire Potential Developable Capacity & Generation by Type

	Capacity (MW)	Generation (Thousands MWh)
Biogas	10	70
Biomass	505	3539
Hydropower	25	110
Landfill Gas	14	110
Solar	1487	1824
Wind-Offshore	169	503
Wind-Onshore	2237	6663
Total	4,447	12,819

Figure 7: New Hampshire Potential Developable Generation by Type by 2025



4.7.3 NH Existing Renewable Energy Generation

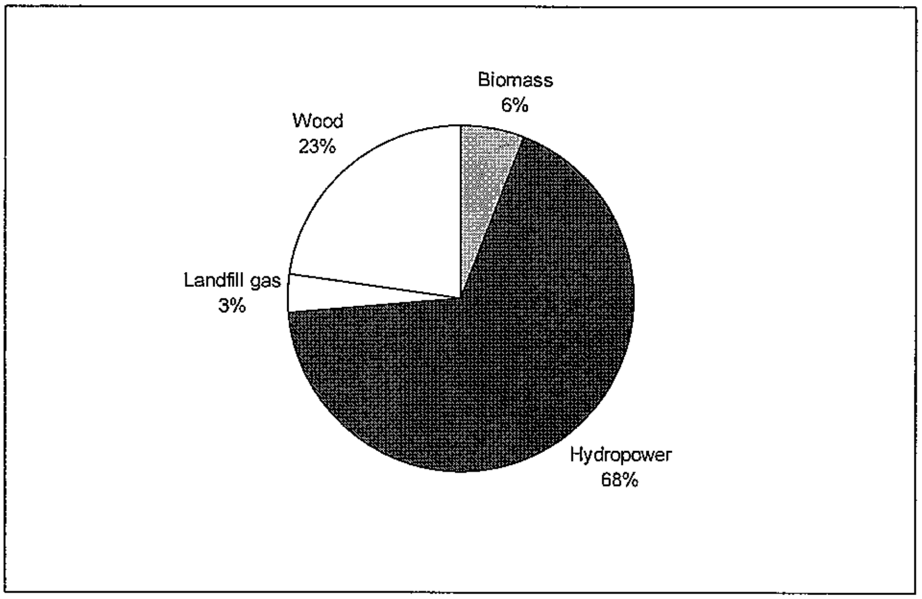
In 2005, 576 MW of renewable energy facilities generated 2.3 million MWh of generation in New Hampshire. This was approximately 10% of overall New Hampshire generation.

Table 15: 2005 Renewable Energy Generation in New Hampshire

	Capacity (MW)	Generation (Thousands MWh)
Biomass	17	133
Hydropower	464	1,570
Landfill gas	13	80
Wood	82	530
Total	576	2,313

Source: NEPOOL GIS, 2005 Generation

Figure 8: 2005 Renewable Energy Generation in New Hampshire



Source: NEPOOL GIS, 2005 Generation

4.8 RPS Market Experience

For the most part, REC market prices for the different State RPS markets in New England and classes have been relatively consistent; with the exception of Connecticut Class I RECs. In general, RECs for new renewable energy have tended to be near the maximum possible price (set by the Alternative Compliance Price). RECs for existing renewable energy have tended to be low, almost having no value.

Table 16: Summary of State RPS Markets

		Percent Required in 2006		REC Offering Price (2007)		Expected REC Supply (2007)	
	Year RPS started	New only	Mixed (New and Existing)	New only	Mixed (New and Existing)	New only	Mixed (New and Existing)
CT	2004	2%	3%	$50	$0.75	Under	Over
MA	2003	2.5%		$55		Under	
ME	2000		30%		$0.40		Over

Source: Price data from Evolution Markets

Massachusetts RECs

In 2004, there was an insufficient supply of Massachusetts RECs to meet Massachusetts RPS demand, as witnessed by the fact that utilities and competitive electric suppliers needed to make alternative compliance payments to meet their obligations[14]. In 2004, Massachusetts RECs traded in the range of $40 to $51[15]. These ranges were very close to the Massachusetts 2004 alternative compliance price of $51.41.

While Massachusetts has not yet reported on the status of the RPS for 2005 or 2006, it is expected that there was an insufficient supply. Massachusetts RECs traded in the range of $46 to $53 in 2005. This was very close to the alternative compliance price of $53.19. And in 2006 Massachusetts RECs traded in the range of $52 to $54 compared to the alternative compliance price of $55.13.

Currently, market prices of Massachusetts RECs are indicating that supply might still be short, as 2007 trades are occurring in the $54-$55 range compared to the alternative compliance price of $57.12.

4.8.1 Connecticut RECs

In 2004, there was sufficient Class I REC supply to meet Connecticut RPS demand, as witnessed by the fact that there were no alternative compliance payments made by Connecticut utilities or competitive energy suppliers[16]. Connecticut Class I trades were in the range of $35 to $43 per REC, which were between 64% and 78% of the Connecticut Alternative Compliance Price of $55.

In 2005, the Connecticut Department of Public Utility Control (DPUC) ruled that some existing biomass plants, including one in New Hampshire, qualified as Class I facilities

[14] "Annual RPS Compliance Report for 2004," Massachusetts Division of Energy Resources, January 2006, Available at http://www.mass.gov/doer/rps/rps-2004annual-rpt.pdf

[15] Monthly REC Market Report data, Evolution markets, Available at http://www.evomarkets.com/

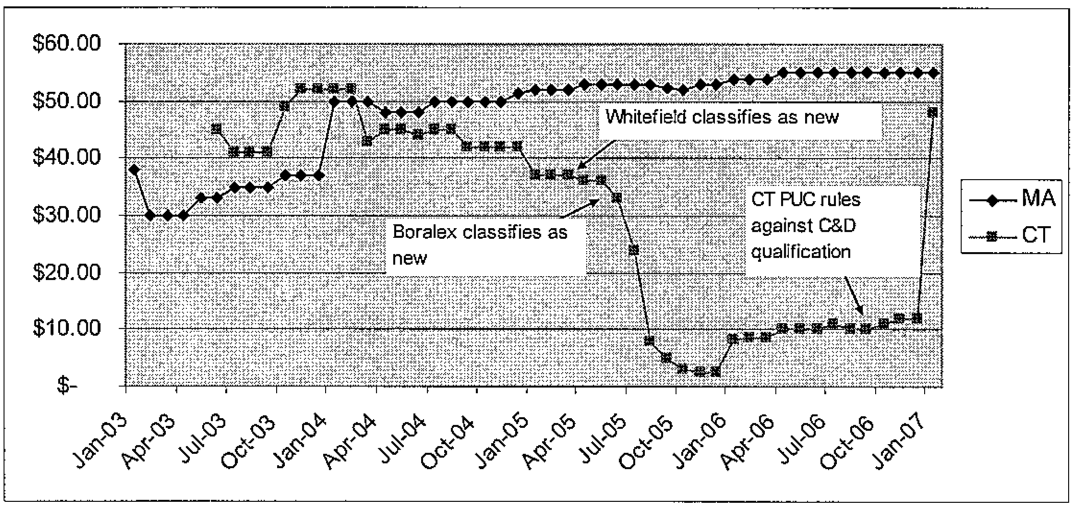
[16] Connecticut 2004 RPS Compliance Report, Available at http://www.dpuc.state.ct.us/dockcurr.nsf/6eaf6cab79ae2d4885256b040067883b/70df0239d40276fe8525712b005e4589?OpenDocument

because they installed new pollution controls[17]. In March 2005, Whitefield Power & Light Company, a 16 MW biomass generation facility located in Whitefield, New Hampshire and in June 2005, Boralex Stratton Energy Inc., a 46 MW biomass generation facility located in Stratton, Maine, were approved as Class I eligible.

This increased market supply by an additional 323,000 Class I RECs that appear to have "over-supplied" the Connecticut Class I market for 2005 and into 2006. This change in supply resulted in a steep decline in Class I REC market prices, down to about $2 per REC (a decline of almost 95%) in the latter half of 2005. In 2006, there appeared to be some mild recovery in market prices (trading was in the $7-$10 range) as the Connecticut RPS requirement increased another 0.5%.

In August 2006, the Connecticut DPUC, ruled that construction and demolition debris does not qualify as an eligible biomass fuel source. This served to reduce the amount of eligible biomass supply. The 2007 RPS requirement calls for an increased percentage of 1.5%. This reduction in supply and increase in demand has resulted in a rapid rise in Class I market prices for the 2007 compliance year. 2007 Class I RECs are currently trading around $45, an increase of 330% over 2006 Class I RECs. Prices are once again approaching the alternative compliance price.

Figure 9: New REC Market Prices



Source: Evolution Markets

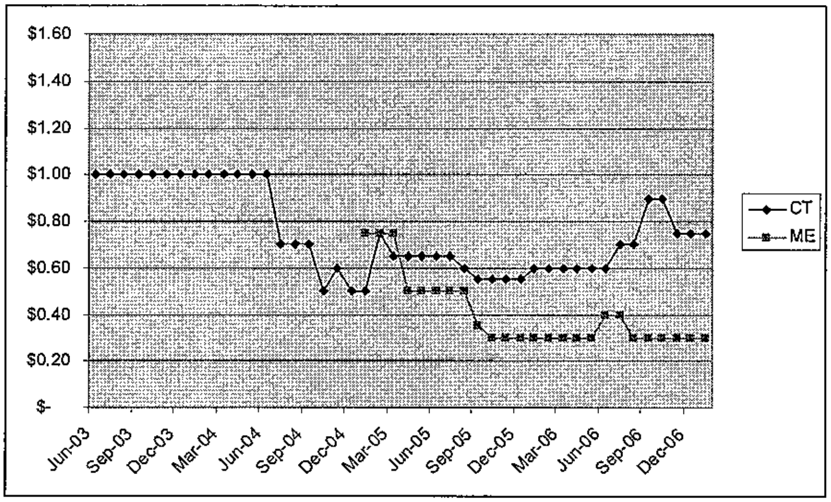
4.8.2 Existing RECs

Market price data for the two existing renewable requirements, Connecticut Class II and Maine, goes back to 2003. The data shows that market prices for existing renewable energy facilities are extremely low, below $1, due to the large supply available. As of

[17] "Is the Connecticut REC market wrecked, "SNLi, September 2005, Available at http://www.snl.com/InteractiveX/article.aspx?CDID=A-2149787-11102

December 2006, Maine RECs were trading around $0.20 and Connecticut Class II RECs were trading around $0.55[18].

Figure 10: Existing REC Market Prices



Source: Evolution Markets

[18] "REC Markets," Evolution Markets, December 2006, Available at http://www.evomarkets.com/assets/mmu/mmu_rec_dec_06.pdf

5 Economic Modeling

5.1 Methodology & Assumptions

Our analysis of proposed NH RPS legislation utilizes a linear spreadsheet model developed in Microsoft Excel for calculating RPS supply, demand and cost. A review of 22 other State RPS studies found that linear spreadsheet modeling was a common method used and also found no evidence to suggest that any other method provided better quality results[19]. Benefits of a spreadsheet model include that it is transparent, providing stakeholders with easy access to assumptions and calculation methodology and that it is flexible in enabling changes in assumptions and scenarios.

5.1.1 RPS Demand Methodology & Assumptions

Retail electric demand for electricity for each New England state was calculated through 2025. Future growth was projected by applying historic annual growth rates of electric loads for each state. Retail electric loads were based on data reported by the US Energy Information Administration (EIA). Some states including New Hampshire provided their own state collected data, which was used instead for load projections.

RPS demand for each state in the region was estimated by applying the legislated percentage for any compliance year against the projected eligible load. New Hampshire municipal utilities are not expected to be required to participate in the RPS. Therefore their load, approximately 1.5% of total New Hampshire load, was excluded from the analysis. In some cases, adjustment factors were applied to help account for differences in how retail load was calculated. For example, Massachusetts includes line losses in calculation of total load.

A separate voluntary market for renewable energy does exist in New England. However, in this analysis, voluntary (so called, "green") market demand was assumed to not significantly impact the RPS markets due to the relatively small number of customers participating in current New England-based programs[20]. Therefore, voluntary demand was not considered in this analysis.

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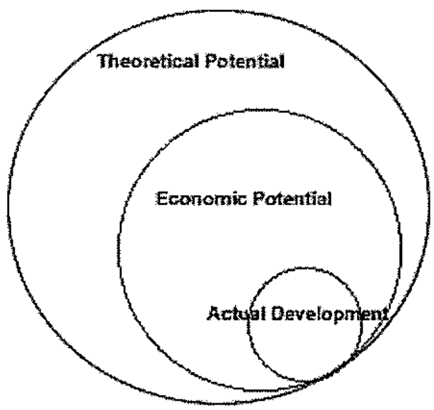
[19] Wiser et al., "Is it Worth it? A Comparative Analysis of Cost-Benefit Projections for State Renewables Portfolio Standards," June 2006, Available at http://www.osti.gov/energycitations/servlets/purl/888981-lLdI4c/888981.PDF

[20] "Green Power Marketing in the United States: A Status Report," National Renewable Energy Laboratory, Eighth Edition,October 2005, Available at http://www.eere.energy.gov/greenpower/resources/pdfs/38994.pdf

5.1.2 RPS Supply Methodology & Assumptions

Estimates of potential developable new renewable energy supply in New England were developed from several different sources. The primary source, as mentioned above, was a 2004 cost study by the New York State Energy Research and Development Authority (NYSERDA) for a New York RPS that included analysis of the New England markets. Other sources of data consulted included other state RPS studies conducted for New England states, the US National Renewable Energy Laboratories (NREL) and ISO New England.

Figure 11: Renewable Energy Supply Diagram



In the study, supply assumptions were based on economic potential. Economic potential is lower than theoretical potential. Theoretical potential consists of all possible sources of renewable energy that could be developed without any consideration for land use or legal restrictions or economic costs. This study did not attempt to determine theoretical potential. Instead it based supply on economic potential. Economic potential considers all sources of renewable energy that might under certain scenarios be competitive in the market. Included in economic potential is some supply that would only become cost competitive with particular public policy incentives, including a RPS.

Not all of the resources that have economic potential will be developed and come to market. Some resources with economic potential will not be developed due to either economic or non-economic "hurdles".

Supply estimates were developed for 2010, 2015, 2020 and 2025. Supply estimates were not developed for each year. It was not believed to be realistic to predict year-to-year changes, and estimated changes in supply over longer periods of time provided for more useful and realistic analysis. In developing supply estimates, modeler judgment was used to integrate information from the many different resources to develop a reliable estimate of potential supply.

It is assumed that primarily New England resources will be utilized to satisfy RPS compliance. Renewable energy imports are possible and in fact have been used to satisfy small portions of compliance in both Massachusetts and Connecticut[21]. However, they are not expected to be significant given that every state in the Northeast region of the United States, with the exception of New Hampshire, now have their own RPS requirements.

For 2010, ISO New England interconnection requests were used to make estimates of near-term supply. Supply in 2015, was based on modeler judgment of possible development potential between near-term and long-term supply. By 2020 all possible potential supply is considered. It is important to note, again, that this estimate is significantly below the technical potential for renewable energy development in New England.

Existing supply of renewable energy in New England was based on 2005 generation data obtained from the New England Power Pool (NEPOOL) GIS (Generation Information System) tracking system. Types of information available from the GIS system for each facility were: type of generation, location, annual generation, RPS eligibility in the different state classes and capacity. This was utilized to help determine existing supply available for the different State RPS, including a potential New Hampshire RPS.

5.1.3 RPS Cost Methodology & Assumptions

A Levelized Cost of Energy (LCOE) was calculated for each of the types of renewable energy generation that were believed to be available in the commercial marketplace between 2007 and 2025. The LCOE defines the stream of revenues that minimally meets the requirements for equity return, debt payments, and annual operating & maintenance costs.

The LCOE assigns a cost to every unit of energy produced by a given facility, in this analysis, cents per kilowatt hour. Cents per kilowatt hour was chosen because most people would be familiar with this measure from electric utility bills. LCOE allows for equivalent comparisons of facilities of different sizes and technologies[22].

This methodology is appropriate for modeling the average costs for any given renewable energy type. The methods used here are recognized by energy policy analysts as acceptable means of assessing renewable energy technology cost [23]. Many factors can have an impact on the costs of any specific facility. These factors include state specific renewable energy incentives, site costs, and financing rates. In policy modeling and

[21] 2004 RPS compliance reports for Connecticut and Massachusetts
[22] "Project Financial Evaluation, "US Department of Energy: Energy Efficiency and Renewable Energy, Available at http://www1.eere.energy.gov/ba/pdfs/financial.pdf
[23] "A Manual for the Economic Evaluation of Energy Efficiency and Renewable Energy Technologies," National Renewable Energy Laboratory, March 1995, Available at http://www.nrel.gov/docs/legosti/old/5173.pdf

assessment, many individual costs are generalized into one capital cost for each technology.

All commercial facilities had the same set of financing requirements applied to them. It was assumed that capital structure of these projects would be a 70/30 debt-to-equity ratio over a 20-year financing period. The return on equity was 13% and debt financing was 6.3%. These financing requirements are based on information provided by the National Renewable Energy Laboratory and independent expert feedback [24, 25].

This study assumed 100% Independent Power Producer financing at 13% equity. In reality, a percentage of projects will be municipal financed projects in New England. Municipal projects have lower carrying charges that reduce their levelized costs of energy. It is believed that omitting municipal financing slightly inflates the actual region's energy costs related to renewable energy, but simplified modeling and provided more conservative cost projections.

The Levelized Cost of Energy for small-scale renewable energy projects, such as PV and small wind was calculated in a slightly different manner than larger scale commercial projects. It was found that utilizing the formulas for LCOE for large-scale commercial projects resulted in a LCOE that was substantially higher than values reported in other studies for small projects. This is probably due to the fact that financing small-scale renewable energy projects would most likely be a relatively straightforward loan and would not have all of the cost and financing requirements of larger projects. This analysis used a loan with a 20-year term and a 6.5% interest rate.

The technology costs in this study were carefully checked against technology costs presented in other studies to ensure that reasonable technology costs were being calculated. The four RPS studies that were primarily utilized for technology cost comparison were studies for the following states: New York (2004), New Jersey (2004), Pennsylvania (2004) and Massachusetts (2000). Emphasis was placed on technology costs listed in the most current studies.

The technology costs utilized in this study were found to be reasonable --- as they are similar to the costs used in other recent RPS studies. In most cases, costs modeled were on the higher end of costs listed. For example, this study projected a Levelized Cost of Energy for wind near transmission lines built in 2006 ranging from 7.5-11.1 cents per kilowatt hour (depending on wind speed). The New Jersey RPS study listed levelized

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[24] "Project Financial Evaluation, "US Department of Energy: Energy Efficiency and Renewable Energy, Available at http://www1.eere.energy.gov/ba/pdfs/financial.pdf

[25] E-mail correspondence with Dr. Ryan Wiser, Lawrence Berkeley National Laboratories, November 16, 2006

costs for wind ranging from 4-5 cents per kilowatt hour[26]. The Pennsylvania RPS study listed levelized costs for wind ranging from 4-11 cents per kilowatt hour[27].

The premium for new renewable energy (REC market price) was determined by:

1. Calculating the premium between the Levelized Cost of Energy and projected wholesale electricity rates for each technology. The 2006 Annual Energy Outlook was utilized to obtain New England specific projections of wholesale electricity rates.
2. Developing a supply curve for new renewable energy technologies by the renewable energy premium for each technology.
3. Finding the intersection of the RPS supply and demand curve for a given year. This yielded the expected renewable energy premium representing the modeled REC price. The REC price for new renewable energy is expected to be relatively consistent for all of the New England states that have new requirements.

This modeling approach only takes into account cost when determining the modeled REC market price. The model selects the least cost technologies to fill the given RPS demand and does not take into consideration the type of renewable energy or other factors.

The following hypothetical example illustrates how the marginal cost would set the modeled market price. If the RPS demand was 1000 MWh (1000 RECs), then the renewable energy premium per megawatt hour would be set by the last and most costly renewable energy generator used to meet that final demand. In this example, it would be Renewable Generator C. Renewable Generator A and B have lower revenue requirements, however, their combined generation is only 700 MWh. Renewable Generator C is required to meet the demand and therefore would be able to sell the RECs it generates at $1.50. Renewable Generator A and B would be unlikely to "leave money on the table" and sell their own equivalent RECs for less, when the market is willing to pay $1.50 for RECs from Renewable Generator C. Therefore, the modeled market price of RECs would be $1.50.

[26] "New Jersey Renewable Energy Market Assessment," Navigant Consulting, August 2004, Available at http://www.navigantconsulting.com/A559B1/navigantnew.nsf/vGNCNTByDocKey/PP9D043FBD5214/$FILE/NCI-Report-for-NewJersey-REMA-Final-8-04--.pdf

[27] "Economic Impact of Renewables in Pennsylvania," , Black & Veatch, March 2004, Available at http://www.cleanenergystates.org/library/pa/PA%20RPS%20Final%20Report.pdf

Table 17: Hypothetical Illustration of REC Price Assuming Adequate Supply

	Additional Revenue Required per MWh	Generation (MWh)	Cumulative Generation (MWh)
Renewable Generator A	$0.50	200	200
Renewable Generator B	$1.00	500	700
Renewable Generator C	$1.50	300	1000
Renewable Generator D	$2.00	500	1500

5.1.4 NH RPS Scenario Methodology & Assumptions

In the study, the economic costs were modeled using the RPS requirements as listed in NH LSR-H-0208. Two scenarios were developed using base case assumptions: the model predicted (modeled) scenario and a maximum cost renewable (maximum) scenario. To simplify modeling, the NH five class system was reduced to three main categories: new, existing and solar. This was done to simplify the modeling process. However, it is believed that reducing the number of classes does not significantly change the economic impact estimates.

The New Hampshire RPS is projected to have direct costs primarily related to the purchase of RECs and/or ACPs in order to meet the required percentages in the RPS. The direct costs are broken out by scenario and renewable class for several different years. Each of the different costs associated with the renewable classes are listed together in the combined category of the Table 19.

In the maximum cost scenario, there is an insufficient number of RECs being generated in the marketplace to meet RPS demand which results in REC prices that are expected to be very close to the ACP. The maximum cost of the RPS is reached when the utilities and competitive electric suppliers must meet 100% of their load obligation with ACPs.

In the modeled scenario there are a sufficient number of RECs being generated in the marketplace to meet RPS demand. This is with the exception of the required solar class percentage in the beginning years of the RPS. This results in the REC price being equal to the marginal cost as discussed above.

Projections of construction of new renewable energy facilities in New Hampshire were developed by looking at the regional demand produced through the RPS. The percentage of construction in New Hampshire was assumed to be proportional to New Hampshire's regional percentage of renewable resources. This was based on the assumption that New Hampshire would have an equal opportunity to compete for renewable energy projects as other New England states. The only exception to this was the construction of new solar which-based on the legislation-would be expected to occur only within New Hampshire.

Spreadsheet modeling was also used to determine the potential displaced natural gas fired power generation as a result of increased development of renewable energy in the region. The avoided cost of displaced natural gas was calculated on a regional basis and benefits to New Hampshire were calculated on a proportional basis.

A separate case was developed where the available economic supply of wind was reduced 50%. Wind is expected to make up a significant portion of new supply. This case models the impact of less wind resources being developed than would be expected in the base case. Two scenarios were developed using the 50% wind assumption: the model predicted (modeled) scenario and a maximum cost renewable (maximum) scenario.

This study would have benefited from additional variations in assumptions including evaluation of the impact of changes in wholesale electricity prices, natural gas prices and projected retail loads. However, funding and time limitations necessitated focusing on one core set of assumptions. The modeling performed provides reliable estimates and information on the magnitude of costs and benefits. Additional scenarios would not materially change the findings of the study.

5.2 Analysis

Based on projected NH and regional energy demand and LSR-H-0208 RPS specified percentage requirements, a NH RPS is anticipated to have a significant impact on overall region-wide demand for renewable energy. New Hampshire new (RPS induced) renewable energy demand would be modeled to contribute 2% to overall demand in New England for new renewable energy in 2010 and 11% to overall demand in 2025.

Table 18: NH Modeled Requirements

	LSR-H-0208 RPS Requirements			Projected Generation (Thousands MWh)		
	New	Existing	Solar	New	Existing	Solar
2008	0%	4.0%	0%	0	476	0
2009	0.5%	5.5%	0%	60	662	0
2010	1%	6.5%	0.04%	122	792	5
2015	6%	7.5%	0.30%	777	971	39
2020	11%	7.5%	0.30%	1,514	1032	41
2025	16%	7.5%	0.30%	2,340	1097	44

Figure 12: Projected Regional RPS Demand for New Renewable Energy

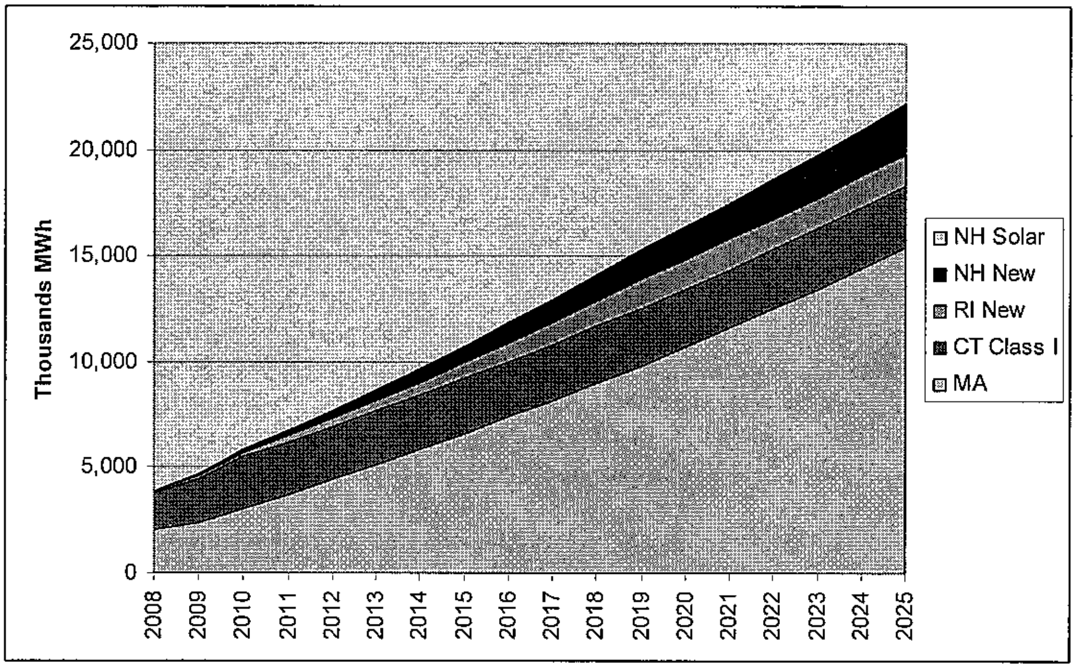
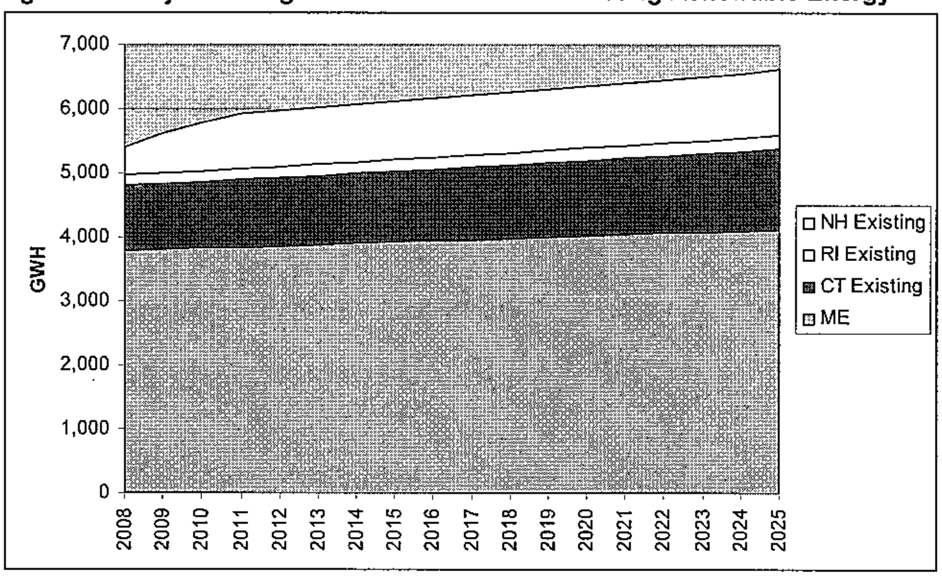


Figure 13: Projected Regional RPS Demand for Existing Renewable Energy



5.2.1 RPS Cost

In the first year, only existing renewable energy requirements are a portion of the RPS. In the first year of the RPS, the modeled direct cost to NH electricity consumers is $7,140,000. The maximum (possible) cost in the first year is $13.3 million. Supply for existing renewable energy is expected to exceed New Hampshire RPS demand as shown in 4.6.4. However, there is considerable uncertainty as to the expected REC market price for existing renewable energy generation, specifically as would pertain to Class III.

None of the other New England RPS have percentage requirements for existing renewable energy that are as close to potential qualifying supply or have the eligible technologies for existing renewable energy classes so narrowly defined as in the proposed NH legislation.

Research judgment was utilized to determine that a New Hampshire existing REC price would be $15 (around 55% of ACP). This is based primarily on the observation of Connecticut Class I REC behavior in 2004 which were priced at approximately 65% of ACP. In 2004, supply was estimated to be very close to demand but did not exceed demand. This is the only actual New England state RPS market experience with similar conditions (tight but sufficient supply) for basing estimates of REC market prices.

In 2010, the new renewable class and solar class would both be effective. For the new class, the modeled annual cost is $3.6 million with the maximum possible cost at $6.5 million. The solar class LCOE is modeled to be approximately 45 cents per kWh, which translates into $450 per MWh, this is far greater than the ACP for solar of $150. The modeled solar cost will be the maximum ACP cost.

In 2010, the modeled total cost is $16.9 million for all of the renewable classes and the maximum cost for the all of the classes would be $30.6 million. By 2025, the modeled total annual cost of the RPS is $23.8 million and the maximum RPS cost is projected to be $160 million

Table 19: LSR-H-0208 RPS Direct Cost $2006 (Thousands)

Class	Scenario	2008	2009	2010	2015	2020	2025
New	Maximum			6,485	41,344	80,533	124,457
	Modeled			3,578	10,615	2,325	4,014
Existing	Maximum	13,327	19,030	23,357	25,840	27,454	29,170
	Modeled	7,140	10,195	12,513	13,843	14,708	15,627
Solar	Maximum			770	5,537	5,883	6,251
	Modeled			770	5,537	5,883	4,180
Combined	Maximum	13,327	19,030	30,612	72,721	113,870	159,877
	Modeled	7,140	10,195	16,860	29,995	22,916	23,820

Without a RPS, the projected retail electric costs for households in New Hampshire is expected to be approximately $1.4 billion in 2008 growing to $2.0 billion in 2025 in real dollars. Under the modeled scenario all of the different renewable classes are modeled to increase retail electric costs by 0.5% in 2008, peak around 1.8% in 2015 and gradually reduce back down to 1.2% in 2025. Under the maximum scenario all of the different renewable classes are modeled to increase retail electric costs by 0.9% in 2008 to 8.0% in 2025.

Table 20: Retail Electric Costs $2006 (Thousands)

	2008	2009	2010	2015	2020	2025
No RPS	1,471,558	1,495,372	1,520,583	1,659,533	1,808,312	2,007,907
Maximum Cost RPS	1,484,885	1,514,402	1,551,196	1,732,254	1,922,182	2,167,784
Modeled Cost RPS	1,478,697	1,505,567	1,537,444	1,689,528	1,831,228	2,031,727

Percent Difference	2008	2009	2010	2015	2020	2025
Maximum Cost RPS	0.9%	1.3%	2.0%	4.4%	6.3%	8.0%
Modeled Cost RPS	0.49%	0.7%	1.1%	1.8%	1.3%	1.2%

Under the modeled scenario, in 2008, retail rates on a kilowatt hour basis are modeled to increase by 6 hundredth of one cent ($0.0006), peak in 2015 at 21 hundredths of one cent ($0.0021) and decrease to 15 hundredths of one cent ($0.0015) in 2025. Under the maximum scenario, in 2008, retail rates on a kilowatt hour basis are modeled to increase by 10 hundredths of one cent ($0.001) and increase to 99 hundredths of one cent ($0.0099) in 2025.

Table 21: Retail Electric Rates

Cents per kilowatt hour (2006)	2008	2009	2010	2015	2020	2025
Maximum Cost RPS	0.10	0.15	0.23	0.52	0.76	0.99
Modeled Cost RPS	0.06	0.08	0.13	0.21	0.15	0.15

Under the modeled scenario, the average household in New Hampshire in 2008 could expect to spend $.03 more per month on their electric bill, $.65 more per month in 2015 and $.24 more in 2025. Under the maximum cost scenario, the average household in New Hampshire in 2008, could expect to spend $.54 more per month on their electric bill and $2.23 more in 2025.

Table 22: Average Household Monthly Increase

$2006	2008	2009	2010	2015	2020	2025
Maximum Cost RPS	0.61	0.86	1.36	3.01	4.38	5.73
Modeled Cost RPS	0.33	0.46	0.75	1.24	0.88	0.85

At the levels described in LSR-H-0208, a New Hampshire RPS is expected to have relatively modest cost impacts on retail electric costs, even in the maximum cost scenario. These findings are consistent with other studies that have analyzed the economic costs and benefits in the New England region of a Renewable Portfolio Standard. For example, studies of Rhode Island and Massachusetts estimated the increase in retail rates to be up to $0.0025 through 2015 (the longest time horizon in the studies).

Looking at the NH RPS in 2010, the existing renewable energy requirement is expected to make up the highest proportional cost at 74% and results in 86% of the overall RPS generation. The new renewable requirement is the next highest proportional cost at 21% and results in 13% of the overall RPS generation. The solar requirement makes up 5% of the proportional cost for 1% of the RPS generation.

By 2025, the existing renewable energy requirement is expected to make up the highest proportional cost at 66% and results in 32% of the overall RPS generation. The new renewable requirement is the next highest proportional cost at 17% and results in 67% of the overall RPS generation. The solar requirement makes up 18% of the proportional cost for 1% of the RPS generation.

Table 23: RPS Class Cost and Generation

	2010				2015				2025			
	Cost (Thousands of $2006)		MWh (Thousands)		Cost (Thousands of $2006)		MWh (Thousands)		Cost (Thousands of $2006)		MWh (Thousands)	
New	3,578	21%	122	13%	10,615	35%	777	43%	4,014	17%	2,340	67%
Existing	12,513	74%	792	86%	13,843	46%	971	54%	15,627	66%	1,097	32%
Solar	770	5%	5	1%	5,537	18%	39	2%	4,180	18%	44	1%

5.2.2 Predicted New Capacity in New Hampshire

The model predicts that total New England regional RPS demand is modeled to result in 1,061 MW of new construction in New Hampshire by 2025. This was determined by looking at the renewable energy supply developed to meet RPS demand. Capacity was determined by taking the capacity factor for any given selected technology. The development in New Hampshire was based on its relative (to the region) proportion of economic renewable energy resources. This was based on the assumption that New Hampshire would be just as likely as any other state to have its natural resources utilized for renewable energy generation.

Ninety percent of new capacity would be modeled to be wind generation. Biomass would make up the second-highest new capacity at 5% of new generation. It is important to note that the model selects the lowest cost renewable energy technologies able to meet RPS demand. The model was not adjusted to account for any possible "barriers" in the marketplace, such as potential difficulty in the siting of technologies like wind.

These findings are consistent with other studies that are projecting that wind will make up a large proportion of new renewable energy construction in New England and throughout the United States. A review of 26 state RPS studies revealed that in the eastern portion of the United States, wind was the single largest expected renewable energy resource to be developed, representing 62% of incremental generation[28].

Throughout the United States and along the East Coast significant size wind projects are being proposed. Just recently, a 600 MW offshore wind project was proposed off the coast of Delaware[29]. The high proportion of interconnection requests through 2010 (90%) in New England for wind is another strong indicator that wind may make up a significant portion of new renewable energy construction in New England.

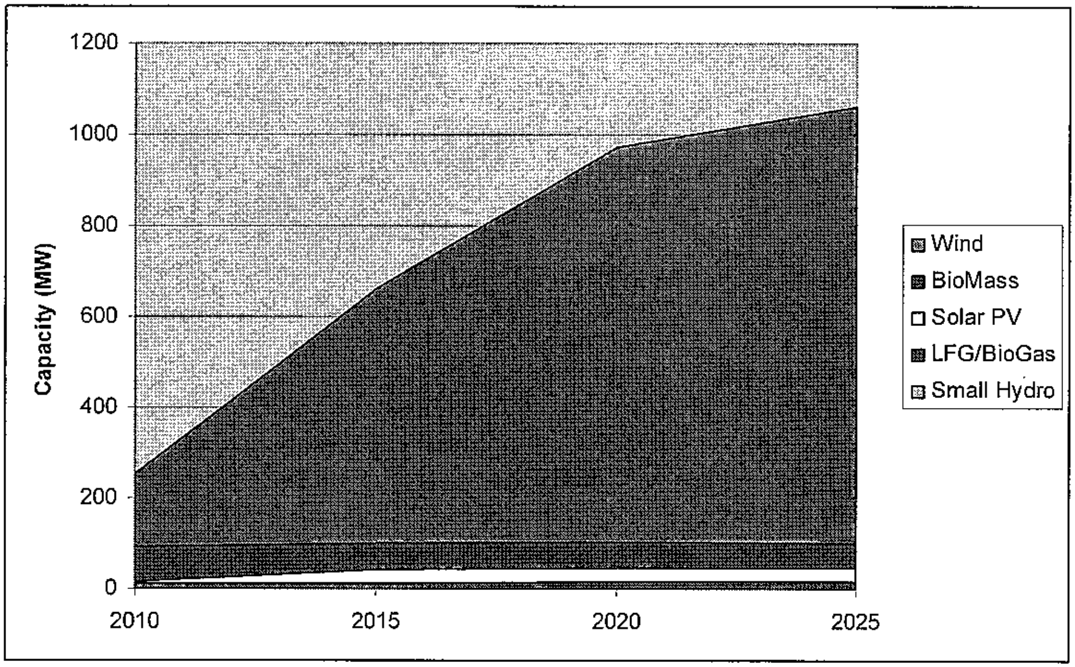
Table 24: Cumulative Projected Renewable Energy Construction in New Hampshire (MW)

	Wind	BioMass	Solar PV	LFG/BioGas	Small Hydro
2010	159	80	4	10	0
2015	564	57	30	12	0
2020	871	57	31	14	0
2025	960	53	33	15	0

[28] Wiser, Ryan, "The Costs and Benefits of State RPS Policies: Cost-Impact Studies, Actual Costs, and Cost Containment,"Lawrence Berkeley National Laboratory, May 31, 2006, Available at www.oregon.gov/ENERGY/RENEW/docs/Wiser_Oregon_RPS_Cost_May_2006.ppt

[29] E-mail correspondence from Joe Fontaine, New Hampshire Department of Environment Services, February 5, 2007

Figure 14: Cumulative Projected Renewable Energy Construction in New Hampshire



5.2.3 Impact on Natural Gas Consumption

New England has a high dependence on natural gas power plants for electricity generation. In 2005, natural gas was utilized to generate 50.8 million MWh of electricity in the region. Natural gas was the single largest fuel source utilized and accounted for 38% of all New England generation[30]. Throughout the country, new natural gas power plants have accounted for over 95% of all new electric generation capacity additions.[31]Rising demand for natural gas has been one factor that has contributed to rising and volatile natural gas prices in New Hampshire and the region.

Electricity from renewable energy can serve as a hedge against natural gas price risk in two ways. Renewable energy can displace natural gas for the generation of electricity. Several modeling studies have consistently found that increased levels of renewable energy and energy efficiency will put downward pressure on natural gas prices. The modeled price elasticity of natural gas ranges from 0.75%-2.5%[32]. This means that a 1% reduction in national natural gas consumption would be expected to result in a .75% to 2.5% reduction in the national price of natural gas.

New England currently consumes approximately 800 million MMBTU (Million British Thermal Units) of natural gas annually. This accounts for approximately 4% of national

[30] NEPOOL GIS generation data 2005
[31] Wiser et al., "The Value of Renewable Energy as a Hedge against Fuel Price Risk," Lawrence Berkeley National Laboratory, September 2004, Available at http://www.oe.energy.gov/DocumentsandMedia/wrec_hedge_final_sept_2004.pdf
[32] See Footnote 29

natural gas consumption. Natural gas consumed for power generation is the single largest use in New England at approximately 350 million MMBTU or 45% of regional usage.

In calculating the impact of New England RPS on natural gas consumption, a 60% displacement rate was assumed. This was believed to be appropriate based on displacement rates used in other natural gas studies and also due to the high New England reliance on natural gas for electricity generation.

The RPS of Connecticut, Rhode Island and Massachusetts will reduce national natural gas consumption by 30 million MMBTU or 0.13% in 2010 and 90 million MMBTU or 0.35% in 2025. This reduction is modeled to reduce annual regional natural gas costs by $181 million in 2010 and $534 million in 2025. Of those cost reductions, almost 98% are expected to be concentrated specifically in the power sector. This is due to the fact that while there is some expected price reduction in natural gas due to the New England RPS, the large majority of savings is in avoided natural gas consumption for power generation in the region.

Table 25: Total Natural Gas Savings Due to New England RPS

	Savings (Millions $2006)	
New England RPS w/o NH RPS	2010	2025
New England	181	534
New Hampshire	17	51
New England RPS w/ NH RPS	2010	2025
New England	184	594
New Hampshire	18	57

New England has a regional power pool, thus consumers in New Hampshire can expect to have cost savings related to reduced natural gas consumption as a result of other New England state RPS. New Hampshire retail electric load is approximately 9.5% of regional retail electric load. Therefore New Hampshire would be expected to share at a proportional rate of the regional cost reductions. New Hampshire retail consumers would see overall reductions in natural gas costs of $17 million in 2010 and $51 million in 2025 due solely to other New England state RPS.

A New Hampshire State RPS would also assist in further reducing natural gas prices and natural gas consumption at both the regional and state level. Based on the RPS proposed in LSR-H-0208, new renewable energy generation developed as a result of the New Hampshire RPS would be modeled to reduce national natural gas consumption an additional 500,000 MMBTU or 0.006% in 2010 and 10 million MMBTU or 0.045% in 2025. This is modeled to have an additional regional annual reduction on power costs of $3 million in 2010 and $57 million in 2025. New Hampshire retail electricity consumers would be expected to see an additional total annual reduction in electric costs of $300,000 in 2010 and $5.6 million in 2025.

When taking into account modeled savings due to reduced consumption of natural gas, there is a slight reduction in the modeled costs of the RPS program for New Hampshire

Table 26: Retail Electric Rates

Cents per kilowatt hour (2006)	2008	2009	2010	2015	2020	2025
Maximum Cost RPS	0.10	0.15	0.23	0.51	0.73	0.95
Modeled Cost RPS	0.06	0.08	0.13	0.20	0.13	0.11

Table 27: Average Household Monthly Increase

$2006	2008	2009	2010	2015	2020	2025
Maximum Cost RPS	0.61	0.85	1.35	2.94	4.25	5.53
Modeled Cost RPS	0.33	0.45	0.74	1.17	0.75	0.65

This study also looked at the monetary value of the hedge that renewable energy provides. This was determined by looking at the natural gas displaced by renewable energy and calculating the equivalent premium required to purchase a natural gas future contract for that displaced generation. In other words, what would be the cost to "stabilize" the portion of natural gas generation required if a RPS did not exist. Studies have shown that the cost premium for a long-term fixed natural gas contract to be $0.5-$0.8 per MMBTU[33].

On a regional level, a New Hampshire RPS has a modeled economic hedge value of $260,000 -$425,000 in 2010 and $5-$8 million in 2025. This hedge would be modeled to have an economic value for New Hampshire of $25,000 -$40,000 in 2010 and $485,000 - $775,000 in 2025.

The above analysis has focused solely on the ability of new renewable energy to displace future natural gas fired power generation. A percentage of the proposed New Hampshire RPS legislation is to help maintain existing levels of renewable energy generation. Therefore, it is important to determine the avoided cost of increased natural gas generation if the level of renewable energy required by the New Hampshire RPS were to disappear. In other words, if renewable energy facilities went out of business because the New Hampshire RPS did not exist to help cover expenses and costs of capital, what would be the expected price increases in electricity as a result of increased natural gas fired generation.

If a New Hampshire RPS for existing renewable energy did not exist and as a result the percentage of renewable energy in the region were to decrease by the percentages specified in the New Hampshire RPS, then natural gas fired generation would be modeled to increase national natural gas consumption an additional 3.3 million MMBTU or 0.01%

[33] Wiser et al., "The Value of Renewable Energy as a Hedge against Fuel Price Risk," Lawrence Berkeley National Laboratory, September 2004, Available at http://www.oe.energy.gov/DocumentsandMedia/wrec_hedge_final_sept_2004.pdf

in 2010 and 4.6 million MMBTU or 0.02% in 2025. This would result in an expected natural gas price increase of approximately 0.02% in 2010 and 0.02% in 2025. The region would expect to see an increase in total retail electricity costs of $20 million in 2010 and $26.6 million in 2025. This would be expected to increase New Hampshire total retail electricity costs by $1.8 million in 2010 and $2.6 million in 2025.

Furthermore, the hedge value benefit would also be lost which has a value at the regional level of $1.7-$2.7 million in 2010 and $2.3-$3.6 million in 2025. This economic value lost at the state level would be $150,000-$250,000 in 2010 and $225,000-$350,000 in 2025.

5.3 New Hampshire Economic Development

Ensuring a market and fostering demand for renewable energy in New Hampshire can provide business and employment development benefits in the state. This will occur as imported sources of energy are replaced by internal sources, such as biomass, wind and solar, and in state (New Hampshire) businesses start-up and grow to meet market demand for renewable energy.

While in the analysis above the economic costs -- primarily the increased costs of electricity and higher prices to be paid by NH consumers -- were highlighted, there is an important benefit side to increased reliance on renewable energy in the state. As part of the full evaluation of the economic impact of a RPS in NH, the employment and state revenue generation effects of legislation are considered.

5.3.1 Overview

The renewable energy industry has the potential to provide important employment and state tax revenue benefits within the New England region. There are a variety of jobs that can be created by renewable energy businesses in New Hampshire. These include both *direct* - those created in the manufacturing, delivery, construction and installation, project management, and operation and maintenance of the different components of the renewable energy facility under consideration and *indirect* (induced) employment. For example, the jobs associated with the construction of a new biomass facility are direct jobs while the jobs created to manufacture the steel used to build the facility are induced.

5.3.2 Economic Benefits of a RPS

In determining the economic implications of a State RPS, relevant research on the employment and economic benefits of RPS was critically reviewed. The review identified strong and consistent findings that renewable energy can provide more US jobs than a comparable investment in the fossil fuel energy sources.

The most current and comprehensive meta-study (see citation in footnote) concluded that "...(a)cross a broad range of scenarios, the renewable energy sector generates more jobs per average megawatt of power installed, and per unit of energy produced, than the fossil fuel-based energy sector,... (a)ll states stand to gain in terms of net employment from the implementation of a portfolio of clean energy policies at the federal level." [34]

Under a variety of the most likely scenarios, the renewable energy industry consistently generated more jobs per average MW (MW^a) than the fossil fuel industries. In the scenario assuming most renewable energy comes from biomass burning, this could amount to as many as 240,000 new jobs created nationally by 2020, versus no more than 75,000 new jobs if the country depends on fossil fuels.

A conservative projection is that the renewable energy sector in New Hampshire would enhance employment by 1,100 full-time equivalent workers and generate approximately $1 million in new state revenue each year based on the expected level of renewable energy development in New Hampshire by 2025. The employment addition would be about triple the employment gained in the state from all new firms in 2006[35].

This analysis assumed that NH has average competitive position in providing renewable energy in the New England region and nationally. The meta-analysis estimates of NH employment gains from renewable energy were factored down on a proportional (total employment) basis from the national level to obtain state level estimates. This was all from the source commonly deemed as one of the most reputable and comprehensive.

This estimate was validated and adjusted (see Table 28) using model assumptions from the Electrical Power Research Institute and California Energy Commission and a relatively conservative employment multiplier of 1-to-1. The multiplier reflects that every new job directly created and induced by renewable energy would generate income for households that would be spent in other (unrelated to renewable energy) sectors of the state's economy. This would include jobs in retail and personal services sectors. The estimates of total employment generated are consistent, after adjusting for total state employment differences, with RPS economic projections for Massachusetts and Pennsylvania .

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[34] Daniel Kammen, a professor in UC Berkeley's Energy & Resources Group and Goldman School of Public Policy, and head of UC Berkeley's Renewable and Appropriate Energy Laboratory (RAEL), directed the team that reviewed 13 previous reports that looked at the economic and employment "Renewable energy is not only good for our economic security and the environment, it creates new jobs," Kammen said. "At a time when rising gas prices have raised our annual gas bill to $240 billion, investing in new clean energy technologies would both reduce our trade deficit and reestablish the U. S. as a leader in energy technology, the largest global industry today. (Putting Renewables To Work: How Many Jobs Can the Clean Energy Industry Generate? Daniel M. Kammen, Kamal Kapadia, Matthias Fripp, 2004).

[35] "New Hampshire Economic Review," Public Service of New Hampshire, October 2006, http://www.psnh.com/SharePDFs/EconRev2006.pdf

Table 28: New Hampshire Renewable Development

Renewable Type	Mfg & Const. Jobs per MW 20 yr life	O-M-T Jobs per MW	Mfg & Cons. % of annual jobs	Jobs 2010	2015	2020	2025
Wind	2.57	0.29	0.31	62	236	365	402
Geothermal	4	1.67	0.11	0	0	0	0
BioMass	4.29	1.53	0.12	140	98	98	98
LFG/BioGas	3.71	2.28	0.08	25	30	35	37
Solar Thermo	5.71	0.22	0.56	0	0	0	0
Solar PV	7.14	0.12	0.75	2	14	15	16
Small Hydro	5.71	0.12	0.7	0	0	0	0
Direct Employment				228	378	512	547
Multiplier				*228*	*378*	*512*	*547*
Total Employment				457	756	1,023	1,094

Source for model assumptions: Electrical Power Research Institute and Ca Energy Commission and study generated assumptions particular to RPS effect on renewable market in NH

The jobs would be generated from the switch from fossil fuels imported into the state to renewable energy produced in the state. About 75% of the jobs created would be in operations and maintenance and fuel processing. The remainder would be in construction, manufacturing and installation.

The benefits would be concentrated among the renewable energy companies and also NH supplier firms in industries with currently high (relative to US average) employment concentration, suggesting strong competitive position. [36]

[36] Table 28 shows the benefiting industry list with relative 2004 employment concentration (Location Quotient [LQ] greater than one indicating NH employment concentration above the national average for that industry), employment levels and the number of establishments.

Table 29: New Hampshire Industries Potentially Benefiting from a State RPS

Naics Code	Description	Potential Industry Entry by Renewable Energy Type	2004 Annual Establishments	2004 Annual Employment	2004 Annual Wages
11331	Logging	Biomass	115	449	$15,213,389
11531	Support Activities for Forestry	Biomass	24	86	$5,089,159
32611	Plastics Packaging Materials and Unlaminated Film and Sheet Manufacturing	Solar	13	726	$30,063,068
32721	Glass and Glass Product Manufacturing	Solar	13	642	$31,860,464
33151	Ferrous Metal Foundries	Wind, Biomass	6	1,371	$55,334,202
33232	Ornamental and Architectural Metal Products Manufacturing	Solar	75	1,540	$62,971,939
33291	Metal Valve Manufacturing	Biomass	12	1,368	$58,616,279
33399	All Other General Purpose Machinery Manufacturing	Biomass	34	1,443	$81,385,050
33441	Semiconductor and Other Electronic Component Manufacturing	Wind	150	6,947	$334,373,171
33451	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	Wind	87	7,581	$564,955,646
33593	Wiring Device Manufacturing	Solar	9	860	$39,318,967

Source: Bureau of Labor Statistics State and County Employment and Wages from the Quarterly Census of Employment and Wages

Without a significant in-state market for renewable energy created by a NH RPS these jobs and the associated tax revenues would not be generated at this scale. This follows from the assumption that there is a New England regional market for renewable energy and that with the NH market base created by a NH RPS a significantly larger number of companies in the state would be motivated to enter the market and then be well-positioned to compete effectively in the regional market. Without a RPS in NH, firms in the state would not be as aware of renewable energy market opportunities, not have a local market to serve, and not be able to develop expertise and a strong base to grow from and compete effectively in the regional market for renewable energy.

The estimate is based on the average job created per renewable energy type. The estimated ranges of employment benefit per MW^a used vary by renewable energy source. They range from 10.56 jobs per MW^a for the least labor efficient solar sources to 0.71 for the most efficient wind sources. Biomass's range is from 0.78 to 2.84 employment effect per MW^a.

The implications of the expected business development and employment growth with RPS implementation in NH are significant. This is particularly true, at a time when many smaller businesses in the state are finding it increasingly difficult to compete with larger national companies such as "big box" retailers. The newfound opportunity for NH residents to start businesses, with "local" demand for renewable energy guaranteed by RPS, would be of significant economic and also social benefit. The business development and employment generation would be distributed across the state and it would provide economic opportunity for individuals with diverse profession backgrounds and interests.

State revenue would be from the business profits and business enterprise tax revenue generated from the NH companies supplying the renewable energy sector. It is based on the assumption that firms in the renewable energy sector would generate an average amount of state revenue per worker currently in the state.

Not only will new renewable energy facilities have positive economic impacts, but sustaining existing facilities will maintain significant economic benefits. In 2005, existing renewable energy facilities in New Hampshire employed 194 paying $12.8 million in annual wages. The hydroelectric power generation industry employed 52 paying $2.9 million in annual wages. Other renewable facilities, including biomass, employed 142 paying $9.9 million in annual wages[37]. The average wage per job in a renewable energy facility in New Hampshire was $65,979. This was well above the New Hampshire 2005 average wage for job of $39,794[38].

[37] "State and County Employment and Wages from the Quarterly Census of Employment and Wages," 2004 data, Bureau of Labor Statistics, Available athttp://www.bls.gov/data/home.htm#tools
[38] "CA34 – Average wage per job," , 2005 data, Bureau of Economic Analysis, Available at http://www.bea.gov/bea/regional/reis/default.cfm?catable=CA34&section=2

6 50% Wind Scenario

An additional scenario was modeled in which the potential wind sites throughout the region were reduced by 50%. This scenario helps to determine the cost and development impacts if wind sites experience economic or non-economic barriers to development.

RPS compliance costs would be expected to increase under the 50% wind scenario. Renewable energy premiums would be expected to increase significantly. Under the base case scenario, in 2010, RECs for new renewable energy are modeled to be $32.5 per MWh. Under the 50% wind scenario, REC prices for new renewable energy are expected to increase 82% to $59 per MWh. By 2025, the 50% wind scenario would be expected to result in REC market prices of $20.1 per MWh, 570% higher than the base case of $3 per MWh.

Table 30: New Renewable Energy Premium ($Nominal/MWh)

	Base Case	50% Wind	% Difference
2010*	$ 32.5	$ 59.0	82%
2015	$ 17.0	$ 29.0	71%
2020	$ 2.2	$ 16.5	650%
2025	$ 3.0	$ 20.1	570%

*50% Wind premium is projected to be the ACP

Under the base case scenario, in 2010, RPS direct costs are modeled to be $16.8 million. Under the 50% wind scenario, REC prices for new renewable energy are expected to increase 18% to $19.8 million. By 2025, the 50% wind scenario would be expected to result in RPS direct costs of $48.5 million, 104% higher than the base case of $23.8 million.

Table 31: RPS Direct Costs ($2006 millions)

	Base Case	50% Wind	% Difference
2010	$16.8	$19.8	18%
2015	$30.0	$37.3	24%
2020	$22.9	$38.0	66%
2025	$23.8	$48.5	104%

While costs experience a significant increase under the 50% wind scenario, the overall retail electric consumer impact is still expected to be low. Under the base case scenario, the highest modeled increase in retail electricity rates due to a NH RPS would be 0.20 cents per kWh. Under the 50% wind scenario, the highest modeled increase in retail electricity rates due to a NH RPS would be 0.27 cents per kWh. The largest average household monthly increase in electric costs under the base case scenario would be $1.17 and $1.54 under the 50% wind scenario.

Table 32: Retail Electric Rates

Cents per kilowatt hour (2006)	2008	2009	2010	2015	2020	2025
Maximum Cost RPS	0.10	0.15	0.23	0.51	0.73	0.95
Modeled Cost RPS	0.06	0.08	0.15	0.25	0.23	0.27

Table 33: Average Household Monthly Increase

$2006	2008	2009	2010	2015	2020	2025
Maximum Cost RPS	0.61	0.85	1.35	2.94	4.25	5.53
Modeled Cost RPS	0.33	0.45	0.86	1.47	1.33	1.54

The model predicts that total wind development in New Hampshire would decrease by 383 MW from 960 MW in the base case scenario to 577 MW in the 50% wind scenario through 2025. Biomass development is predicted to increase significantly by 125 MW from 53 MW in the base case scenario to 178 MW in the 50% wind scenario through 2025. The model did not predict any other renewable energy capacity changes as a result of less wind development.

Even in the 50% wind scenario, wind would make up the largest capacity type in New Hampshire. Biomass would make up the second-highest new capacity at 22% of new generation.

Table 34: Projected Construction in New Hampshire (MW) (50% Wind)

	Capacity (MW)	
Wind	577	72%
BioMass	178	22%
Solar PV	33	4%
LFG/BioGas	15	2%
Small Hydro	0	0%

Employment and state revenue are expected to be almost the same between the base case and the 50% wind scenario New Hampshire would be expected to generate 1200 full-time equivalent jobs under the 50% wind scenario, this is approximately 100 more jobs than the base case scenario. New Hampshire state revenue would be expected to be $1.1 million per annum under the 50% wind scenario.

7 RPS Recommendations

7.1.1 Allow Long-Term Contracting to Meet RPS Requirements

Long -term contracting is expected to assist in the development of new renewable energy projects. In the states that enact long-term contract legislation, it is expected that renewable energy projects will be more likely to obtain the financing they need. In addition, analysis indicates that long-term contracts may reduce the renewable energy premiums up to 60% lower than would be observed through market based REC procurement.

As time goes on more states appear to be switching towards long-term contracting as a strategy for renewable energy procurement. Connecticut, Maine and Vermont have all passed legislation that encourages long-term contracts for renewable energy. New Hampshire should give serious consideration to this strategy as it is being employed as a tool to guarantee in-state development of renewable energy. In considering long-term contracts, it is important to consider the risk of stranded costs.

7.1.2 Renewable Energy Fund through Systems Benefit Charge

All of the New England states with the exception of New Hampshire have some form of renewable energy fund. New Hampshire has proposed a renewable energy fund to be funded through alternative compliance payments. This funding mechanism will likely introduce significant uncertainty in annual budgeting that may hurt the success of the program. If the RPS requirements in any given compliance year are met then there would be no funds available to help promote future generation. This could lead to a boom/bust cycle that puts New Hampshire at a competitive disadvantage relative to other New England states.

It is our position that a Systems Benefit Charge dedicated to renewable energy and separate from the existing System Benefit Charge for energy efficiency and low income households would greatly increase New Hampshire's ability to develop renewable energy projects. As with long-term contracting, funds from the Systems Benefit Charge could be directly targeted to in-state economic development.

7.1.3 Add an Energy Efficiency Class to RPS

NH may want to also consider adding an additional efficiency class, similar to the Connecticut Class III. A recent study of a potential North Carolina RPS found that by including an energy efficiency class, the net incremental cost was actually negative. The energy efficiency component was also expected to add significantly more jobs than just a renewable energy component alone[39].

Utilizing the reported costs and electricity production from the New Hampshire Systems Benefit Charge for 2005, it was found that energy efficiency measures costs $17 per avoided MWh[40]. Contrasting this with the $145 expected retail cost of a megawatt of new renewable energy in 2010, shows that there may significant cost reductions associated with a RPS class that seeks to reduce consumption versus increase capacity[41].

An energy efficiency class can serve to make New Hampshire businesses more competitive by reducing expenses associated with energy consumption. A class could provide financial support for New Hampshire businesses to implement demand reduction and cogeneration systems.

7.1.4 Consider the Effectiveness & Cost of the Proposed NH Class Structure

The class structure proposed in LSR-H-0208 is unique in the New England region. Careful consideration should be given to the effectiveness and cost of the proposed classification system.

The inclusion of a solar class is unique to New England state RPS. Consideration should be given to the cost relative to the energy production from a solar class. In 2015, the solar class is expected to account for 18% of the cost but only 2% of total New Hampshire RPS mandated generation. By 2025, the solar class is still expected to account for 18% of the cost but only 1% of total New Hampshire RPS generation.

The intent of Class III and Class IV is to provide financial support for the continued operations of existing renewable energy facilities in New Hampshire. There are a couple of areas to consider relative to these classes. The first is that facilities outside of New Hampshire would compete with New Hampshire facilities for the Class III and Class IV requirements. Therefore an existing RPS requirement does not guarantee that funds will flow through to existing New Hampshire facilities.

The projected supply and demand for resources that are eligible for Class III (existing biomass under 25 MW) for the near term is expected to be closely matched. This would put upward pressure on Class III REC market prices. In contrast, the supply of resources

[39] "Analysis of a Renewable Portfolio Standard for the State of North Carolina," La Capra Associates et al., December 2006, Available http://www.ncuc.commerce.state.nc.us/rps/NC%20RPS%20Report%2012-06.pdf

[40] Calculated from $16.5 million in expenses for 972,000 lifetime MWhs, "Report to the Legislative Oversight Committee on Electric Restructuring Results and Effectiveness of the System Benefits Charge," New Hampshire Public Utility Commission , October 2006, http://www.puc.state.nh.us/Electric/100106%20LI-SBC%20legislative%20report.pdf

[41] $145 is based on an EIA projection of 11.6 cents per kilowatt hour ($2006) in 2010 plus an expected renewable premium of 2.93 cents per kilowatt hour ($2006)

that are eligible for Class IV (existing hydropower equal to or under 5 MW) far exceeds NH demand. This would tend to put strong downward pressure on Class IV REC market prices. Therefore the class structure may result in significantly different financial support to different existing facilities in New Hampshire based solely on technology type independent of actual need.

Different existing renewable energy facilities will have significantly different revenue requirements. Some facilities may be able to sell their power below wholesale market rates while others may need to sell their power at above wholesale market rates in order to be economically viable. A RPS is "need blind" and does not target aid. This may result in additional unneeded revenue for facilities that are already economically viable and may be insufficient to support the revenue requirements of distressed facilities.

At a minimum, because market-based REC procurement is based on marginal cost, it could result in higher costs than could be achieved through other options such as long-term contracts. New Hampshire may want to consider utilizing long-term contracts to support existing facilities in New Hampshire to lower costs and better match facilities revenue requirements.

8 Summary

New Hampshire is the only New England state that has not passed some form of Renewable Portfolio Standard legislation. Massachusetts, Maine and Connecticut all have RPS legislation that is currently in effect. Rhode Island has RPS legislation that takes effect in 2007 and Vermont has implemented a voluntary requirement that becomes a mandatory RPS in 2012 if certain goals are not reached.

A New Hampshire RPS would increase regional demand for renewable energy and help the region diversify away from fossil fueled sources of generation. This would reduce energy market uncertainty and hedge against fossil fuel price volatility. While this study did not specifically quantify the estimated air quality impacts of a NH RPS, renewable energy power generation is associated with low to no air pollution emissions which would replace polluting sources of power generation in the region. This would help in improving regional air quality and help to reduce carbon dioxide emissions, a potent greenhouse gas.

Our analysis indicates that regional demand for renewable energy would have significant employment and state revenue impacts for the state of New Hampshire. It is estimated that regional demand for new renewable energy will result in approximately 1100 full-time equivalent jobs and provide approximately $1.1 million in new state revenue annually in New Hampshire by 2025. Furthermore, it would help support existing renewable energy facilities in the state that employed 194 people and paid $12.8 million in wages in 2005.

The RPS proposed in LSR-H-0208 is estimated to increase renewable energy demand in New England by 2% in 2010 and 11% in 2025. It is projected that New Hampshire RPS demand coupled with regional demand from other State RPS will result in new renewable energy sources in NH of 960 MW of wind, 53 MW of biomass, 33 MW of solar and 15 MW of biogas by 2025.

A New Hampshire RPS is expected to have some negative cost impact, in the early years of implementation. In the long term it is expected to have positive long-term economic and environmental benefits for in the state. The extent of the long term benefits depend on future fossil fuel prices and federal and state environmental regulations.

A New Hampshire RPS would be expected to reduce regional natural gas consumption by 500,000 MMBTU in 2010 and 10 million MMBTU in 2025. New Hampshire retail electricity consumers would be expected to see savings in electric costs of $300,000 in 2010 and $5.6 million in 2025 as a result.

A New Hampshire RPS for existing generation may help maintain renewable energy facilities. A loss of renewable energy generation equivalent to the amount specified in NH LSR-H-0208 would increase natural gas costs and consumption. This would result in an estimated increase in New Hampshire total retail electricity costs by $1.8 million in 2010 and $2.6 million in 2025.

In the modeled scenario, retail electricity rates (including benefits from reduced consumption of natural gas) on a kilowatt hour basis are modeled to increase by 6 hundredth of one cent ($0.0006), peak in terms of increased costs in 2015 at 20 hundredths of one cent ($0.0020)and decrease to 11 hundredths of one cent ($0.0011) in 2025. The average household could expect to see a monthly increase from $0.33 to $1.17 in their electric utility bill as a result of a New Hampshire RPS.

New Hampshire could benefit from implementing a RPS because it leads to an increase in regional demand that would be expected to result in new renewable energy projects specifically in New Hampshire. A New Hampshire RPS would also allow projects that generate power "behind the meter" to benefit by selling RECs that would be eligible for a New Hampshire RPS. Currently, these types of New Hampshire based projects are not eligible in other New England states. Most importantly a NH RPS would send a strong signal to potential in-state renewable energy providers that New Hampshire is committed to renewable energy and this would result in additional business development in new renewable energy technologies.

Other New England states have programs in place in addition to a RPS to promote in-state renewable energy development. Two programs that New Hampshire should consider are: (1) long-term contracting for renewable energy; and (2) a dedicated renewable energy development fund. A New Hampshire RPS only guarantees increased regional demand for renewable energy; it does not guarantee that renewable energy supply will come from New Hampshire.

New Hampshire RPS demand, with the exception of solar, can be fulfilled outside of the state. There is adequate potential new supply throughout New England to meet the New Hampshire RPS requirement. There is also sufficient supply of existing biomass and small hydropower outside of New Hampshire to meet the New Hampshire RPS requirements. However, Class III may experience REC market prices close to the ACP, due to the relatively close levels of supply and demand for qualifying biomass.

There is evidence that long-term contracting and renewable energy development funds can be useful tools for ensuring that renewable energy development occurs within the state. Long-term contracts can help to motivate increased renewable energy development and also reduce the long term costs associated with renewable energy. A New Hampshire renewable energy development fund financed through a separate Systems Benefit Charge could provide financial resources to help foster new renewable energy development within the state. Relying on only the alternative compliance payment as a funding source, may leave the fund with inadequate resources to be useful.

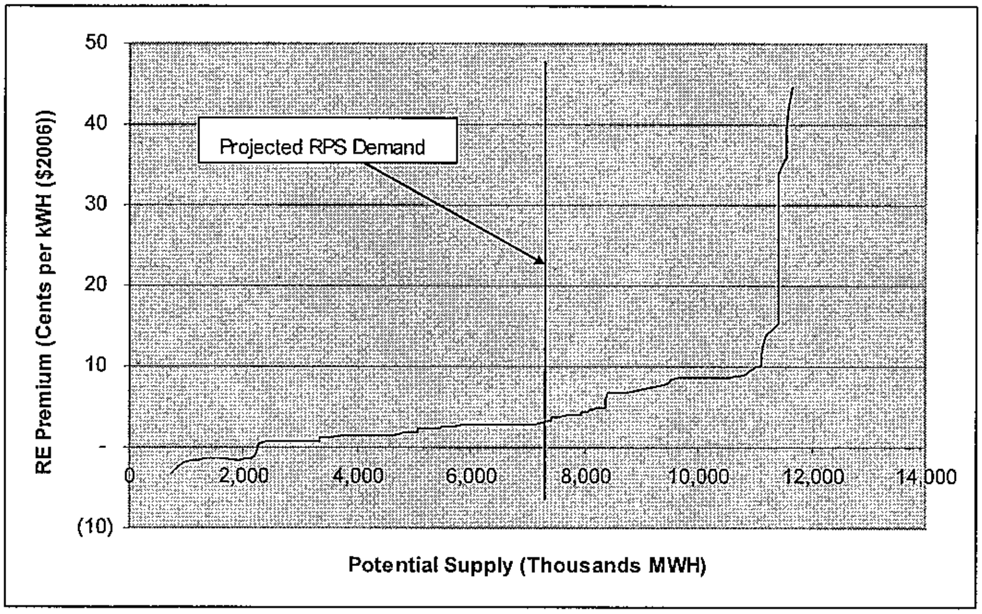
Adding an efficiency class similar to Connecticut Class III to the RPS should also be considered. An efficiency class can lower the costs associated with the RPS program and increase the competitiveness of New Hampshire businesses. New Hampshire should also consider the cost and effectiveness of the proposed class structure.

In conclusion, a NH RPS can help diversify NH's and the region's power generating capacity and reduce dependency on imported sources. It can increase the potential for new renewable energy development within the state and also help to maintain existing renewable energy resources. There are costs associated with a RPS, however, the net economic and environmental benefits are expected to be positive for New Hampshire.

9 Supply Curve for New Renewable Energy

9.1 2010

Figure 15: New Renewable Energy Supply Curve 2010

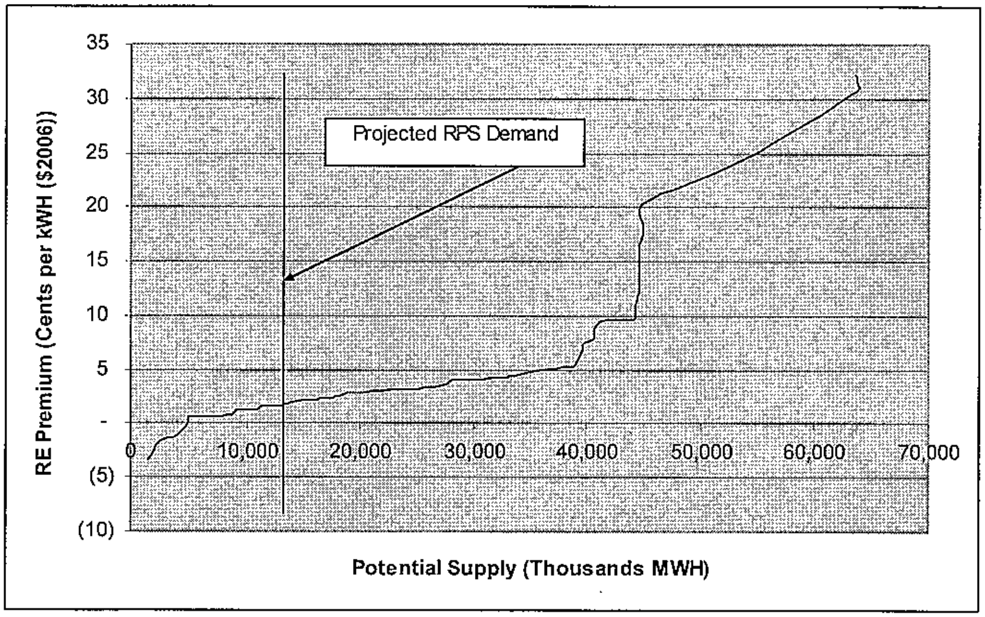


Technology	Premium in Cents ($2006)	Generation
Biomass Cofiring	(3.26)	744,600
Biogas Cogeneration from Waste Water Treatment	(1.64)	350,400
Landfill Gas with Existing Collection	(1.34)	1,033,592
Landfill Gas without Existing Collection	0.16	120,625
Solid Oxide Fuel Cells (SOFC).	0.62	118,260
Wind Class 6 - Near Transmission	0.68	976,915
Wind Class 6 - Far Transmission	1.17	0
Wind Class 5 - Near Transmission	1.30	755,638
Direct Fired Biomass @$0.78/MMBtu	1.40	378,432
Wind Class 6 - Distant Transmission	1.54	262,187
Gasification Biomass @$0.78/MMBtu	1.82	125,894
Wind Class 5 - Far Transmission	1.83	0
Existing Hydroelectric w/ Power - Maine	1.97	203,801
Wind Class 5 - Distant Transmission	2.23	0
Wind Class 4 - Near Transmission	2.30	297,840
Molton Carbonate Fuel Cells (MCFC)	2.47	118,260
Direct Fired Biomass @$1.88/MMBtu	2.84	817,133
Gasification Biomass @$1.88/MMBtu	2.90	744,950
Wind Class 4 - Far Transmission	2.90	0
Landfill Gas (Low Yield)	3.25	357,408

Wind Class 4 - Distant Transmission	3.34	0
Gasification Biomass @$2.66/MMBtu	3.65	0
Direct Fired Biomass @$2.66/MMBtu	3.85	541,718
Wind Class 3 - Near Transmission	3.94	0
Gasification Biomass @$3.49/MMBtu	4.46	0
Existing Hydroelectric w/ Power - Vermont	4.46	138,758
Wind Class 3 - Far Transmission	4.64	0
Direct Fired Biomass @$3.49/MMBtu	4.93	284,525
Wind Class 3 - Distant Transmission	5.16	0
Small Wind - Customer Sited 100kW	5.33	1,876
Existing Hydroelectric w/ Power - Connecticut	6.75	47,698
Biogas Cogeneration from Animal Waste	6.80	131,400
Wind Class 6 - Offshore	6.94	354,123
Existing Hydroelectric w/o Power - Maine	7.94	550,697
Existing Hydroelectric w/ Power - Massachusetts	8.41	60,707
Wind Class 5 - Offshore	8.59	311,287
Wind Class 4 - Offshore	8.82	935,218
Existing Hydroelectric w/o Power - Vermont	10.12	251,500
Existing Hydroelectric w/o Power - New Hampshire	10.35	108,405
Wind Class 3 - Offshore	11.58	0
Existing Hydroelectric w/o Power - Connecticut	13.79	60,707
Existing Hydroelectric w/o Power - Massachusetts	15.20	195,129
Existing Hydroelectric w/o Power - Rhode Island	16.02	43,362
Small Wind - Customer Sited 50kW	22.03	1,251
Small Wind - Customer Sited 10kW	33.92	44
Photovoltaic - Commercial 250kW	35.84	113,880
Tidal/Wave Power Generation	39.86	1,445
Photovoltaic - Residential 2.5kW	44.77	122,640

9.2 2015

Figure 16: New Renewable Energy Supply Curve 2015

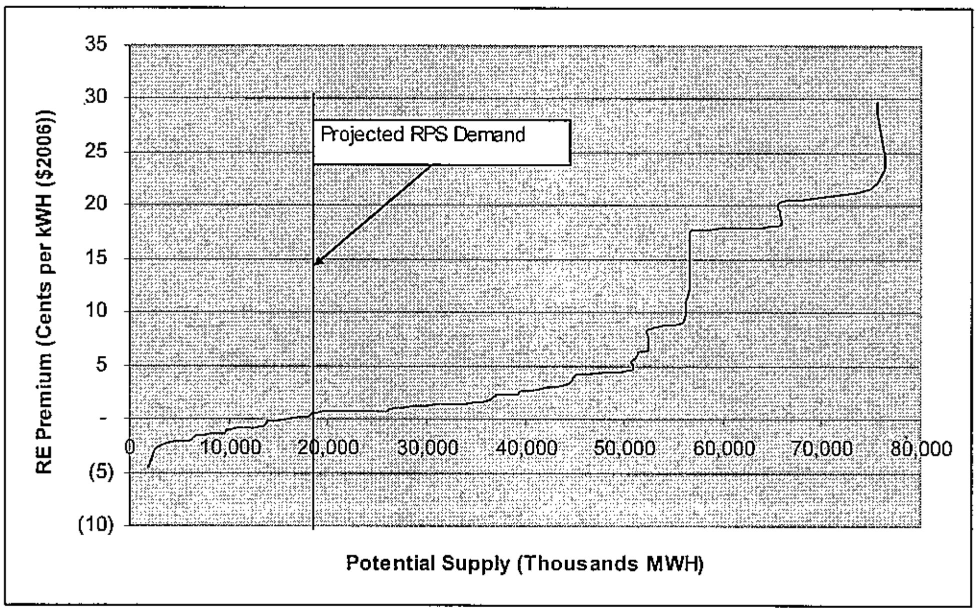


Technology	Premium in Cents ($2006)	Generation
Biomass Cofiring	(3.36)	1,489,200
Biogas Cogeneration from Waste Water Treatment	(1.72)	993,875
Landfill Gas with Existing Collection	(1.18)	1,495,595
Wind Class 6 - Near Transmission	0.12	976,915
Landfill Gas without Existing Collection	0.52	139,547
Wind Class 6 - Far Transmission	0.68	2,654,192
Wind Class 5 - Near Transmission	0.74	755,638
Solid Oxide Fuel Cells (SOFC).	0.84	236,520
Wind Class 6 - Distant Transmission	1.10	262,187
Gasification Biomass @$0.88/MMBtu	1.26	125,894
Wind Class 5 - Far Transmission	1.34	1,834,169
Direct Fired Biomass @$0.88/MMBtu	1.64	378,432
Wind Class 4 - Near Transmission	1.72	1,670,882
Wind Class 5 - Distant Transmission	1.79	339,538
Wind Class 4 - Far Transmission	2.40	3,454,944
Gasification Biomass @$2.14/MMBtu	2.41	744,950
Existing Hydroelectric w/ Power - Maine	2.59	203,801
Wind Class 4 - Distant Transmission	2.90	1,164,554
Molton Carbonate Fuel Cells (MCFC)	2.94	236,520
Wind Class 3 - Near Transmission	2.97	2,628,000
Direct Fired Biomass @$2.14/MMBtu	3.12	2,234,849
Gasification Biomass @$3.02/MMBtu	3.23	1,030,721
Wind Class 3 - Far Transmission	3.73	2,628,000
Landfill Gas (Low Yield)	4.04	357,408
Gasification Biomass @$3.97/MMBtu	4.10	1,817,484
Direct Fired Biomass @$3.02/MMBtu	4.17	3,092,164
Wind Class 3 - Distant Transmission	4.31	0
Small Wind - Customer Sited 100kW	4.41	6,967

Direct Fired Biomass @$3.97/MMBtu	5.28	5,452,453
Wind Class 6 - Offshore	5.36	367,920
Existing Hydroelectric w/ Power - Vermont	5.42	138,758
Biogas Cogeneration from Animal Waste	6.18	308,456
Wind Class 5 - Offshore	6.81	324,821
Tidal/Wave Power Generation	7.41	2,891
Wind Class 4 - Offshore	7.66	935,218
Existing Hydroelectric w/ Power - Connecticut	8.02	47,698
Existing Hydroelectric w/o Power - Maine	9.38	550,697
Wind Class 3 - Offshore	9.70	3,080,016
Existing Hydroelectric w/ Power - Massachusetts	9.91	60,707
Existing Hydroelectric w/o Power - Vermont	11.84	251,500
Existing Hydroelectric w/o Power - New Hampshire	12.10	108,405
Existing Hydroelectric w/o Power - Connecticut	16.02	60,707
Existing Hydroelectric w/o Power - Massachusetts	17.63	195,129
Existing Hydroelectric w/o Power - Rhode Island	18.56	43,362
Small Wind - Customer Sited 50kW	20.36	4,645
Photovoltaic - Commercial 250kW	24.36	8,736,035
Photovoltaic - Residential 2.5kW	30.70	9,923,376
Small Wind - Customer Sited 10kW	32.29	163

9.3 2020

Figure 17: New Renewable Energy Supply Curve 2020

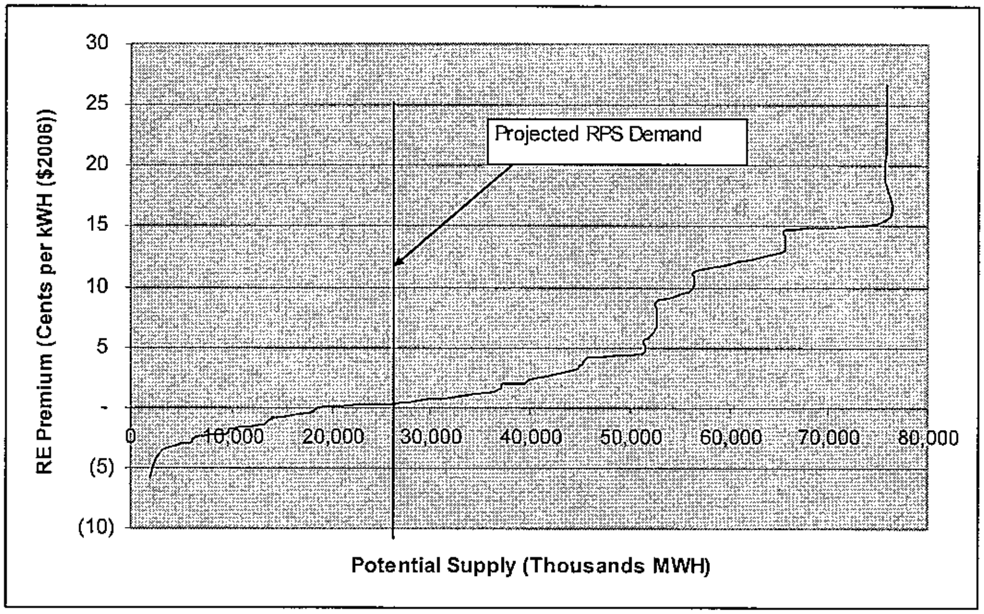


Technology	Premium in Cents ($2006)	Generation
Biomass Cofiring	(4.57)	1,861,500

Biogas Cogeneration from Waste Water Treatment	(2.70)	993,875
Landfill Gas with Existing Collection	(2.09)	2,033,284
Wind Class 6 - Near Transmission	(2.05)	1,024,570
Wind Class 5 - Near Transmission	(1.50)	795,408
Wind Class 6 - Far Transmission	(1.45)	2,783,665
Wind Class 6 - Distant Transmission	(0.99)	274,976
Wind Class 5 - Far Transmission	(0.85)	1,930,704
Wind Class 4 - Near Transmission	(0.62)	1,769,170
Wind Class 5 - Distant Transmission	(0.36)	357,408
Gasification Biomass @$1/MMBtu	(0.24)	125,894
Landfill Gas without Existing Collection	(0.15)	163,987
Wind Class 4 - Far Transmission	0.11	3,658,176
Solid Oxide Fuel Cells (SOFC).	0.22	354,780
Wind Class 4 - Distant Transmission	0.65	1,233,058
Wind Class 3 - Near Transmission	0.80	6,229,586
Direct Fired Biomass @$1/MMBtu	0.81	378,432
Gasification Biomass @$2.44/MMBtu	1.00	744,950
Wind Class 3 - Far Transmission	1.65	9,002,214
Gasification Biomass @$3.44/MMBtu	1.87	1,030,721
Existing Hydroelectric w/ Power - Maine	2.20	203,801
Small Wind - Customer Sited 100kW	2.21	25,869
Wind Class 3 - Distant Transmission	2.28	0
Direct Fired Biomass @$2.44/MMBtu	2.33	2,234,849
Molton Carbonate Fuel Cells (MCFC)	2.60	354,780
Gasification Biomass @$4.51/MMBtu	2.81	1,817,484
Direct Fired Biomass @$3.44/MMBtu	3.39	3,092,164
Landfill Gas (Low Yield)	3.85	357,408
Wind Class 6 - Offshore	4.21	386,316
Direct Fired Biomass @$4.51/MMBtu	4.53	5,452,453
Existing Hydroelectric w/ Power - Vermont	5.41	138,758
Wind Class 5 - Offshore	5.65	342,866
Biogas Cogeneration from Animal Waste	6.28	308,456
Wind Class 4 - Offshore	6.48	990,230
Tidal/Wave Power Generation	7.62	5,782
Existing Hydroelectric w/ Power - Connecticut	8.37	47,698
Wind Class 3 - Offshore	9.05	3,182,683
Existing Hydroelectric w/o Power - Maine	9.91	550,697
Existing Hydroelectric w/ Power - Massachusetts	10.52	60,707
Existing Hydroelectric w/o Power - Vermont	12.72	251,500
Existing Hydroelectric w/o Power - New Hampshire	13.02	108,405
Existing Hydroelectric w/o Power - Connecticut	17.47	60,707
Small Wind - Customer Sited 50kW	17.75	17,246
Photovoltaic - Commercial 250kW	18.21	8,736,035
Existing Hydroelectric w/o Power - Massachusetts	19.30	195,129
Existing Hydroelectric w/o Power - Rhode Island	20.35	43,362
Photovoltaic - Residential 2.5kW	22.15	9,923,376
Small Wind - Customer Sited 10kW	29.73	604

9.4 2025

Figure 18



Technology	Premium	Generation
Biomass Cofiring	(5.83)	1,861,500
Biogas Cogeneration from Waste Water Treatment	(3.70)	993,875
Landfill Gas with Existing Collection	(3.01)	2,033,284
Wind Class 6 - Near Transmission	(2.97)	1,024,570
Wind Class 5 - Near Transmission	(2.34)	795,408
Wind Class 6 - Far Transmission	(2.28)	2,783,665
Wind Class 6 - Distant Transmission	(1.76)	274,976
Wind Class 5 - Far Transmission	(1.60)	1,930,704
Wind Class 4 - Near Transmission	(1.34)	1,769,170
Wind Class 5 - Distant Transmission	(1.04)	357,408
Gasification Biomass @$1.14/MMBtu	(0.91)	125,894
Landfill Gas without Existing Collection	(0.81)	163,987
Wind Class 4 - Far Transmission	(0.51)	3,658,176
Solid Oxide Fuel Cells (SOFC).	(0.39)	473,040
Small Wind - Customer Sited 100kW	(0.13)	25,869
Wind Class 4 - Distant Transmission	0.10	1,233,058
Wind Class 3 - Near Transmission	0.28	6,229,586
Direct Fired Biomass @$1.14/MMBtu	0.28	378,432
Gasification Biomass @$2.77/MMBtu	0.51	744,950
Wind Class 3 - Far Transmission	1.23	9,002,214
Gasification Biomass @$3.91/MMBtu	1.49	1,030,721
Existing Hydroelectric w/ Power - Maine	1.86	203,801
Wind Class 3 - Distant Transmission	1.95	0
Direct Fired Biomass @$2.77/MMBtu	2.01	2,234,849
Molton Carbonate Fuel Cells (MCFC)	2.32	473,040
Gasification Biomass @$5.13/MMBtu	2.55	1,817,484

Direct Fired Biomass @$3.91/MMBtu	3.22	3,092,164
Biogas Cogeneration from Animal Waste	3.50	308,456
Landfill Gas (Low Yield)	3.74	357,408
Wind Class 6 - Offshore	4.15	386,316
Direct Fired Biomass @$5.13/MMBtu	4.52	5,452,453
Existing Hydroelectric w/ Power - Vermont	5.52	138,758
Wind Class 5 - Offshore	5.78	342,866
Wind Class 4 - Offshore	6.73	990,230
Tidal/Wave Power Generation	8.03	14,454
Existing Hydroelectric w/ Power - Connecticut	8.88	47,698
Wind Class 3 - Offshore	9.65	3,182,683
Existing Hydroelectric w/o Power - Maine	10.63	550,697
Existing Hydroelectric w/ Power - Massachusetts	11.33	60,707
Photovoltaic - Commercial 250kW	12.87	8,736,035
Existing Hydroelectric w/o Power - Vermont	13.83	251,500
Existing Hydroelectric w/o Power - New Hampshire	14.16	108,405
Small Wind - Customer Sited 50kW	14.76	17,246
Photovoltaic - Residential 2.5kW	15.52	9,923,376
Existing Hydroelectric w/o Power - Connecticut	19.22	60,707
Existing Hydroelectric w/o Power - Massachusetts	21.30	195,129
Existing Hydroelectric w/o Power - Rhode Island	22.50	43,362
Small Wind - Customer Sited 10kW	26.79	2,242

10 Definition of Key Acronyms

ACP - stands for Alternative Compliance Payment. It is a "penalty payment" paid by the utility or the competitive electric supplier if they are unable to purchase enough RECs to meet their RPS obligation.

GIS - stands for Generation Information System. The system is used to track RECs generated or imported into the New England Power Pool.

GWh - stands for gigawatt-hour. It is equivalent to 1000 MWh or 1,000,000 kWh

kWh - stands for kilowatt-hour. A unit of energy that is typically seen in retail electricity sales.

MMBTU - stands for one million BTUs (British Thermal Units). This is a standard unit of measurement used to denote the amount of heat energy in fuels. It is the equivalent to approximately 1,000 cu.ft. of natural gas.

MW - stands for megawatt. It is a measure of the capacity of a power facility to generate electricity.

MWa - stands for average megawatt. It represents the average number of megawatt-hours, not megawatts, over an annual period. It is useful when comparing facilities that have different annual hours of electricity generation.

MWh - stands for megawatt-hour. It is equivalent to 1000 kWh.

NEPOOL - stands for New England Power Pool. It is the interconnected power grid for the New England region.

REC - stands for Renewable Energy Certificate. It represents 1000 kWh (1 MWh) of power generation from a renewable energy resource.

RPS - stands for Renewable Portfolio Standard. It is a public policy that requires a specific percentage of electricity sold to retail customers come from renewable energy resources.