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Analysis of Renewable Energy Policy Options in Vermont

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Sustainable Energy Advantage

Analysis of Renewable Energy Policy Options for Vermont

The SPEED Program and Renewable Portfolio Standard

Produced for the
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Executive Summary

This report aims to provide the Vermont Public Service Board (PSB) with information that will help it fulfill a request by the Vermont Legislature to study whether Vermont should continue the Sustainably Priced Energy Development (SPEED) program or implement a renewable portfolio standard (RPS). It is based on stakeholder input, a review of the RPS programs in other states, and economic analysis of the potential costs and benefits of alternative SPEED and RPS designs for Vermont.

Although the report does not offer recommendations, it seeks to provide more than simply background information. It sets out the questions and issues that should be considered in the process of deciding whether to continue SPEED or implement an RPS, and then when deciding what the specific design of the selected policy should be. It identifies the specifics advantages and disadvantages of taking a variety of different policy approaches.

Both an RPS and the Vermont SPEED program are policy mechanisms that seek to address the barriers that can inhibit renewable energy from coming online. An RPS is a mandate that a state's electricity supply include a minimum quantity of renewable energy. It requires electricity suppliers to get a certain—and usually gradually increasing—percentage of their electricity from renewable energy sources. It is the most popular and widely used state policy mechanism for encouraging wholesale renewable energy power development, with 29 states plus the District of Columbia and Puerto Rico having mandatory RPSs.

The Sustainably Priced Energy Development program (SPEED) is unique to Vermont. It was enacted in 2005 to promote the development of in-state renewable energy and to ensure, that economic benefits of those resources flow to the Vermont economy and the state's ratepayers. SPEED set out several goals with the two currently most important being that the state's utilities enter into sufficient contracts to generate 5% of Vermont's 2005 load with SPEED resources by 2012 and that they supply 20% of Vermont's load with SPEED resources by 2017. A Standard Offer program added in 2009 covers projects smaller than 2.2 megawatts and provides approved projects with fixed price payments for every megawatt-hour of electricity they produce. The price varies depending upon the technology and the year.

The Context for Vermont's Renewable Energy Policy Decisions

Decisions about SPEED and a possible RPS should be made in reference to Vermont conditions and renewable energy trends in the region.

Vermont-specific information relevant to future renewable energy policy includes:

- About half of Vermont's electricity demand comes from renewable resources with the majority of that being hydropower from Hydro-Quebec and the New York Power Authority. In-state renewable electricity generation (primarily from hydropower and biomass) represents about 20% of Vermont electricity use.
- Overall, almost one half of Vermont's electricity supply comes from out-of-state.

- Vermont, like its neighboring New England states and New York, has among the highest energy prices in the country. However, Vermont has experienced smaller rate increases than most of the northeastern US.
- The state's strong desire to minimize future increases in electricity costs should be considered when designing energy policy.
- Vermont has remained a state with vertically integrated utilities subject to regulation, while the rest of New England restructured and incorporated retail choice.
- The Legislature, in Section 202a of Title 30, has stated that it is in the public interest to advance renewable energy, but that it should be pursued in a way that benefits the state's economy and balances a range of specific economic and environmental goals
- Other acts of the Legislature are also relevant. For example, Section 218c of Title 30 requires utility companies and the Vermont PSB to consider a broad range of possible alternatives for meeting the public's need for energy services. Section 218c requires utility companies to file Integrated Resource Plans.
- Vermont's utilities are highly supportive of increased use of renewable energy.
- Vermont has a range of strong programs in place to support investments in renewable energy and the efficient use of electricity. Any new renewable energy requirements considered by Vermont should build upon, integrate with, and complement Vermont's current portfolio of clean energy policies.
- Vermont has been a national leader in demand-side management and energy efficiency. The State has one of the most aggressive efficiency programs and Efficiency Vermont's (EVT) performance is widely recognized as excellent
- The State is strongly committed to addressing climate change. Governor Shumlin has established a Climate Cabinet, composed of senior administration officials of many agencies, to lead the state towards reduced greenhouse gas emissions and fossil fuel dependency.

Among the renewable energy trends in the region:

- Biomass and hydroelectric resources dominate the region's existing fleet of renewable energy facilities, but the vast majority of recently constructed or proposed projects are for wind energy generators.
- There are over 3,400 MW of land-based and over 1,700 MW of ocean-based renewable energy projects in various stages of active, publicly announced, development throughout New England.[1]
- Operating and proposed biomass projects are facing increasing barriers to viability.
- Although solar photovoltaic (PV) generators today produce far less energy than wind or biomass, the solar sector is experiencing marked growth in most New England states.
- The resource base in New England for hydro and landfill gas is significant but it is also largely saturated. Nevertheless, incremental capacity, repowering and a modest amount of new development may be possible in some cases.
- Renewable energy imports from adjacent areas into New England have generally been on the rise steadily since 2004.

[1] Source: Sustainable Energy Advantage, LLC proprietary database.

- The renewable energy resource potential—especially wind and hydroelectric—is great in adjacent control areas but it far exceeds the capacity of existing (and proposed) transmission ties into New England. Import growth could accelerate with transmission expansion.
- The bulk of renewable energy demand in the region is created by the current RPSs in the other five New England states. From January 2011 through 2025, New England RPS mandates will create the market for an estimated 18,000 incremental GWhs of new renewable energy,

Assessing the SPEED Program

An important feature of the SPEED program is that, when utilities enter into contracts with renewable energy generators, they do not need to keep or retire the renewable energy certificates (RECs) associated with the generation. They can instead sell the RECs to satisfy the RPSs of other states in the region. That is the primary difference between SPEED and an RPS.

Among the advantages and positive impacts of the SPEED program, key ones are:

- It has provided the state's utilities with direction and encouraged them to emphasize entering into contracts with renewable energy generators. Because utilities can recover their costs, they have an incentive to seek out contracts with renewable energy generators.
- The SPEED program is leading to additional renewable energy development in Vermont.
- It has addressed the very important issue of long-term contracts for renewable energy generators. It is difficult for many renewable energy projects to receive financing without first having a long-term contract, and the SPEED program addresses that barrier.
- Because of the sale of RECs, the program is less expensive per megawatt hour than an RPS program.

The key disadvantages of the SPEED program are:

- Although Vermont utilities have contracts through SPEED with renewable energy generators, neither those utilities nor their customers can legitimately claim that they are receiving renewably generated electricity. When there is a situation in which one party is paying for power from a renewable energy generator but a different party is paying for RECs from that same generator, they both should not claim to be receiving the same renewably generated electricity. Because the RECs represent the price premium associated with renewable power, the entity that pays that price premium can legitimately claim to be paying for and receiving renewably generated electricity. Although Vermont utilities and their end users should not represent that they are receiving or using renewably generated electricity, they can reasonably claim the following:
    - They have contracts with renewable energy generators.
    - They are helping renewable energy projects to be developed.
- It is unclear the extent to which the SPEED program is increasing the total supply of renewable energy in the region, even though it is increasing the supply in Vermont. To explain this, imagine a hypothetical 10 megawatt SPEED project. If the RECs associated with that project are sold to meet the Massachusetts RPS, it means that one fewer 10 megawatt project needs to be built in Massachusetts or elsewhere in the region to meet the Massachusetts RPS.

- Because SPEED goals are expressed as state goals, it is unclear what an individual utility's goals are or should be.

The SPEED Standard Offer Program is comparable to the types of feed-in tariff programs that have been used in Germany, Spain, and elsewhere to significantly increase renewable energy generation. Because the smaller projects targeted by this program are generally more expensive than larger renewable energy projects, very few of them would be able to be completed without the program. This program will lead to 50 megawatts of renewable energy generation located in Vermont.

The key advantages of the Standard Offer program are:

- Project owners who receive Standard Offer contracts know exactly how much money they will receive over time.
- By offering different prices for different technologies, the program is able to account for differences between technologies and support the commercialization of a range of technologies, not just the least expensive ones.
- By having the 50 megawatt cap, the program avoids one of the disadvantages of some European feed-in tariffs, which is creating a program with an unpredictable and uncapped cost for ratepayers.

The key disadvantage of the Standard Offer program is that it is difficult to set the exact right price level for the Standard Offer payments. It risks giving project developers more money than they actually need to get projects built.

The Legislature asked the Public Service Board to consider the advantages and disadvantages of making the SPEED program mandatory. That change alone would not necessarily make a significant difference, since the program is currently on track to meet its initial targets while remaining voluntary. It could perhaps also meet the more ambitious 20% in 2017 goal while remaining voluntary. But if the SPEED goal were raised to 25%, 50%, or higher, it would become more important for the goal to be mandatory to ensure that all utilities give it sufficient attention to achieve it. Such a higher SPEED goal, along with making the program mandatory, would not significantly alter the advantages and disadvantages of the current program. But, to the extent that the goal is higher, the program would accomplish more. To the extent that it is mandatory, there would be greater certainty about the results.

If the SPEED program continues, it will be important to decide whether to allow the Standard Offer to sunset or to issue a new Standard Offer for more megawatts.

Deciding about an RPS

Having an understanding of how RPSs work best and what they can—and cannot—effectively accomplish can be helpful to deciding whether or not it is appropriate to implement an RPS in Vermont.

Various renewable energy analysts and stakeholders have looked at the track record of RPS programs in the many states that have RPSs. They have identified best practices to emulate and pitfalls to avoid. From this literature and analysis of the specifics of Vermont's situation, several key points to keep in mind emerge:

- Vermont has many options and the best RPS design is not obvious.
- It is important to be clear and specific about goals.
- An RPS is only one component of a successful state clean energy policy.
- A successful RPS needs to balance competing design features.
- A state should be aware of how its RPS relates to and interacts with the RPSs of nearby states.
- Renewable Energy Certificates (RECs) have proven to be a useful feature of an RPS.
- An RPS should include measures to control compliance costs.
- Policymakers should consider how to help renewable energy projects secure financing and/or long-term contracts.

Setting Goals. A state can have a variety of reasons for supporting the development of renewable energy. Just saying that an RPS will be used to get more of a state's electricity from renewables is insufficient, because it begs the question of why. One of the most important steps in determining whether to adopt an RPS is deciding what the specific reasons are for establishing it and what its goals will be.

The various possible goals overlap and a single RPS design can seek to accomplish several things at the same time. But, by knowing *which specific goals are most important* and which are subsidiary, an RPS can be constructed to be as effective as possible. This sort of consideration of goals is also important as Vermont decides whether or not to retain the SPEED program.

There are five categories of goals that could be relevant to Vermont: (1) energy system goals, (2) environmental goals, (3) economic goals, (4) technology development goals, and (5) administrative and political goals. For each possible goal (e.g., reduce dependence on fossil fuels and nuclear power; decrease reliance on centralized power plants; slow global warming; preserve traditional land use patterns, natural resource areas, and the appearance of the Vermont landscape; maximize the economic benefits of renewable energy for the state), the report shows how an RPS might be designed to address it and discusses some of the factors to consider in deciding whether it should be a priority for Vermont.

RPS Program Design Options

If Vermont chooses to implement an RPS, it will be faced with many program design choices. The state's goals, the nature of its electricity system, its current electricity supply, the extent and cost of potentially available renewable energy resources, the regional market, the RPS designs of nearby states, and other factors should all influence the many detailed rules, requirements, targets, and enforcement mechanisms that comprise the design of an RPS. This large number of variables creates numerous options. The design choices a state makes determine whether its RPS will be successful.

The design choices include:

- Whether to use ***tradable Renewable Energy Certificates (RECs)*** and thereby allow electricity and renewable attributes to be sold separately.

- How to select the proper ***size and timing of the RPS's targets***. In other words, Will the renewables requirement go up 1% a year or 2% a year? Will the end goal be 25% or 75% renewables?
- Whether to include ***geographic restrictions*** that require all of the renewable energy to be delivered into Vermont and some of it to be generated there, and how to incorporate geographic restrictions in a way that does not violate the Commerce Clause of the US Constitution.
- Which ***types of renewable energy resources*** will be eligible for the RPS by energy source (e.g., biomass, solar), specific technologies (e.g., biomass gasification, photovoltaic), size (e.g., facilities less than 200 MW), and type (e.g., distributed generation)
- What ***vintage*** generating facilities will be eligible for the RPS. Will the RPS be restricted to newly installed renewable energy generators or will some or all existing facilities be included?
- Whether the RPS will include ***preference mechanisms***, such as carve-outs and multipliers, that advantage some technologies or types of projects over others.
- Whether ***energy efficiency*** will be included as part of the RPS.
- Whether ***all or just some load-serving entities*** will be required to participate in the RPS, and how to treat the variation among utilities in the length and size of their existing contracts with renewable energy facilities.
- Whether to include a mechanism or ***mechanisms to limit the cost of the RPS*** to ratepayers.
- Whether to incorporate ***flexibility mechanisms*** into the RPS to make it easier for obligated entities to meet their RPS obligations, both financially and administratively.
- How an RPS can be used to help overcome the ***contracting and financing*** problems that many renewable energy projects face.
- Whether ***reverse auctions*** or the ***central procurement approach*** will be used.

Scenarios and Results

The report presents the results of analysis of the costs and benefits of alternative approaches to a redesigned SPEED program or an RPS. It present 15 scenarios in order to show how design changes would affect not just total costs and benefits but also the distribution of those costs and benefits. The scenarios vary in the following key ways:

- A mandatory SPEED program vs. an RPS
- A final renewable energy target for the Vermont's electricity supply of 25%, 50%, 75%, or 100%.
- Inclusion or exclusion of hydroelectric projects larger than 200 megawatts.
- 20% or 10% of the target achieved through smaller distributed generation (DG) projects in Vermont.
- For DG, the use of an RPS DG carve-out (DG tier) vs. the SPEED Standard Offer program.

In the scenarios, RPS and SPEED policies are assumed to take effect in 2013 and achieve their appointed targets 20 years later, in 2032. The scenarios assume that 18.6% of total supply, as well as 18.6% of the RPS/SPEED target, comes from renewable energy facilities smaller than 200 MW with a commercial operation date before 2005. The remainder of the target must therefore come from newer facilities or, in selected scenarios, from hydroelectric facilities larger than 200 MW.

A summary of the scenario cost and environmental (emissions) impact analysis is provided in the table below. The results are sorted from least to highest cost of compliance. All the modeled scenarios would be more costly than the Reference Case.

Table 1. Summary of RPS/SPEED Policy Cost and Environmental Impact

Summary of RPS/SPEED Policy Cost and Environmental Impact				
Scenario	Policy Cost Above Reference Case (NPV M$)	% Cost Increase Over Reference Case	Billed Rate Impact Above Reference Case (30-Yr Levelized cents/kWh)	CO2 Impact vs. Reference Case (tons)
SPEED 25%; No large hydro DG 20% = Standard Offer	$2	0%	0.00	0
RPS 50%; Large hydro DG 20% = RPS tier	$35	1%	0.03	(10,453,913)
RPS 25%; No large hydro DG 20% = RPS tier	$52	1%	0.05	(8,316,313)
SPEED 50%; No large hydro DG 20% = Standard Offer	$62	1%	0.06	0
RPS 50%; Large hydro DG 20% = Standard Offer	$78	2%	0.07	(10,453,913)
SPEED 75%; No large hydro DG 20% = Standard Offer	$141	3%	0.14	0
RPS 50%; No large hydro DG 10% = RPS tier	$179	4%	0.17	(16,116,259)
SPEED 100%; No large hydro DG 20% = Standard Offer	$206	4%	0.21	0
RPS 75%; Large hydro DG 20% = RPS tier	$208	4%	0.19	(18,677,894)
RPS 50%; No large hydro DG 20% = RPS tier	$221	5%	0.21	(16,137,055)
RPS 75%; Large hydro DG 20% = Standard Offer	$297	6%	0.27	(18,677,894)
RPS 50%; No large hydro DG 20% = Standard Offer	$325	7%	0.30	(16,137,055)
RPS 75%; No large hydro DG 20% = RPS tier	$490	10%	0.46	(25,875,808)
RPS 75%; No large hydro DG 20% = Standard Offer	$610	13%	0.57	(25,875,808)
RPS 100%; No large hydro DG 20% = RPS tier	$762	16%	0.72	(35,852,320)

Collectively, the Vermont utilities have already committed to enough New (post-2005) renewable energy supply to meet the 25% target. In the RPS 25% case, as well as the other RPS cases, the retirement of RECs currently in Vermont utility portfolios occurs slowly over time, with a slightly larger share of the RECs being retired until all RECs from current commitments are consumed. In the 50% Case with 200+ MW hydro ineligible, New renewable energy purchases beyond current commitments are not required until 2020. Such purchases are not required until 2018 in the 75% Case and not until 2016 in the 100% Case. In the 50% Case with 200+ MW hydro eligible, New renewable energy purchases beyond current commitments are not required until 2029. Such purchases are not required until 2023 in the 75% Case and not until 2020 in the 100% Case. [Note that these calculations do not include the 20% Vermont-based DG requirements.]

Even in the years when Vermont utilities would not need to enter into additional contracts with renewable energy generators, the Vermont RPS would still be helping to expand the renewable energy supply in the region. To the extent that utilities retire RECs that are already in their control, rather than sell those RECs for use in satisfying the RPS in another New England state, they create the need for more RECs for that other state's RPS. That should induce developers to bring additional renewable energy online to fill the gap in the REC supply. What this means is that, during the first years of an RPS, the utilities would have a relatively easy transition whereby they could gradually retire RECs in their control, yet Vermont would still be incentivizing the construction of additional renewable energy in the region.

Here are a few key conclusions from the modeling results:

- If hydro facilities larger than 200 MW <u>are</u> eligible for SPEED or RPS, renewable supply from the region would likely exceed demand in Vermont, and very little incremental renewable energy capacity would likely be built in Vermont beyond the DG requirement.
- The vast majority of new, large, non-DG, renewable energy coming online in New England over the period until 2032 is projected to be wind.
- Policy cost results are highly sensitive to the percentage of the requirement met by distributed generation. The DG requirement accounts for a disproportionate amount of the total policy cost.
- For the 20% DG RPS tier, new development potential among the lower cost distributed resources (landfill gas, hydro and farm methane) is in short supply. As a result the majority of DG in the 50% and higher scenarios would be derived from wind and solar.

Economic Benefits. In addition to imposing costs on ratepayers, an RPS or SPEED program would also provide economic benefits. For one thing, the penetration of new renewable resources creates an economic benefit through electricity and capacity price suppression. The net present value of this benefit is modeled in the report and ranges from $0 in the 25% scenarios to $61 million in the 100% scenario in which hydro larger than 200 MW is not eligible.

Beyond price suppression, to the extent that renewable energy projects would be located in Vermont, it would lead to additional jobs and increased local economic activity. It is beyond the scope of this report to be able to do a comprehensive assessment of how all the positive and negative economic impacts of renewable energy policy would balance out. But it is important to keep in mind that the cost numbers for RPS or SPEED do not tell the entire story. There would be some positive economic benefits that would counterbalance at least some of the costs.

A. Introduction

This report aims to provide the Vermont Public Service Board (PSB) with information that will help it fulfill a request by the Vermont Legislature to study whether Vermont should continue the Sustainably Priced Energy Development (SPEED) program or implement a renewable portfolio standard (RPS).

The current report is based on stakeholder input, a review of the RPS programs in other states, and economic analysis of the potential costs and benefits of alternative SPEED and RPS designs in Vermont's context. It identifies possible designs for an RPS or a revised SPEED program. It also analyzes the implications and advantages of different possible RPS and SPEED goals, targets, design features, and compliance mechanisms.

The report starts with brief descriptions of RPS policies and the Vermont SPEED program. We then discuss the context for renewable energy policymaking in Vermont, with an emphasis on those state-specific factors that should be considered when deciding whether to establish an RPS. This is followed by consideration of some of the advantages and disadvantages of the current SPEED program.

The report devotes more attention to describing RPS features, options, and implications. This is not only because an RPS would be a new program for Vermont whereas SPEED is already established and familiar, but because there are numerous options for how an RPS can be structured and because there is the experience of 31 other RPS programs to draw on and learn from. In a series of report sections, we cover:

- Lessons that can be learned from the experiences of other states
- Clean energy development trends in the region that could affect the desirability and design of an RPS
- Possible goals for an RPS and how each of those goals could be achieved by the various design features of an RPS
- RPS program design options, along with the relative advantages and disadvantages of each of them for Vermont
- How RPS compliance could be monitored and an RPS program could be evaluated.

The last part of the report presents the results of the analysis of the costs and benefits of alternative approaches to a redesigned SPEED program or an RPS. We present 15 scenarios in order to show how design changes would affect not just total costs and benefits but also the distribution of those costs and benefits. To give the PSB the information it needs to respond to the Legislature's charge, our scenarios consider a mandatory SPEED program and an RPS at each of the following percentages of Vermont's electricity supply: 25, 50, 75, and 100 percent. We also consider the effects of either including or excluding larger projects over 200 megawatts in SPEED or an RPS.

Because readers of this report may choose to focus on specific sections rather than read it in its entirety, we have tried to make each section self-contained so that it can be read on its own. This inevitably introduces some repetition into the report as the same topics occasionally come up in several sections even though they are discussed in different ways.

B. What Are RPS and SPEED?

Both an RPS and the Vermont SPEED program are policy mechanisms that seek to address the barriers that can inhibit renewable energy from coming online.

Renewable Portfolio Standard

An RPS is a mandate that a state's electricity supply include a minimum quantity of renewable energy. It requires electricity suppliers to get a certain percentage of their electricity from renewable energy sources. To stimulate the gradual but continued development of new renewable energy facilities, the percentage generally increases over time. Because an RPS does not set a specific price that electricity suppliers must pay for renewable energy generation, there is competition among generators to sell to electricity suppliers and that competition theoretically ensures that renewable energy is secured at the least cost. Electricity suppliers typically are required to demonstrate RPS compliance on an annual basis and RPS policies are backed by various types of compliance enforcement mechanisms.

The RPS is the most popular and widely used state policy mechanism for encouraging wholesale renewable energy power development. Currently, 29 states plus the District of Columbia and Puerto Rico have mandatory RPSs. In addition, similar policies have been adopted by various countries in Europe and Asia.

According to recent analysis by Lawrence Berkeley National Laboratory (LBNL), 56% of all US electricity sales will be subject to an RPS mandate once all the binding RPS requirements now in existence are fully implemented. These mandates will require roughly 73 GW of new renewable capacity by 2025, which is the equivalent of "30%of projected load growth between 2000 and 2025." Already, the impact has been significant. As LBNL calculates, of the more than 37 gigawatts of non-hydro renewable energy capacity added in the US from 1998 through 2009, roughly 61% occurred in states with active or impending RPS requirements.[2]

A variety of alternative terms are used somewhat interchangeably to describe a "renewable portfolio standard". These include renewable electricity standard, renewable energy standard, clean energy standard, and clean energy portfolio standard. The term "clean" rather than "renewable" is often, but not always, used when the standard includes non-renewable technologies.

SPEED

Vermont's Sustainably Priced Energy Development program (SPEED) is a policy unique to Vermont. It was enacted in June 2005 in 30 V.S.A. 8001 and 8005. The aim of the law is to promote the development of in-state renewable energy and to ensure, that to the greatest extent

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[2] Ryan Wiser et al., *Supporting Solar Power in Renewable Portfolio Standards: Experience from the United States* (Berkeley: Lawrence Berkeley National Laboratory, 2010), p. 3. Available at http://eetd.lbl.gov/ea/ems/reports/lbnl-3984e.pdf.

possible, the economic benefits of those resources flow to the Vermont economy in general and the ratepayers of the state in particular.

SPEED sets minimum goals that require the state's utilities to enter into sufficient contracts to collectively supply all new load growth from January 1, 2005 through July 1, 2012 with the renewable energy resources specified in the law, as well as to generate 5% of Vermont's 2005 load with SPEED resources. An additional SPEED goal is to generate 20% of Vermont's load with SPEED resources by 2017. Because the utilities are not required to pay the price premium for renewables, the renewable energy certificates (RECs) that represent that price premium can be sold to satisfy the RPSs of other states in the region. [Renewable energy certificates are discussed in section E below.]

In 2009, the Legislature amended the SPEED policy to add a Standard Offer Program covering projects smaller than 2.2 megawatts. Renewable energy generators that are accepted into the queue for the Standard Offer receive a fixed price established by the PSB for every megawatt-hour of electricity they produce. The price varies depending upon the technology and the year, and the schedule of prices is published on the SPEED Program website.

For the Standard Offer, the Vermont Legislature directed the PSB to base prices upon the cost of deploying the technology, even if that results in prices in excess of other alternatives in the market. Specifically, the standard-offer price for a technology is derived by the Board from (1) the cost of the technology (which includes consideration not only of installation costs but also of reasonably expected tax credits and grants), (2) a return on equity which the statute specifies must be the highest rate of return on equity of any Vermont investor-owned utility, and (3) an adjustment that results in an appropriate, but not excessive, incentive for rapid deployment. By definition, the mechanism is not designed to produce a least-cost power portfolio, but rather to create a structure that encourages up to a maximum commissioned amount of 50 megawatts of distributed renewable energy projects.[3]

[3] See Board Order, January 1, 2010, Docket No. 7553

C. The Vermont Context

Vermont's Electricity Portfolio

About 50% of Vermont's electricity demand comes from renewable resources, the majority of that from out-of-state resources (hydropower from Hydro-Quebec and the New York Power Authority). In-state renewable electricity generation represents about 20% of Vermont electricity use (primarily from in-state hydropower and biomass facilities). Overall, almost one half of Vermont's electricity supply comes from out-of-state sources, including the hydropower contracts mentioned above and system power contracts for predominately fossil fuel merchant generators within the region.

Vermont has a relatively clean carbon emission electricity source mix today and it will remain that way at least through the end of the existing contracts with Vermont Yankee and Hydro-Quebec (H-Q) that are due to expire in 2012 and 2016, respectively. Vermont's utilities recently replaced a significant portion of the H-Q existing contract with a new H-Q contract, and have committed to procurement of wind and out-of-state nuclear power. However, there are still significant resource acquisition decisions that will be made in future years by Vermont's utilities. Therefore, in considering any RPS or mandatory SPEED program, it would be important to set targets, ramp up timing, vintage dates, and eligibility definitions in a way that harmonizes with and builds upon the utility's integrated resource plans (IRP) and recent procurement decisions.

Electricity Rates

Vermont, along with its neighboring New England states and New York, has among the highest energy prices in the country outside of Hawaii. However, Vermont has experienced smaller rate increases than most of the northeastern US. In any case, the state's strong desire to minimize future increases in electricity costs should be considered when deciding whether to establish any new renewable requirement and if the program should include cost containment measures. In addition, when assessing possible program designs and the impact on electricity rates of bringing more renewables online, renewables' beneficial effect in suppressing natural gas prices and wholesale electricity prices should be recognized.

Existing Vermont Legislative Energy Goals

In evaluating possible new renewable energy programs, it is important to consider the state's current renewable energy goals. The Legislature has established several specific renewable energy goals in statute in recent years. Specifically, the Legislature has stated that it is in the public interest to advance the state energy policy (as established in Section 202a of Title 30) by:

(1) Balancing the benefits, lifetime costs, and rates of the state's overall energy portfolio to ensure that to the greatest extent possible the economic benefits of renewable energy in the state flow to the Vermont economy in general and to the rate paying citizens in particular.

(2) Supporting development of renewable energy and planned energy industries in Vermont, and the jobs and economic benefits associated with such development, while retaining and supporting existing renewable energy infrastructure.

(3) Providing an incentive for the state's retail electricity provides to enter into affordable, long-term, stably priced renewable energy contracts that mitigate market price fluctuation for Vermonters.
(4) Developing viable markets for renewable energy and energy efficiency projects
(5) Protecting and promoting air and water quality by means of renewable energy programs.
(6) Contributing to reductions in global climate change and anticipating the impacts to the state's economy that might be caused by federal regulation designed to attain those reductions.
(7) Supporting and providing incentives for small, distributed renewable energy generation, including incentives that support locating such generation in areas that will provide benefit to the operation and management of the state's electric grid."[4]

These renewable energy goals, while diverse and not specifically prioritized by the Legislature, suggest several considerations and a framework for guiding the design of any Vermont RPS or revised SPEED program:

The first goal (balancing benefits and costs) indicates that any new program should ensure an appropriate balance between rate impacts and renewable energy benefits. When other states have established RPS programs, they typically have addressed concern about the cost impact of RPS policies by including cost containment mechanisms, such as alternative compliance payments or rate caps (see section H.11, below). In addition, states have used competitive solicitations or reverse auctions in an effort to minimize costs in achieving RPS goals.

The second goal indicates that it is important to determine how a potential RPS or revised SPEED program can be effective at ensuring development of new renewable energy projects while also providing support for existing renewable energy projects.

The third goal clearly supports the use of long-term contracts to procure renewable energy with price stability. Minimum contract duration requirements are one approach that many states have included in their RPS policies to facilitate project financing and to lower overall compliance costs as compared to shorter-term purchases. Contracting requirements are simpler to implement in regulated markets, such as Vermont, because traditional cost-based regulations can assure that cost recovery is determined appropriately.

The state's strong commitment to the use of renewable energy to meet the environmental goals of clean air and water and addressing climate change is reflected in goals four and five (see fuller discussion on Vermont's carbon reduction goals below). These goals suggest that any new renewables requirements should focus on zero and low emission renewable energy resources.

The last goal (added in 2011) suggests that the design of an RPS or revised SPEED mechanism should consider how to effectively support the growth of smaller customer-sited resources and distributed generation. In recent years, Vermont communities have demonstrated strong interest and implementation efforts to develop community-based renewable energy projects. Therefore,

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[4] 30. V.S.A. sec. 8001

any RPS established in Vermont should be designed to support this opportunity and interest in community-owned and community-scale renewable projects.

In addition to considering guidance from these renewable energy-specific goals, it is important to note that they augment but do not supplant general state energy policy under Section 202a of Title 30. Section 202a states as follows:

> To assure, to the greatest extent practicable, that Vermont can meet its energy service needs in a manner that is **adequate, reliable, secure** and **sustainable**; that assures **affordability** and encourages the state's **economic vitality**, the **efficient use** of energy resources and cost effective demand side management; and that is **environmentally sound**. [Emphasis added]

Further, section 218c of Title 30 requires utility companies and the Vermont PSB to consider a broad range of possible alternatives for meeting the public's need for energy services:

> After safety concerns are addressed, at the lowest present value life cycle cost, including environmental and economic costs, through a strategy combining investments and expenditures on energy supply, transmission and distribution capacity, transmission and distribution efficiency, and comprehensive energy efficiency programs.

Section 218c specifically requires utility companies to file Integrated Resource Plans. The IRP process requires acquisition of resources by Vermont utilities, including renewable energy, to be based on the most cost-effective portfolio. It is therefore important to determine how any renewable energy requirements could complement the utility IRP process. As to this issue, in 2004 the Public Service Board found that the IRP requirements and RPS legislation are not mutually exclusive, but can be complimentary. At that time, the Board stated that, because section 218 requires the Board to make these considerations, "vetting an RPS requirement through a company's IRP filing will ensure that utility companies are not required to make a choice of renewable resources that will deter the development of otherwise desirable non-renewable alternative energy investments." [5]

Vermont's Energy Regulatory Framework

Vermont has remained a state with vertically integrated utilities subject to regulation, while the rest of New England restructured and incorporated retail choice. If Vermont decides to adopt an RPS, the Public Service Board would still oversee utility procurement and contracting. Therefore, Vermont could choose not to use alternative compliance payments as an enforcement component of an RPS, because enforcement could occur through discretionary financial penalties determined in regulatory proceedings at the PSB. (For a discussion of the advantages and disadvantages of alternative compliance payments and discretionary financial penalties, see section H12 below.)

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[5] Public Service Board, A Vermont Renewable Energy Portfolio Standard: Draft Legislation and Report (January, 2004), p. 16.

It also should be noted that Vermont's utilities are highly supportive of increased use of renewable energy to meet their customer electricity demands. For example, Green Mountain Power (GMP) has invested in major wind development and provides credits per kWh to its customers installing solar photovoltaic (PV) systems. Central Vermont Public Service (CVPS) has established a highly successful Cow Power program, allowing customers to voluntarily pay a premium to create a market for farmers to deploy anaerobic digesters to process cow manure and farm waste.

Vermont's Existing Clean Energy Programs

Vermont has strong programs in place to support investments in renewable energy and the efficient use of electricity. Current utility and regulatory energy policies that actively encourage growth in clean energy sources and energy efficiency include the recently expanded net metering and streamlined solar registration for small system interconnection, implementation of SPEED, the standard offer program, the small-scale renewable energy incentive program, the state solar tax credits, and the Vermont Clean Energy Development Fund.

Any new renewable energy requirements considered by Vermont should build upon, integrate with, and complement Vermont's current portfolio of clean energy policies. For example, if, as is often the case, an RPS were to focus on least-cost renewable resources, the Vermont Clean Energy Development Fund could be used to direct public funding to higher cost and emerging renewable energy technologies and industry support. The Fund and an RPS could be used in tandem to support renewable energy technologies in various stages of commercialization and maturity.

Vermont also has a strong history of leadership and investment in demand-side management and energy efficiency. In fact, the State has one of the most aggressive efficiency programs in the nation with an efficiency system benefit charge that is among the highest of the states. The program has a levelized cost of saved energy that is significantly less than the avoided cost of wholesale energy.[6]

Efficiency Vermont's (EVT) performance is widely recognized as excellent and has several attributes that contribute to its success. Among these is that EVT has statewide coverage, strong statewide brand identification, is administered by a non-profit organization, and serves as a single point-of-contact for Vermonters. EVT is also highly experienced in delivering programs and is implemented through an existing, effective oversight and accountability system by the PSB. EVT delivers a comprehensive portfolio of energy efficiency program offerings, including product rebates, aggressive marketing, technical assistance, and commercial and industrial customer incentives. This current, comprehensive, and effective Vermont framework for supporting energy efficiency investment should be considered in determining if a Vermont RPS or revised SPEED program should include energy efficiency as an eligible resource, rather than focusing strictly on renewable energy.

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[6] Charles Kubert and Mark Sinclair, *State Support for Clean Energy Deployment: Lessons Learned for Potential Future Policy* (Boulder: National Renewable Energy Laboratory, 2011), p. 83. Available at http://www.nrel.gov/docs/fy11osti/49340.pdf.

Vermont’s Targets for Renewable Energy Development and Carbon Emission Reduction

The Vermont Legislature has established a non-binding goal that 20% of Vermont’s electricity in 2017 should be supplied by SPEED resources (defined as in-state renewable facilities coming into service post 2004). Meeting this goal would require development of a significant amount of new in-state renewable energy generation—somewhere between 125 and 350 MW depending upon the resource mix and rate of load growth. Therefore, it may be useful to evaluate the relative merits and design of an RPS or revised SPEED program by its effectiveness as a tool to meet the current legislative goal for driving the development of significant new in-state renewable energy.

The State is also strongly committed to addressing climate change, with targets of reducing Vermont’s greenhouse gas emissions by 25% from 1990 levels by 2012, 50% by 2028, and, if practical, 75% by 2050. These goals were established by an Executive Order from Governor Douglas in 2005 and subsequently affirmed and reinforced by the Vermont Legislature in 2006 (Act No. 168). Recently, Governor Shumlin established a Climate Cabinet, composed of senior administration officials of many agencies, to lead the state towards reduced greenhouse gas emissions and fossil fuel dependency. Vermont also joined with other northeast states to establish the Regional Greenhouse Gas Initiative (RGGI), which caps region-wide carbon dioxide emissions from the electric sector.

These climate actions and commitments imply that a major goal of any new renewable energy policy and program should be reduction of carbon emissions.

D. The SPEED Program's Advantages and Disadvantages

As noted in Section B above, Vermont's Sustainably Priced Energy Development program (SPEED) aims to promote the development of in-state renewable energy and to ensure that, to the greatest extent possible, the economic benefits of those resources flow to the Vermont economy in general and the ratepayers of the state in particular. This section of the report looks at the strengths and weaknesses of the SPEED program. It also considers the implications of making the voluntary goals in the SPEED program mandatory.

The SPEED Program has two relatively different components—the overall SPEED goals with utility contracts with large generators and the Standard Offer program. Those two components are discussed individually below.

SPEED Goals and Large SPEED Projects

The laws that established the SPEED program require the state's utilities collectively to enter into sufficient contracts to meet certain specified goals. The two most important goals are that, by 2012, the state receives sufficient electricity from SPEED resources to equal 5% of Vermont's 2005 load and that 20% of Vermont's electricity comes from SPEED resources by 2017. A third SPEED goal related to load growth is less important, because the state's strong energy-efficiency programs and the recession have meant that the electricity load has not grown since 2005.

An important feature of the SPEED program is that, when utilities enter into contracts with renewable energy generators, they do not need to keep or retire the renewable energy certificates (RECs) associated with the generation. They can instead sell the RECs to satisfy the RPSs of other states in the region.

The advantages and positive impacts of the overall SPEED program include:

- It has provided the state's utilities with direction and encouraged them to emphasize entering into contracts with renewable energy generators. Because utilities can recover their costs, they have an incentive to seek out contracts with renewable energy generators.
- The SPEED program is leading to additional renewable energy development in Vermont.
- It has addressed the very important issue of long-term contracts for renewable energy generators. It is difficult for many renewable energy projects to receive financing without first having a long-term contract, and the SPEED program addresses that barrier.
- The SPEED program acts as a useful complement to other states' RPSs. As discussed below in section F8, one limitation of an RPS in a state with a restructured electricity system is that the existence of the RPS is often insufficient for a project to attract financing in the absence of a long-term contract for the sale of power. The SPEED program provides such a long-term contract. Conversely, a SPEED-type contract for power would be insufficient for a renewable energy project to get built, if the project did not receive the additional income that comes from the sale of RECs.
- Because of the sale of RECs, the program is less expensive per megawatt hour than an RPS program.

- There has been important flexibility in the program that has allowed the Legislature and the Board to make appropriate modifications to the program, such as the addition of the Standard Offer Program and removal of technology caps.
- The program has been relatively easy for the Board, along with the SPEED Facilitator[7], to administer and oversee.

Disadvantages of the SPEED program:

- Although Vermont utilities have contracts through SPEED with renewable energy generators, neither those utilities nor their customers can legitimately claim that they are receiving renewably generated electricity. When there is a situation in which one party is paying for power from a renewable energy generator but a different party is paying for RECs from that same generator, they both should not claim to be receiving the same renewably generated electricity. Because the RECs associated with a renewable energy facility represent the price premium associated with renewable power, the entity that pays that price premium can legitimately claim to be paying for and receiving renewably generated electricity. Although Vermont utilities and their end users should not represent that they are receiving or using renewably generated electricity, they can reasonably claim the following:
    - They have contracts with renewable energy generators.
    - They are helping renewable energy projects to be developed.
- It is unclear the extent to which the SPEED program is increasing the total supply of renewable energy in the region, even though it is increasing the supply in Vermont. To explain this, imagine a hypothetical 10 megawatt SPEED project. If the RECs associated with that project are sold to meet the Massachusetts RPS, it means that one fewer 10 megawatt project needs to be built in Massachusetts or elsewhere in the region to meet the Massachusetts RPS. Although the SPEED program undoubtedly makes it easier for renewable energy projects to be built and likely speeds up the development process, not all SPEED generation represents an increase to total regional renewable energy capacity and not all SPEED generation represents an incremental contribution to reducing regional greenhouse gas emissions.
- Because SPEED goals are expressed as state goals, it is unclear what an individual utility's goals are or should be.
- Even though the cost to ratepayers may be less than with an RPS, the SPEED program still increases ratepayers' costs.

The Standard Offer Program

The Standard Offer Program covers projects smaller than 2.2 megawatts. Renewable energy generators that are accepted into the queue for the Standard Offer receive a fixed price established by the PSB for every megawatt-hour of electricity they produce. This is comparable to the types of feed-in tariff programs that have been used in Germany, Spain, and elsewhere to significantly increase renewable energy generation.

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[7] VEPP Inc. serves as the SPEED Facilitator.

The price paid under the Standard Offer varies depending upon the technology and the year, and ranges from $86.9 per megawatt hour for landfill gas in year one to $240 per megawatt hour for photovoltaics in all years. The Legislature directed the PSB to base these prices upon the actual cost of deploying each technology and told the Board to determine the costs by considering: (1) the cost of the technology (including not only installation costs but also reasonably expected tax credits and grants), (2) a return on equity which the statute specifies must be the highest rate of return on equity of any Vermont investor-owned utility, and (3) an adjustment that results in an appropriate, but not excessive, incentive for rapid deployment.[8]

The program was limited to 50 megawatts. Projects can apply to be in the queue for receiving a Standard Offer contract. If accepted, they then have 6 months to prepare an interconnection application and 2½ years after that to get built.

The Board initially determined that no single technology would be able to account for more than 25% of the 50 megawatt total. But because some of the technologies are resource constrained, those technologies produced few Standard Offer applications, while solar and wind had significant waiting lists. The Board therefore decided to allow the technology caps to expire at the end of May 2011 and to accept additional projects from the solar and wind waiting lists.

Advantages and positive impacts of the Standard Offer program:

- It will lead to 50 megawatts of renewable energy generation located in Vermont. Because the smaller projects targeted by this program are generally more expensive than larger renewable energy projects, very few of the Standard Offer projects would be able to be completed without the program.
- Project owners who receive Standard Offer contracts know exactly how much money they will receive from the program over time. This eliminates much of the uncertainty often associated with distributed generation renewable energy projects.
- By offering different prices for different technologies, the program is able to account for differences between technologies and support the commercialization of a range of technologies, not just the least expensive ones.
- It likely contributes to increased jobs and economic activity in the state. An even-handed 2009 economic analysis by the Department of Public Service indicated that the existing Standard Offer program would increase the total number of jobs in the state and increase capital investment. It should be noted, however, that the analysis's projection of an average 13 additional full-time jobs per year, after a larger initial infusion of temporary construction jobs, was less than some advocates for the Standard Offer program had predicted.[9]
- By having the 50 megawatt cap, the program avoids one of the disadvantages of some European feed-in tariffs, which is creating a program with an unpredictable and uncapped cost for ratepayers.

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[8] See Board Order, January 1, 2010, Docket No. 7553

[9] Vermont Department of Public Service, *The Economic Impacts of Vermont Feed in Tariffs* (Montpelier: Vermont Department of Public Service). Available at http://publicservice.vermont.gov/planning/DPS%20White%20Paper%20Feed%20in%20Tariff.pdf.

Disadvantages of the Standard Offer program:

- It is difficult to set the exact right price level for the Standard Offer payments. Like other feed-in tariffs, this one risks giving project developers more money than they actually need to get projects built, especially if Standard Offer rates are not adjusted regularly to account for technology cost reductions and learning curves.
- The Department of Public Service report showed that, even though jobs would be created and some businesses would benefit, ratepayers' costs would increase and certain sectors of the economy would be net losers. However, given the scale of the program it should be remembered that the impact on ratepayers' bills will be modest and no sector of the economy will be significantly impacted.
- As discussed above for the large SPEED program, because RECs can be sold to satisfy other states' RPSs, it is unclear the extent to which the Standard Offer program increases the total supply of renewable energy in the region.
- There is no provision for the program to continue after the initial 50 megawatts of projects are completed.

Making the SPEED Program Mandatory

The Legislature asked the Public Service Board to consider the advantages and disadvantages of making the SPEED program mandatory. It is not clear that that change alone would make a significant difference, since the program is currently on track to meet its initial targets while remaining voluntary. It could perhaps meet the more ambitious 20% in 2017 goal while remaining voluntary. Of course, it would be easier to achieve that goal if the program is mandatory. Moreover, a mandatory goal would presumably lead to all utilities being required to contribute to the goal.

If the SPEED goal were raised to 25%, 50%, or higher, it would become more important for the goal to be mandatory to ensure that all utilities give it sufficient attention to achieve it. Such a higher SPEED goal, along with making the program mandatory, would not significantly alter the advantages and disadvantages of the current program. But, to the extent that the goal is higher, the program would accomplish more. To the extent that it is mandatory, there would be greater certainty about the results and greater assurance of appropriately strong participation by all utilities.

If the SPEED program continues, it will be important to address the pending sunset of the Standard Offer. The state would need to decide whether a new Standard Offer for more megawatts should be issued in order to retain a program aimed at incentivizing distributed generation.

Here are a few things to consider if the SPEED program, or some part of it, is retained into the future:

- With any program that does not require the retirement of RECs, it is important that all parties be clear about what should and should not be claimed as resulting from the program. Using careful, precise wording for the nature of the program and its impacts would prevent it from being vulnerable to charges of being misleading or deceptive.

- If the Standard Offer program is retained, it might make sense to consider using a reverse auction for at least some aspects of it, in order to reduce costs. Vermont may want to monitor the results that will emerge from the new California Reverse Auction Mechanism (see section H9) to determine whether that approach is appropriate for Vermont.
- If the Standard Offer program is retained, the state may wish to modify some of its provisions to ensure that projects that bid into the queue are even more likely to be completed than currently. This might mean asking projects to be further along before applying and giving them a stronger financial incentive to move quickly to completion. When projects are accepted into the queue and apply for interconnection, but then do not get completed, it increases the administrative costs of the Standard Offer program both for the state and the utilities.
- If Vermont moves to adopt an RPS but still wishes to support distributed generation, it could make sense to retain the Standard Offer program for that purpose. The scenarios in section I compare some of the costs and benefits of using the Standard Offer program for distributed generation, as opposed to a distributed generation carve-out within an RPS.

E. RPS Lessons Learned from Other States

Because 29 states have renewable portfolio standards in place, Vermont can learn from those states' experiences when considering whether to establish an RPS and assessing the merits of different RPS design features.

Various RPS stakeholders and analysts have looked at the track record of state RPS programs to identify best practices to emulate and pitfalls to avoid. A recent overview of the subject with clear guidance for states designing an RPS is:

- State-Federal RPS Collaborative, *Recommended Principles and Best Practices for State Renewable Portfolio Standards* (Montpelier, VT: Clean Energy States Alliance, 2009). Available at www.cleanenergystates.org/resource-library/resource/recommended-principles-and-best-practices-for-state-renewable-portfolio-standards.

Two other useful reports that cover related matters are:

- R. Wiser, K. Porter, and B. Grace, *Evaluating Experience with Renewable Portfolio Standards in the United States* (Berkeley: Lawrence Berkeley National Laboratory, 2004). Available at http://eetd.lbl.gov/ea/ems/reports/54439.pdf. Summarized and updated in the slides for an April 2011 webinar for the Connecticut Energy Advisory Board by Bob Grace. Available at www.ctenergy.org/pdf/RPS_WebinarP.pdf.

- K.S. Cory and B.G. Swezey, *Renewable Portfolio Standards in the States: Balancing Goals and Implementation Strategies* (Boulder, CO: National Renewable Energy Laboratory, 2007). Available at www.nrel.gov/docs/fy08osti/41409.pdf.

From the findings in these reports and the consulting team's own analysis, the following principles and practices are especially important to keep in mind when considering an RPS for Vermont:

1. Vermont has many options and the best RPS design is not obvious.

There is great variation among the RPSs of the different states that have adopted them. No single approach is optimal for all situations or all states.

A state's goals, the nature of its electricity system, its current electricity supply, the extent and cost of potentially available renewable energy resources, the regional market, the RPS designs of nearby states, and other factors should all influence the many detailed rules, requirements, targets, and enforcement mechanisms that comprise the design of an RPS. This large number of variables creates numerous design options. The design choices a state makes will determine whether its RPS will be successful and be perceived to be a useful state policy over time.

2. It is important to be clear and specific about goals.

As discussed in section F below, an RPS can help meet a variety of different environmental, economic, and political goals. But different goals and combinations of goals require different RPS designs. For an RPS to be successful, the state needs to be very clear up front about what specifically it wants to accomplish. It then needs to keep those goals firmly in mind when designing an RPS and should make sure that the policymakers explain how the specific design relates explicitly to those goals.

3. An RPS is only one component of a successful state clean energy policy.

RPSs have proven to be highly useful policy mechanisms, but there are limitations to what they can accomplish efficiently. An RPS should be focused on those specific goals and activities that it can best address, while other clean energy policies and programs are used for goals and activities for which an RPS is too unwieldy, inefficient, or costly a policy mechanism. (For example, because of its least cost approach, an RPS is generally ineffective at supporting investment in emerging renewable energy technologies.)

In the case of Vermont, other valuable clean energy programs and policies are already in place. If an RPS is adopted, it should be designed to integrate with and complement those programs and policies. Some changes to the other programs and policies may be necessary in order to make all the different pieces of the clean energy policy portfolio fit together seamlessly and effectively.

4. A successful RPS needs to balance competing design features.

The various studies of RPS best practices identify a long list of desirable features, each of which seems appropriate and important when viewed in isolation. But what can make designing an RPS complicated is that some of these different features pull in opposite directions. RPS designers therefore must be conscious of the trade-offs between different design features and should try to find the optimal balancing point for their state's particular situation. Here are some of the ways in which there is tension between RPS design features:

- ***Keep it simple but design it to meet specific goals.*** RPS experts encourage states to give an RPS a simple structure that will be easy to administer and to comply with. But the desire to address multiple goals strategically and with specificity inevitably introduces complexity into the design and administration of an RPS. The more objectives an RPS tries to achieve, the more provisions, components, and compliance mechanisms it needs. For example, if an RPS is designed to ensure support for a range of technologies through technology-specific carveouts, for example, this will complicate procurement and compliance monitoring. Acknowledging that, it is still possible to keep an RPS relatively simple to administer within the context of the RPS's specific goals. RPS designers and administrators can avoid reaching the point where adding additional objectives starts to make an RPS overly complicated and cumbersome to administer (or even understand).

- ***Maximize cost-effectiveness but achieve multiple objectives***. The issue of cost-effectiveness is generally viewed through the lens of whether an RPS is stimulating the most energy development at the lowest cost. Invariably, an RPS that allows eligibility for a large number of technologies without regard to their size or geographic location will be more cost-effective on a megawatt-hours-generated basis. And that is *one* important way to assess an RPS. But to the extent that an RPS has other objectives, there should be an assessment of whether *those objectives* are being achieved as cost effectively as possible, even if they increase the cost of the total quantity of new energy generation that comes online. To find the right balance, two types of analysis are needed:

1. For each objective, consider which RPS design will maximize the results at the lowest cost. Which RPS targets, provisions, and cost-control measures will achieve that particular objective as cost-effectively as possible?

2. To find the right balance among objectives, one can imagine having a set budget for the RPS and then consider the best way to divide up those dollars in order to get the optimal set of outcomes and overall most cost-effective results. For example, if shifting $X million towards the goal of advancing a particular technology or towards the goal of encouraging distributed generation within Vermont will reduce the total amount of renewable energy the RPS will generate by Y megawatt-hours, is that tradeoff desirable?

- ***Make it predictable and stable, but allow it to respond to changing market conditions.*** In the case of most laws and regulations, predictability and stability are important so that those affected will know what is expected and can plan ahead. This is especially true with an RPS. The long lead-time required to get an energy generating facility financed, permitted, and installed means that project developers need to have a good sense of what the situation will be several years into the future. And because they will rely on the income from the RPS after the project is built, they need to know that the RPS will remain in place and provide reasonable support long after construction. If project developers do not have a clear sense of what future RPS targets, compliance costs, and price levels will be, they will likely be hesitant to invest or to move forward with their projects.

  Therefore, when an RPS is first established, it should have targets that extend many years into the future and have administrative procedures, provisions, and compliance mechanisms that can remain constant. Once an RPS is in place, policymakers should try to avoid making frequent changes to it. When frequent changes are made, market players understandably begin to assume that there will be yet more changes in the future and do not believe that they can count on the RPS over time. Investment can dry up and projects can be cancelled or delayed.

  On the other hand, some RPS alterations are unavoidable, because it is impossible for anyone to accurately predict the future. Unexpected developments—either in the economy, in the energy market, in federal policy, or in specific technologies—can cause an RPS to fall short of its goals or can cause RPS prices to fall or rise dramatically. In those cases, a change may be necessary in order to maintain confidence in the RPS and stabilize RPS prices. An RPS set in stone that policymakers refuse to update can collapse under its own weight.

So how can a state remain flexible and respond to changing circumstances without making so many frequent alterations that investors and project developers will be scared away? Here are a few suggestions:

- Targets and rules are less likely to need to change if they are realistic and are based on a careful assessment of the available renewable energy resources, of industry trends, and of economic conditions. Initial RPS program design is therefore key. Policymakers need to think carefully about their goals and how to achieve them, so that they will be confident that they have made the right decisions for the state and will be unlikely to want to add or change goals in the near term. Similarly, the percentage targets for the RPS need to be selected with great care, based on sufficient data (rather than aspirational hopes), so that policymakers will be confident that even if the targets are ambitious, they are achievable based on realistic assumptions. They should also make sure that the resource and technology eligibility definitions are clear enough that there will not be any ambiguity requiring future regulatory clarification, involving time-consuming administrative and/or legislative proceedings. Of course, markets, supply and demand imbalances, and other factors can still develop in unexpected ways and changes could turn out to be necessary, but good planning will reduce the likelihood of that.

- The more complexity an RPS has—detailed eligibility requirements and multiple carve-outs and credit multipliers—the more likely that there will be a particular feature that needs to change over time. RPS designers should therefore make sure that each feature is indeed necessary for meeting important objectives and its implications evaluated.

- When RPS policy changes are made, they should be implemented with sufficient lead time that program participants can respond effectively. It is especially important to try to avoid changes that significantly diminish the value of investments that generators and electricity suppliers have already made in good faith based on the RPS rules that were in place.

- RPS program administrators need to devote considerable attention to monitoring the market and regularly evaluating the RPS. This will increase the likelihood of identifying and fixing potential problems well before there is a crisis that requires instant action and sudden changes. Program administrators should also keep legislators and stakeholders well informed of the RPS's progress.

5. A state should be aware of how its RPS relates to and interacts with the RPSs of nearby states.

In the case of Vermont, this is especially important, because the state is part of a single regional wholesale market, the New England Power Pool (NEPOOL), and all the other states in the region already have RPSs. Because electricity and RECs are traded freely within the region, Vermont should consider how a new Vermont RPS, its targets, and ramp-up schedule would affect the supply of RECs for the other RPSs in the region and how those RPSs would impact Vermont's compliance, REC prices, and rate impacts. Although each state RPS inevitably has unique features, markets will be more robust and procurement costs lower if Vermont's resource eligibility definitions, compliance mechanisms, compliance periods, and other RPS features were made as similar as possible to those of other New England states. If Vermont adopts an RPS, any variations from the other states should be made consciously, for well-thought-out reasons.

6. Renewable Energy Certificates (RECs) have proven to be a useful feature of an RPS.

RECs are tradable certificates, typically in electronic form. A REC gets created every time a qualifying renewable energy facility generates one megawatt-hour of electricity. They have become the common currency for renewable energy generation, making it possible to accurately track and verify that the correct quantities of renewable energy have indeed been generated to satisfy the RPS. RECs can be sold "bundled" as a package with the actual electricity produced or they can be traded separately.

Here is how the National Renewable Energy Laboratory describes the way RECs works: "The RECs provide an accurate, durable record of what was produced and a fungible commodity that can be traded among suppliers. A REC is spent or 'retired' from circulation once it is matched uniquely with an identical quantity of electricity consumed by an end-user."[10] After the REC is retired, it cannot be sold again into another market or used again in the same market for future RPS compliance.

The contracting flexibility associated with the use of RECs reduces the cost of RPS compliance for all parties. In New England, ISO New England's Generation Information System (GIS) makes the tracking of RECs especially efficient and reliable. Among the many advantages of using RECs are:

- The use of RECs provides compliance flexibility by freeing renewable energy sellers from the need to deliver renewable electricity in real time to users.
- RECs provide an accurate, durable record of what was produced and a fungible commodity that can traded among suppliers.
- RECs help create a liquid market for renewable energy by making a spot market for RECs possible while also allowing for a forward market that enables hedging and financing.
- The use of RECs can reduce the cost of compliance by providing access to a larger quantity and geographic scope of resource options. Use of RECs allows utilities to seek the lowest cost renewable energy attributes regardless of where the RECs are generated.
- RECs provide verification of compliance with an RPS, reducing the risk of double counting and fraud.
- RECs facilitate transactions across regional boundaries, because they are not subject to the same geographic constraints as commodity electricity.

[10] K.S. Cory and B.G. Swezey, *Renewable Portfolio Standards in the States: Balancing Goals and Implementation Strategies* (Boulder, CO: National Renewable Energy Laboratory, 2007), p. 3.

- They help solve the issue of variability and the mismatch between renewable energy supply and load. Buyers can procure just what they need when they need it.
- The use of unbundled RECs, as opposed to requiring the delivery of electricity, can reduce transmission constraints and costs.[11]

For these reasons, RECs have become the dominate mechanism for RPS compliance. Most of the states with RPS mandates allow RECs to be used for compliance purposes. In fact, only three states—Arizona, Hawaii, and Iowa—do not allow the use of unbundled RECS for RPS compliance

7. An RPS should include measures to control compliance costs.

An RPS runs the risk of being dismantled if the cost of complying with itescalates to unsustainable levels. For that reason, states have included several mechanisms to limit the cost of compliance. These mechanisms, including Alternative Compliance Payments (ACPs), rate caps, contract caps, and regulatory agency discretion, will be discussed in section F11 below. Flexibility measures, such as REC banking, REC borrowing, and compliance waivers, also tend to reduce compliance costs, and they will be discussed in section F12.

8. Policymakers should consider how to help renewable energy projects secure financing and/or long-term contracts.

One weakness of an RPS as a policy mechanism is that it is not inherently adequate to guarantee that a project developer can secure financing for a cost-effective renewable energy project. Even when a developer can show that the projected revenue stream would make the project economically viable, financial institutions may remain hesitant to lend or invest money in the project. They may feel that, because of fluctuating REC prices and the possibility that the state will make future changes to the RPS, REC revenue is not sufficiently assured to justify an investment. Long-term contracts for both power and RECs may be required to ensure that a project can receive financing.

There are a variety of ways in which a state can address the financing and long-term contracts issues within the context of an RPS or with related policies. In section F below, we discuss some options that could be appropriate for Vermont. As a regulated market, Vermont has options that are not available to other states in the region.

9. Other relevant best practices and principles.

In addition to the major points discussed above, additional lessons can be drawn from the experiences of other states:

[11] These advantages of RECs were listed by Bob Grace in the slides for *Webinar: Connecticut's RPS Policy Report: A Common Starting Point*, April 4, 2011, p. 36.

- It generally makes sense to make it clear in the RPS policy that prudently incurred RPS compliance costs will be allowed to be recovered in electricity rates.

- Because all ratepayers, regardless of the nature of their electricity supplier, receive the general benefits of renewable energy, it is usually best for an RPS to apply to all load-serving entities—investor owned, municipal, and electric cooperatives—and the cost of RPS compliance should be shared by all utility customers.

- An RPS should be designed in a way that anticipates the possible creation of a federal RPS or clean energy standard. For example, there might be provisions that allow the RPS administrator to make adjustments to the RPS in order to harmonize it with a federal RPS without having to go back to the legislature to change the law.

F. Renewable Energy Trends in New England

There are over 3,400 MW of land-based and over 1,700 MW of ocean-based renewable energy projects in various stages of active, publicly announced, development throughout New England.[12] While biomass and hydroelectric resources dominate the region's existing fleet of renewable energy facilities, the vast majority of recently constructed or proposed projects are for wind energy generators. This section discusses renewable energy project development trends in New England, estimates RPS demand based on current targets and load forecasts, and summarizes the current renewable energy development pipeline which has emerged in response to such policies.

Overview of Development Trends

In late 2010, the New England States Committee on Electricity (NESCOE) released a Request for Information in an effort to better understand the region's pool of proposed renewable energy projects in support of the potential organization of a coordinated state procurement effort. NESCOE asked for responses from projects which could be in service by 2016 and whose output would qualify for all five Renewable Portfolio Standards in New England, plus Vermont's current renewable energy goals. In a March 2011 summary, NESCOE reported receiving responses from more than 4,700 MWs of projects under development, with wind projects (both on and offshore) representing over 90% of the total. [13]

Also in December 2010, the Federal Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) released a request for information to ascertain interest from parties seeking to obtain commercial leasing rights for the development of offshore wind projects on the Outer Continental Shelf (OCS) off of Massachusetts. Indications of interest were submitted by ten entities.[14] In addition, two unsolicited proposals were received in October 2010 for development in an area of mutual interest between Rhode Island and Massachusetts.[15] Finally, a Call for Information and Nominations is being prepared for release later this year for projects on the OCS off of Rhode Island. The planning and environmental review process for wind energy development on the OCS is ongoing.

While the wind development pipeline appears more robust than at any previous time, operating and proposed biomass projects are facing increasing barriers to viability. For example, this year Massachusetts, representing over 45% of regional Class I demand, is instituting a change to the criteria by which biomass generators are eligible for its RPS, imposing minimum efficiency and sustainable fuel harvesting standards on the heels of a study questioning the greenhouse gas benefits of some biomass-to-electricity generation applications. The addition of a 40% to 60%

[12] Source: Sustainable Energy Advantage, LLC proprietary database.
[13] http://www.nescoe.com/uploads/Summary_of_SIF_Responses_final.pdf
[14] www.boemre.gov/offshore/RenewableEnergy/PDFs/stateactivities/MA/CommercialIndicationsofInterest4-22-11.pdf
[15] www.boemre.gov/offshore/RenewableEnergy/PDFs/stateactivities/RI/FINAL_RIMA_JointTskFrc_Dec2010.pdf

efficiency standard,[16] as well as fuel harvesting requirements, will raise the bar not only for proposed generators (effective immediately) but also for existing generators after a transitional grandfathering period. This represents a decisive shift away from a generation resource which has made substantial contributions to achieving RPS compliance to date. For example, biomass generation has comprised between 26% and 49% of Massachusetts Class I RPS compliance, and between 43% and 54% of the Rhode Island 'new' RES compliance. If currently operating facilities cannot meet the new Massachusetts' requirements by the end of the grandfathering period, then this large portion of RPS compliance will need to be made up by other resources throughout the region. This new policy is likely to cause biomass energy development to trend away from relatively large (e.g. 50 MW) central-station biomass projects able to achieve economies of scale, in favor of smaller (e.g. 5 to 15 MW) distributed biomass combined-heat-and-power (CHP) facilities. Other states in the region may follow Massachusetts' lead in increasing regulatory requirements for biomass resource eligibility.

While it will be challenging for large projects to meet the changed RPS policies that require increased biomass conversion efficiencies, it is not yet clear that the right combination of factors exists in New England to make a wave of small biomass CHP feasible. In addition, the region's operating biomass fleet is experiencing economic pressures, caused by the inadequacy of current energy, capacity, and REC revenue to cover operating costs. These pressures by mid 2011 have caused a number of operating plants to (at least temporarily) cease or curtail operations, with others considering curtailments.

Although solar photovoltaic (PV) generators today produce far less energy than wind or biomass, the solar sector is experiencing marked growth in most New England states. This is due to the confluence of recently developed or expanded policies - including RPS solar carve-outs, net metering, standard offer contracts, and federal tax credits – and rapidly falling costs. Individual state programs will provide incentive for the development of anywhere from a dozen to 400 MWs of solar energy development over the next several years. Similar circumstances may be present for fuel cells in Connecticut, albeit on a much smaller scale.[17]

Looking at the region's renewable resource potential more broadly, one would expect additional electricity production from landfill gas-to-energy, hydroelectric, and anaerobic digestion to continue to make an important but resource-limited contribution to New England's RPS objectives. For hydro and landfill gas, while the resource base is significant, it is also largely saturated; energy facilities have already been developed in the vast majority of locations where these resources exist, although incremental capacity, repowering and a modest amount of new development may be possible in some cases.

Production from Renewable Energy Facilities within ISO-NE

The following tables and graphics summarize the trends in production from renewable energy facilities since RPS requirements first took effect in New England. These illustrations include

[16] Biomass projects would receive a full REC (1 per MWh) for all production in any quarter in which average efficiency was greater than or equal to 60%. One-half REC is granted for average quarterly efficiency of 40%. There is a sliding scale in between. No RECs are afforded to biomass facilities with less than 40% efficiency.
[17] Natural Gas Fuel Cells are a Class 1 Renewable Energy Resource in Connecticut.

both new renewable energy projects that have come online after legislatively determined vintage dates, as well as pre-existing renewable energy; they are intended to provide insight into overall production trends, as opposed to compliance with any individual RPS obligation.

Figure 1. RE Production Trends, By Fuel Type

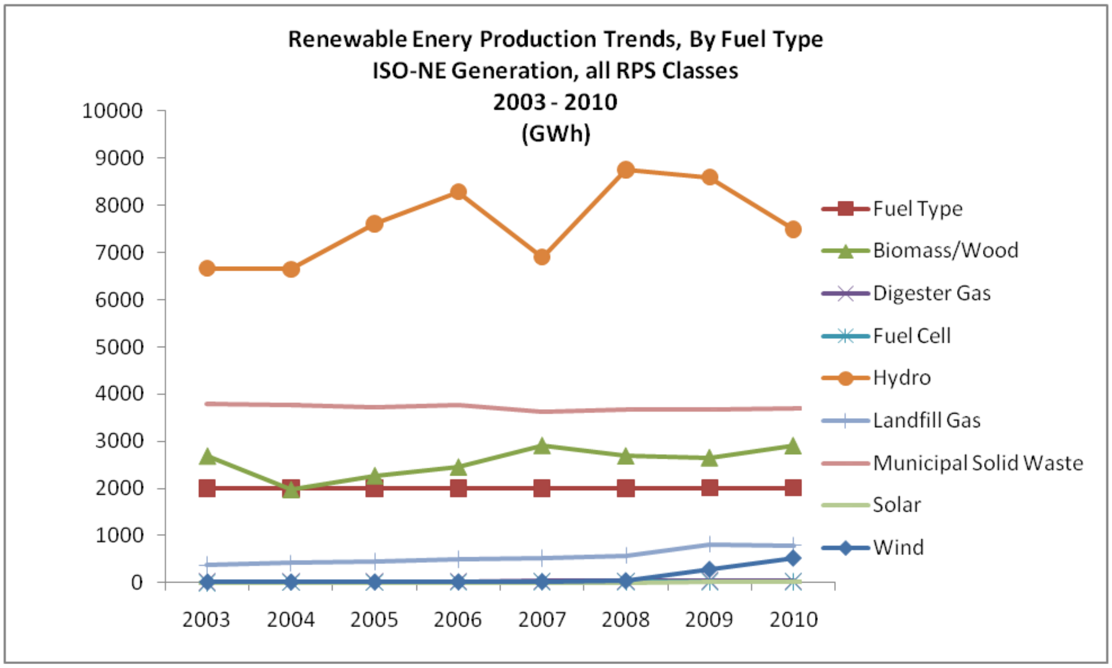


Table 2. Renewable Energy Production, By Fuel Type ISO-NE Generation

Renewable Energy Production, By Fuel Type ISO-NE Generation 2003 - 2010 (GWh)								
Fuel Type	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Biomass/Wood	2,687	1,981	2,275	2,458	2,908	2,690	2,654	2,906
Digester Gas	25	21	26	29	33	35	39	35
Fuel Cell	0	7	10	13	14	13	18	16
Hydro	6,664	6,646	7,609	8,289	6,904	8,760	8,597	7,488
Landfill Gas	374	416	445	498	518	578	816	794
Municipal Solid Waste	3,782	3,764	3,723	3,756	3,635	3,669	3,682	3,703
Solar	0	0	1	2	4	5	12	28
Wind	12	13	12	16	20	40	278	517
Source: NEPOOL GIS, GIS Certificate Statistics								

Production from Renewable Energy Facilities in Control Areas Adjacent to ISO-NE

Renewable energy imports to New England from adjacent control areas have generally been on the rise steadily since 2004, contributing materially to RPS compliance throughout the region. In the latter half of 2010, however, imports declined in some technology categories and the rate of increase moderated for others. These changes suggest that the growth rate of renewable energy imports is moderating, likely representing a market response to the decline in New England REC prices throughout 2010. It is important to note, however, that renewable energy resource potential in adjacent control areas – primarily wind and hydroelectric - far exceeds the capacity of existing (and proposed) transmission ties into New England, so that import growth could again accelerate if justified by future market conditions and with transmission expansion.

Figure 2. RE Production Trends, By Fuel Type - NEPOOL

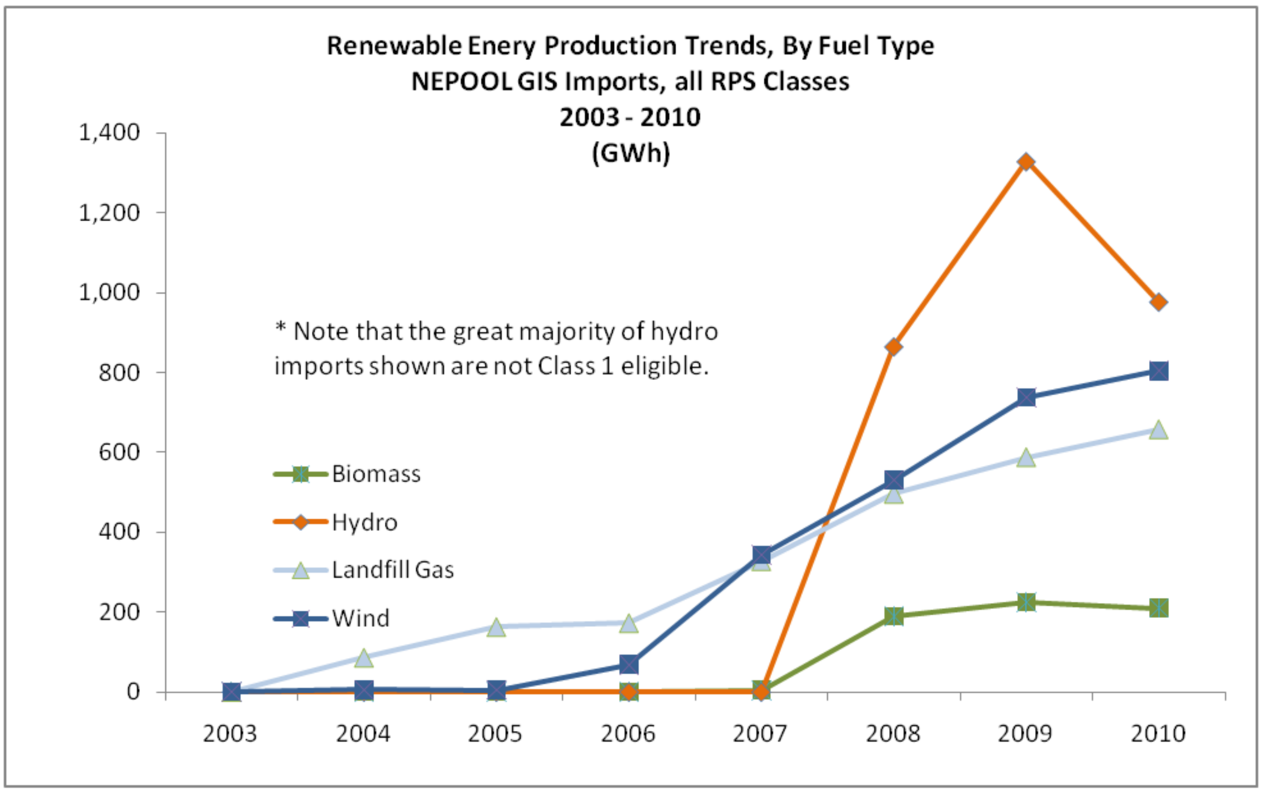


Table 3. RE Production, By Fuel Type – Imported Generation

Renewable Energy Production, By Fuel Type Imported Generation 2003 - 2010 (GWh)								
Fuel Type	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Biomass	0	0	0	0	4	189	224	210
Digester Gas	0	0	0	0	0	0	0	0
Fuel Cell	0	0	0	0	0	0	0	0
Hydro	0	0	0	0	0	865	1,329	977
Landfill Gas	0	86	162	172	327	495	587	656
Municipal Solid Waste	0	0	0	0	0	0	0	0
Solar	0	0	0	0	0	0	0	0
Wind	0	6	5	68	343	530	738	804

RPS Requirements and Demand for New Renewable Energy Supply

The bulk of renewable energy demand in New England is created by the region's current Renewable Portfolio Standards. Connecticut, Maine, Massachusetts, New Hampshire, and Rhode Island all have mandatory RPS requirements and require penalty payments for non-compliance. Most of these RPSs have separate requirements for "New"[18] and "Existing"[19] supply, where "New" targets are met by eligible supply which first entered commercial operations after a specified date[20] and are designed to spur the development of additional eligible resources. "Existing" targets, by comparison, are intended to provide the minimum market incentive necessary to maintain efficient and reliable operation of the existing fleet of renewable resources (those first achieving commercial operation *before* the specified date). Due to their maintenance orientation, the targets for these other classes are generally held constant, with annual obligations varying only based on changes in the load forecast.

From January 2011 through 2025, New England RPS mandates will create the market for an estimated 18,000 incremental GWhs of new renewable energy, based on current RPS targets and the 2011 ISO-NE state-by-state load forecast.[21] This is the equivalent of just over 2,000 aMW (average megawatts)[22] of incremental supply. The tables and graphics below show the

[18] Referred to in most states as Class 1, and sometimes Class 2 (as in NH Solar). The term "New" is used in RI.
[19] Referred to as Class 2, 3 or 4 depending on the state. The term "Existing" is used in RI.
[20] The addition of incremental capacity at existing facilities, or the additional energy produced above a historic baseline as a result of efficiency improvements, are also considered "New" / Class 1 under certain circumstances.
[21] 2011 ISO New England Capacity, Energy, Load and Transmission forecast, net of passive demand resources (PDR).
[22] Average MW is a metric used in discussing renewable energy production from generation types with radically different capacity factors on a comparable basis, and defined as the equivalent MW if operating at 100% capacity factor.

distribution of these requirements by state. The "New" RPS requirements illustrated below were derived by multiplying the load of obligated entities (those retail load-serving entities subject to RPS requirements, adjusted for public power exemptions, where applicable) by the applicable annual "new" / Class 1 RPS percentage target, including any Class 1 carve-out percentages, if applicable.

Figure 3. Class I RPS Obligations by State

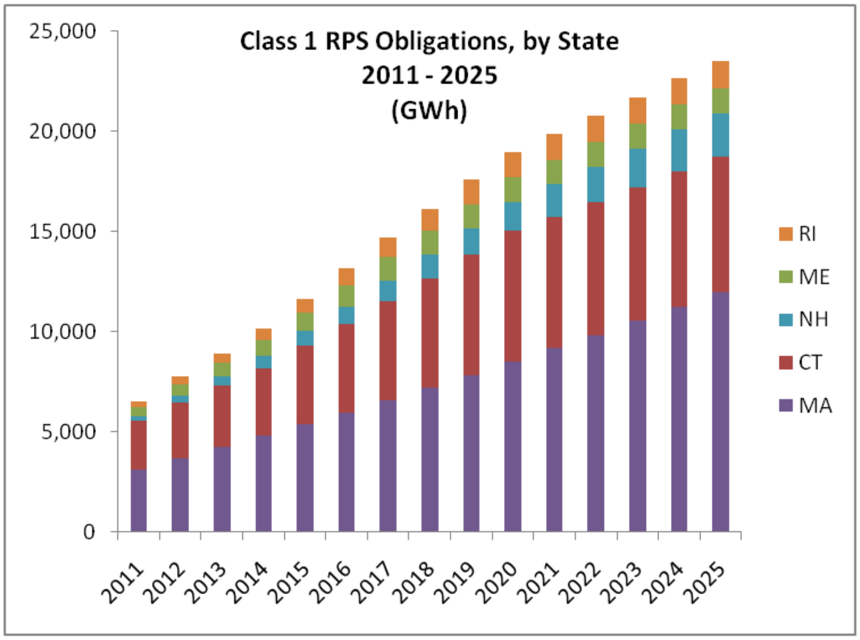


Table 4. Class I RPS Obligations, by State

Class 1 RPS Obligations, by State 2011 - 2025 (GWh)					
Year	**CT**	**ME**	**MA**	**NH**	**RI**
2011	2,425	467	3,131	233	290
2012	2,747	588	3,692	355	378
2013	3,064	695	4,224	477	463
2014	3,402	809	4,791	605	553
2015	3,906	931	5,378	737	689
2016	4,415	1,056	5,976	872	829
2017	4,932	1,182	6,590	1,011	971
2018	5,457	1,192	7,217	1,154	1,116
2019	5,987	1,202	7,854	1,300	1,261
2020	6,525	1,212	8,504	1,449	1,272
2021	6,581	1,222	9,167	1,603	1,285
2022	6,638	1,232	9,843	1,761	1,299
2023	6,695	1,242	10,533	1,923	1,313
2024	6,753	1,252	11,236	2,089	1,326
2025	6,811	1,262	11,953	2,119	1,340

The Renewable Energy Supply Development Pipeline

In the near term, RPS demand will likely be met by a mix of operating and proposed renewable resources in ISO-NE and adjacent control areas. This includes proposed generation in the respective interconnection queues, as well as large projects that have not yet filed for interconnection and small projects or biomass co-firing applications that are not required to go through the large generator interconnection process.

Including all projects for which information has entered the public domain, the estimated energy production from the current slate of operating and proposed renewable energy projects is summarized in the table and graph below. Estimated production (MWh) is provided first for operating projects, and is shown by fuel type for generators located within Vermont, within the rest of ISO-NE, and imported from adjacent control areas. Estimates of production from proposed ISO-NE projects under active development – referred to as the development pipeline - are also provided. Unlike operating projects, projects in the development pipeline still have some risk that the hurdles of permitting, financing or other development milestones will prevent them from coming to fruition. Even those projects that do come to fruition are subject to potential delays to their planned or target dates of commercial operation. As a result, the following tables and graphs show projected production from the development pipeline in two forms:

- the *gross* potential production from the pipeline, assuming all such projects reach commercial operation; and
- the *net*, or *derated*, expected production after a categorical 'probability of success' factor is applied to derate each proposed project's projected output.

This information is summarized by fuel type and shown separately for projects proposed in Vermont and throughout the rest of New England. The probability of success factors assigned to each stage of the development process is also provided. Operating data is sourced from Sustainable Energy Advantage's proprietary database. Pipeline data is derived from *Avoided Energy Supply Costs in New England: 2011 Report.*[23] Derating factors are applied to both the quantity and timing of estimated production.

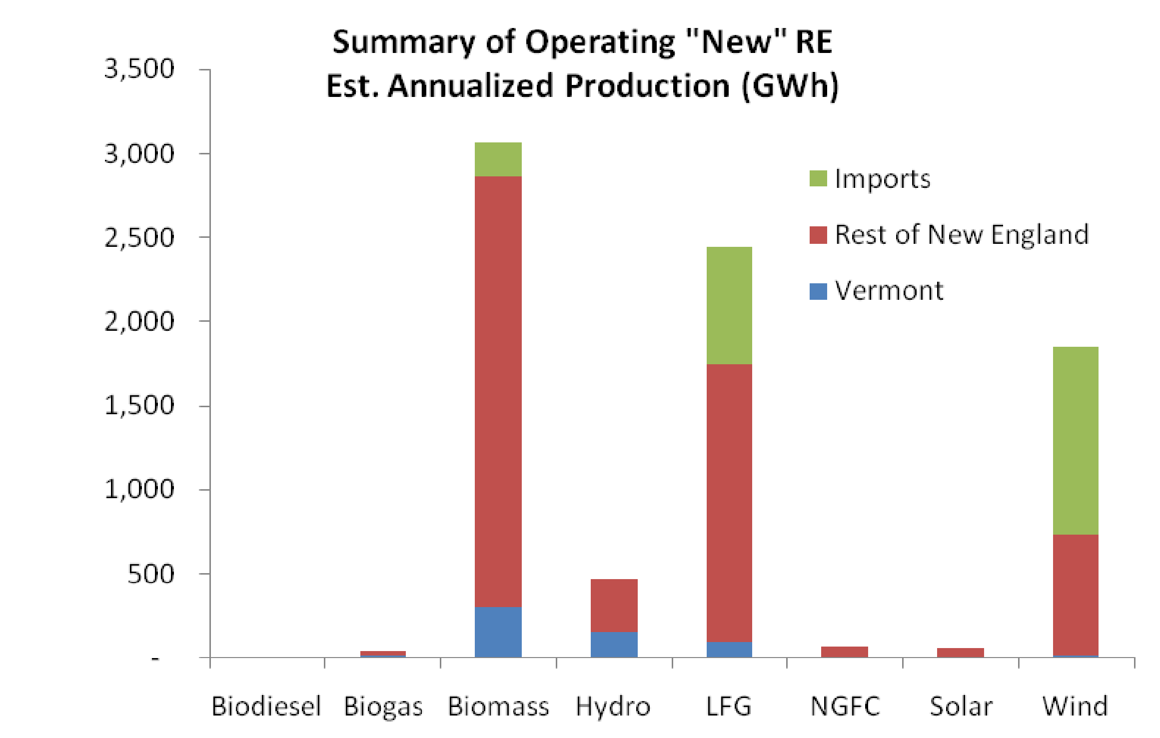
[23] Rick Hornby et al., *Avoided Energy Costs in New England: 2011 Report* (Cambridge: Synapse Energy Economics, Inc., 2011). Sustainable Energy Advantage conducted the renewable energy portion of this study. Available at http://www.synapse-energy.com/Downloads/SynapseReport.2011-07.AESC.AESC-Study-2011.11-014.pdf.

Table 5. Summary of Estimated Production from Class 1 RE Projects – ISO-NE

Summary of Estimated Production from Class 1 Renewable Energy Projects Currently Operating in, or Delivering to, ISO-NE (GWh)				
Fuel Type	**Vermont**	**Rest of New England**	**Imports**	**TOTAL**
Biodiesel	-	5	-	5
Biogas	19	24	-	42
Biomass	307	2,555	208	3,070
Hydro	153	313	-	466
Landfill Gas	94	1,652	698	2,444
Natural Gas Fuel Cells	-	65	-	65
Solar	7	50	-	57
Wind	15	715	1,121	1,851
Other Current Imports			351	351
TOTAL	**595**	**5,378**	**2,378**	**8,351**

Source: Sustainable Energy Advantage, LLC proprietary database

Figure 4. Summary of Operating "New" Renewables



Source: Sustainable Energy Advantage proprietary database

Figure 5. Summary of ISO-NE RE Pipeline

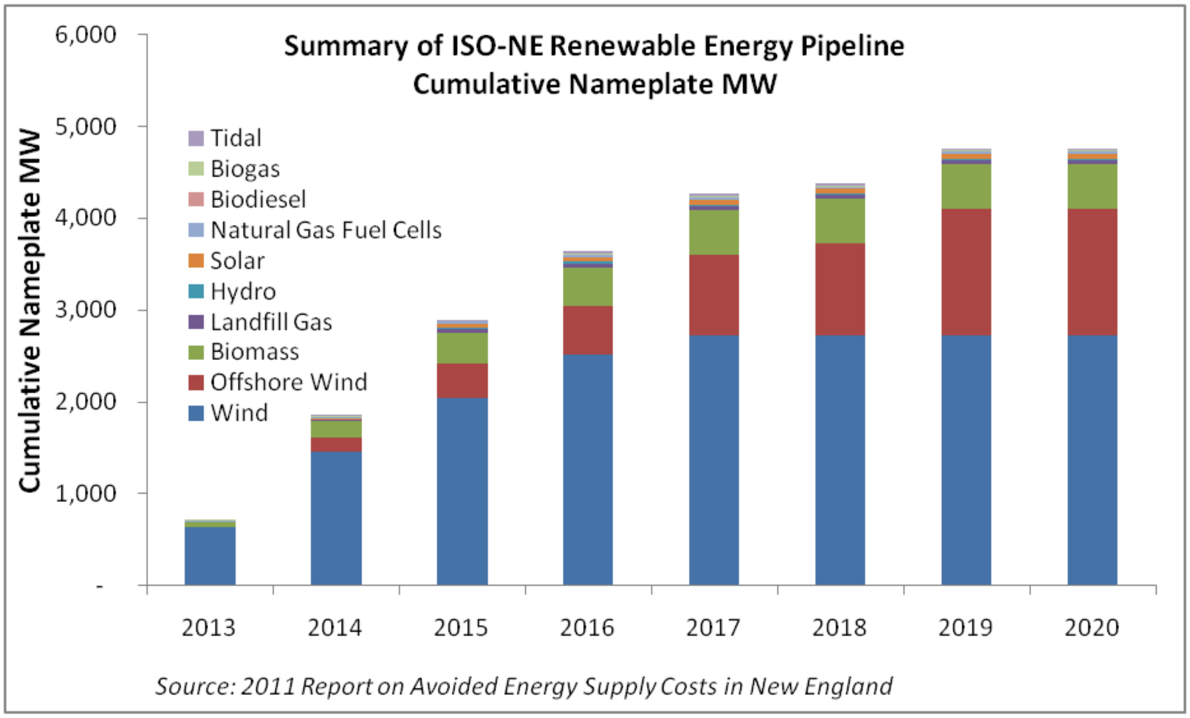


Table 6. Summary of Proposed Renewable Energy Projects - in Vermont

Summary of Proposed Renewable Energy Projects -- <u>in Vermont</u>								
Estimated Gross (Underated) Production, (GWh)								
(GWh)	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Wind	191	383	565	612	612	612	612	612
Offshore Wind	0	0	0	0	0	0	0	0
Biomass	0	36	433	508	508	508	508	508
Landfill Gas	0	2	23	23	23	23	23	23
Hydro	0	5	17	27	27	27	27	27
Solar	0	1	12	14	14	14	14	14
Natural Gas Fuel Cells	0	0	0	0	0	0	0	0
Biodiesel	0	0	0	0	0	0	0	0
Biogas	1	9	33	33	33	33	33	33
Tidal	0	0	0	0	0	0	0	0
Total	192	434	1,083	1,216	1,216	1,216	1,216	1,216

Source: 2011 Report on Avoided Energy Supply Costs in New England

Table 7. Summary of Proposed Renewable Energy Projects - Rest of New England

Summary of Proposed Renewable Energy Projects -- Rest of New England Estimated Gross (Underated) Production, (GWh)								
(GWh)	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Wind	1,562	3,601	4,890	6,096	6,625	6,625	6,625	6,625
Offshore Wind	8	460	1,198	1,668	2,781	3,162	4,358	4,358
Biomass	393	1,284	2,003	2,592	3,117	3,117	3,117	3,117
Landfill Gas	35	66	273	273	273	273	273	273
Hydro	1	11	26	31	31	31	31	31
Solar	3	20	32	43	43	43	43	43
Natural Gas Fuel Cells	40	89	181	181	181	181	181	181
Biodiesel	3	3	3	3	3	3	3	3
Biogas	4	39	43	44	44	44	44	44
Tidal	0	1	23	94	94	94	94	94
Total	2,048	5,575	8,673	11,027	13,193	13,574	14,770	14,770

Source: 2011 Report on Avoided Energy Supply Costs in New England

The production estimates below rely on the following derating methodology in order to estimate the degree of expected attrition in the pipeline and the ultimate expected quantity of renewable energy supply. Probability of success derating factors are assigned based on development status. This methodology was also used in *Avoided Energy Supply Costs in New England*.

Table 8. Success Factors

Parametric Probability of Success Factors, by Project Status Category	
Development Status Category	Probability of Success
Seeking Permits	**60%**
Under Development	**30%**
Feasibility / Pre-Development	**20%**

Table 9. Summary of Proposed Renewable Energy Projects - in Vermont

Summary of Proposed Renewable Energy Projects -- in Vermont Estimated NET (Derated) Production, (GWh)								
(GWh)	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Wind	169	285	347	361	361	361	361	361
Offshore Wind	0	0	0	0	0	0	0	0
Biomass	0	20	245	260	260	260	260	260
Landfill Gas	0	0	6	6	6	6	6	6
Hydro	0	1	5	8	8	8	8	8
Solar	0	0	4	4	4	4	4	4
Natural Gas Fuel Cells	0	0	0	0	0	0	0	0
Biodiesel	0	0	0	0	0	0	0	0
Biogas	0	2	9	9	9	9	9	9
Tidal	0	0	0	0	0	0	0	0
Total	170	310	615	648	648	648	648	648

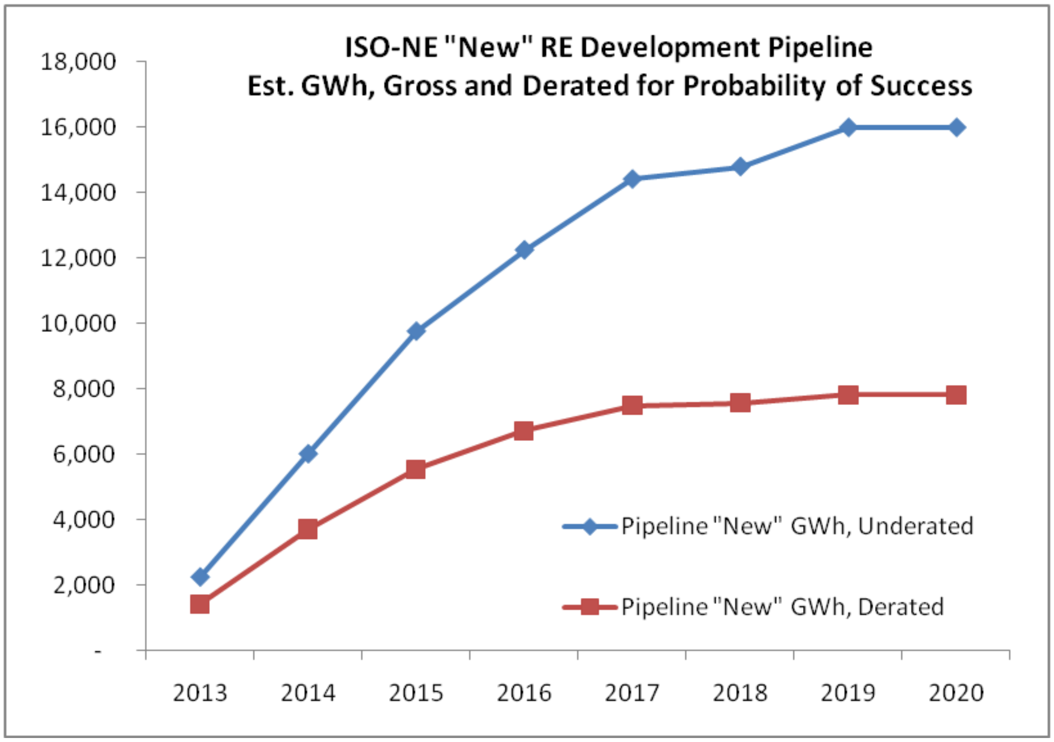
Source: 2011 Report on Avoided Energy Supply Costs in New England

Table 10. Summary of Proposed Renewable Energy Projects - Rest of New England

Summary of Proposed Renewable Energy Projects -- Rest of New England Estimated NET (Derated) Production, (GWh)								
(GWh)	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Wind	915	1,980	2,334	2,635	2,911	2,911	2,911	2,911
Offshore Wind	5	387	1,051	1,504	1,747	1,821	2,062	2,062
Biomass	289	947	1,342	1,717	1,975	1,975	1,975	1,975
Landfill Gas	25	38	99	99	99	99	99	99
Hydro	0	3	8	9	9	9	9	9
Solar	1	6	10	12	12	12	12	12
Natural Gas Fuel Cells	12	27	54	54	54	54	54	54
Biodiesel	3	3	3	3	3	3	3	3
Biogas	1	11	14	14	14	14	14	14
Tidal	0	0	7	24	24	24	24	24
Total	1,251	3,401	4,923	6,074	6,850	6,924	7,165	7,165

Source: 2011 Report on Avoided Energy Supply Costs in New England

Figure 6. ISO-NE "New" RE Development Pipeline



How Development of New RPS-Eligible Supply Is Linked to Policy and Market Stability

Renewable energy markets are created – and limited – by policy. While RPS requirements provide incentive for early-stage development activity – as evidenced by the robust pipeline summarized above – there are very few projects capable of securing financing and entering operation without being able to demonstrate long-term revenue certainty to investors (for at least a large portion of the project's expected output). This is particularly true for REC revenue, for which there are few, if any, alternative means to secure long-term revenue certainty, and the marketplace perceives a high degree of political risk with depending on REC revenue. In New England today, several states have established programs that enable such revenue certainty to be achieved; and, while these programs are critical success factors for the projects that they serve, their current scope is sufficient to support only a very small fraction of the current development pipeline. For example, several Massachusetts utilities recently went through a competitive bidding process for a state-mandated pilot program in which some reported receiving proposals for 28 times more capacity than they were prepared to contract with. Overall, RPS targets far exceed the state long-term contracting programs on which RPS projects are largely dependent. This dearth of long-term contracts, and the associated challenges of project financing, is one of the defining factors in New England's renewable energy market today.

The long-term success of renewable energy markets is similarly dependent on consistency and stability across regional RPS markets. Frequent changes in RPS requirements in the various states have increased uncertainty and act to chill investor interest in RPS projects. Because New England operates as a single control area, and supply in one state (and adjacent control areas) is eligible in all the others, it is important that all states make a coordinated effort for RPS policy stability.

The Effect of Large Regional Resources on In-State Renewable Energy Development

When defining the parameters of the current RPS Study, the Vermont Legislature requested that the Board consider “the effect on the development of in-state renewable energy if out-of-state resources in excess of 200 MW are considered eligible for the RPS.” This question was considered quantitatively as part of the RPS cost modeling associated with this report but is also discussed briefly here in the context of renewable energy trends. This question represents, in part, the tradeoff between least-cost RPS compliance and local benefits.

The table below identifies different potential resources greater than 200 MW and describes how each might compete with, or displace, in-state renewable energy projects. Of course, these large out-of-state projects would not compete with smaller, in-state resources to the extent that those resources are targeted through a specific policy mechanism, such as a possible RPS distributed generation carve-out or Standard Offer Program.

The Effect of Large Regional Resources on Vermont-based Renewable Energy Development

Onshore Wind	• There are a limited number of proposed onshore wind projects in ISO-NE that exceed 200 MW. • These facilities will be eligible for the "New" / Class 1 RPS in all New England states, and will be among the lowest-cost resources in the region. • Like most proposed facilities, these resources will likely need to secure long-term power purchase contracts prior to entering construction. • These facilities could make a material contribution to Vermont RPS compliance, but are also likely to be used to serve other markets. • On a price basis, these facilities would likely compete directly with, and potentially displace, the best wind sites in Vermont.
Offshore Wind	• Most offshore wind projects – if successfully permitted and built – will be larger than 200 MW. • The universe of offshore wind available in New England will be limited for the next 6 to 8 years. • These facilities will be eligible for the "New" / Class 1 RPS in all New England states. • Unless subsidized by one or more state programs, offshore wind projects are unlikely to be the least-cost RPS compliance resource until after 2020, if at all. • For this reason, offshore wind may be unable to compete head-to-head on price with Vermont wind, but may compete with proposed biomass resources on a price basis. • These facilities could theoretically serve much or all of Vermont's RPS obligation (depending on the ultimate target objective), but given the level of participation of other states in the contracting process, the RECs from at least the first several offshore wind projects are likely to remain in their "home" states.
Hydroelectric	• Large hydro in New England is saturated; no hydro larger than 200 MW has been built in recent years and no new or incremental capacity of this scale should be expected in ISO-NE. • In adjacent Canadian control areas, new hydro greater than 200 MW is widely available and planned, and could significantly affect the RPS landscape in Vermont. • If the cost of developing such hydro resources has already been sunk or subsidized, or project sponsors are prepared to build without requiring a committed long-term revenue stream, which appears likely, then they should be expected to be price-takers, displacing the previous marginal RPS resource by entering at the bottom of the stack and accepting the new, lower, marginal REC price. • As such, this Canadian resource would be expected to be available to meet all Vermont RPS demand outside of any specified carve-outs. The eligibility of hydro larger than 200 MW from adjacent control areas would likely replace the need to develop additional Vermont-based renewable energy.

G. Possible Policy Goals and Their Implications for RPS Design

A state can have a variety of reasons for supporting the development of renewable energy. Just saying that an RPS will be used to get more of a state's electricity from renewables is insufficient, because it begs the question of why. One of the most important steps in determining whether to adopt an RPS is deciding what the specific reasons are for establishing it and what its goals will be.

The various possible goals overlap and a single RPS design can seek to accomplish several things at the same time. But, by knowing *which specific goals are most important* and which are subsidiary, an RPS can be constructed to be as effective as possible. A state may conclude that it wants to have a "balanced" RPS that will simultaneously address several goals, but it is important to know how to strike the right balance. This sort of consideration of goals is also important as Vermont decides whether or not to retain the SPEED program.

We have divided the large number of possible goals that could be relevant to Vermont into the following categories:

- Energy system goals
- Environmental goals
- Economic goals
- Technology development goals
- Administrative and political goals

For each goal, we show how an RPS might be designed to address it and we discuss some of the factors to consider in deciding whether it should be a priority for Vermont.

1. Energy Goals

An RPS can influence the mix of energy sources used by Vermont to supply electricity. Reasons for doing that can transcend the environmental and economic goals that will be discussed in section 2 below. They include:

a. Reduce dependence on fossil fuels and nuclear power
b. Increase long-term rate stability and reduce the risk of fluctuating energy prices and fuel supply shortages
c. Decrease reliance on centralized power plants
d. Preserve existing clean energy generation

Reduce dependence on fossil fuels and nuclear power. When the RPS was first developed as a policy mechanism in the 1990s, it was with this very general goal in mind. RPS advocates believed that it would be good for America to move away from relying primarily on fossil fuels and nuclear power—for environmental reasons, for public health reasons, for economic reasons, and for energy security reasons.

If this general goal is Vermont's priority, an RPS should seek to bring the most new renewables online at the lowest cost. That implies:

- An RPS should include the maximum number of possible renewable technologies in the RPS and then allow them all to compete equally based on price. It would not matter if all the renewables development uses the same technology, as long as total development is maximized.
- It should allow projects of all different sizes to qualify and compete as part of the RPS. It would not matter if all the renewables development comes from a single large project or many small projects, as long as total development is maximized.
- It would not matter if the projects are in Vermont or outside the state.
- Such an RPS would likely result in procurement of out-of-state wind and Canadian hydropower

Factors to consider related to this goal:

- A sole focus on this goal leads to a simple, easy-to-understand, easy-to-administer RPS in which the only competition among eligible projects relates to the price at which they are willing to sell their RECs.
- To the extent that the state has specific reasons for wanting to shift away from fossil fuels and nuclear power, this very general goal may not produce the optimal result. For example, if global warming is a primary reason for reducing fossil fuel use, an RPS that takes this approach may not produce as good a result as an RPS that makes distinctions between the varying global warming impacts of different renewable energy technologies (see 2a below).
- The relative cost and merits of energy efficiency versus renewable energy should be given some consideration, since efficiency, as well as renewables, reduces the need for fossil fuels and nuclear power, and generally at a lower cost.

Increase long-term rate stability and reduce the risk of fluctuating energy prices and supply shortages. A virtue of certain renewables—solar, water, and wind—is that they do not require fuel. Once a project gets installed, the future price of the electricity from that project is predictable and considerably more stable than from facilities that need to purchase fuel.

If this is the state's priority goal, it implies:

- Bringing the most renewables (with the possible exception of woody biomass) online at the lowest cost, regardless of technology, size of project, or location.

Factors to consider:

- Because solar, wind, and water do not use fuels, they accomplish this goal well.
- Although landfill gas and farm digesters use fuel, the ongoing supply and cost of their fuel are relatively predictable at the time a project gets built and are generally independent from fossil fuel prices.
- The situation for wood for biomass facilities is more complicated, because the demand for wood goes up when fossil fuel prices rise, since users switch to wood. Moreover, the cost of harvesting and transporting wood goes up. The price and supply of wood are therefore partially but not fully linked to fossil fuel prices. For this goal, it would therefore be undesirable to rely primarily on wood, even though wood could be part of the mix.

- When determining the value of rate stability and reduced risks of supply shortages, it is important to keep in mind that future fuel prices could theoretically move lower as well as higher. If increased fuel supply (for example, because of shale gas) causes fossil fuel prices to go down, stable renewable energy prices will seem less attractive. It is therefore important to use realistic projections of the likelihood of both higher and lower future fossil fuel prices.

Decrease reliance on centralized power plants. Some, but certainly not all, energy experts believe that the electricity system should move decisively in the direction of distributed, small-scale electricity generation and move away from reliance on large power plants that require long-distance transmission. Amory Lovens, for example, argues that the electricity industry is undergoing a profound transition and that small-scale distributed generation will increasingly be embraced as the route to increased overall system reliability and decreased costs.[24] Even if Vermont's RPS designers do not agree that the electricity system needs to undergo the dramatic transformation that Lovens calls for, they may conclude that there would be benefits to moving modestly in the direction of distributed generation.

If Vermont concludes that distributed generation should be a top priority for the RPS, it implies:

- Having an RPS with a preference (carve-out or multiplier) for distributed generation.
- Allowing higher price support for distributed generation than for large-scale power plants.
- Including as wide a range of distributed generation technologies as possible, including ones that are not renewable, such as stationary fuel cells and combined heat and power (CHP).

Preserve existing clean energy generation. States sometimes seek to protect existing clean energy generators, either because of the environmental benefits that those generators provide or because the power plants are perceived to be valuable local businesses that provide jobs and other economic benefits. The existing facilities may be at risk of closing down, because they need repairs and equipment upgrade and/or they have a Public Utility Regulatory Policy Act (PURPA) contract or other long-term contract that is about to end.

The desire to preserve existing renewable energy facilities is quite logical, since it generally requires smaller incentives per kilowatt-hour to keep them operating than is necessary to incentivize the construction of a new clean energy facility. This can therefore be a cost-effective way to help maximize renewable energy generation. Although it would be uninspiring to structure a renewable energy policy that *only* protects existing generation and does not lead to new generation, it can be reasonable to make the protection of existing generation one of several goals.

If this is a priority goal for an RPS, it implies:

[24] Amory B. Lovens et al., *Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size* (Snowmass, Col.: Rocky Mountain Institute, 2007). See http://www.smallisprofitable.org/index.html.

- Either allowing existing facilities to compete equally with new facilities for RPS support, setting up a separate tier of the RPS just for existing facilities, and/or creating an early "vintage date" for RPS eligibility.

Factors to consider:

- Although some states have included existing facilities in their RPSs, an RPS is a blunt, inefficient tool for accomplishing the objective of preserving endangered, older renewable energy generation. Here is why:
    - Many older facilities are profitable and do not need any special support in order to continue to operate. No public interest is served by giving them extra money through an RPS. It is simply a windfall.
    - Because the profitable older facilities do not need the revenue stream that comes from selling renewable energy certificates, they can sell those certificates at low prices and thereby set the price for RECs from old facilities. That price could very well not provide the endangered facilities with enough additional revenue to keep them operating. That means that an RPS for older facilities may not succeed in its primary objective of preserving endangered facilities.
    - Because of the Commerce Clause of the Constitution (see sidebar in section H3 below), it would be difficult to design an RPS that focuses specifically on endangered in-state facilities, because of its obvious in-state economic benefit motivation. Therefore, many of the beneficiaries would be out of state.

2. Environmental Goals

An RPS can be used to address global, regional, and state environmental issues. Possible environmental goals include:

a. Slow global warming
b. Improve air quality
c. Improve water quality, reduce water use, and/or protect fish habitat
d. Preserve traditional land use patterns, natural resource areas, and the appearance of the Vermont landscape.

Slow global warming. Through Vermont's renewable energy goals (30 V.S.A. § 8001), the state has identified climate change as one of the reasons for developing renewable energy. Indeed, the use of fossil fuels for electricity is a primary contributor to the carbon dioxide emissions that cause global warming and the use of renewable energy is one of the most effective ways to reduce those emissions. But not all renewable energy technologies are equally effective at cutting emissions.

If slowing global warming is the state's priority goal, it implies:

- Bringing the most renewables online at the lowest cost, regardless of size of project or location.
- Among the renewable technologies, it may make sense to place less emphasis on the use of woody biomass than other technologies, although not necessarily exclude woody biomass altogether, and on new hydropower development due its effect on release of methane.

Factors to consider:

- Even among those Vermonters who believe that climate change represents an extremely serious threat to the state and the planet, there can be disagreements about how aggressive Vermont should be in tackling global warming. On the one hand, because Vermont represents just a very small share of the world's population and emissions, anything it does will have only a statistically modest impact on the trajectory of global warming. It may therefore make sense to aim for less than the maximum possible reductions in climate change emissions in order to accomplish some of the other possible renewable energy goals listed in this section of the report. On the other hand, some people may argue that maximizing emission reductions is necessary so that Vermont can make a powerful statement to other parts of the country that it is necessary to do as much as possible to slow climate change, even if other energy-related goals need to take a back seat.
- Over past several years, there has been increasing controversy and uncertainty about the extent to which electricity generating facilities that rely on wood are desirable from a global warming standpoint. The experts agree that, if the trees that are used to produce electricity are replaced by newly planted trees, there will ultimately be a climate neutral cycle because the new growing trees will absorb the same amount of carbon dioxide as was released when the wood was used in the power plant. But beyond that, there is much less agreement. Much of the uncertainty relates to the fact that the carbon dioxide is released all at once when the wood is consumed in the power plant, but the re-growing forest only absorbs it gradually. Depending upon one's assumptions about how the wood is obtained and what will happen to the forests from which it is harvested, the gap between emissions and absorption produces a smaller or larger spike in near-term emissions. A highly publicized and widely debated study for the Commonwealth of Massachusetts spearheaded by the Manomet Center for Conservation Studies laid out the issues and concluded that many wood-using power plants have very negative impacts on climate change, especially in the short run.[25] Although the Manomet study may have used assumptions that exaggerate the negative climate change impacts of woody biomass and is based on the Massachusetts in-state biomass resource context, it seems clear that:
    - Wood is less desirable from a climate change perspective than other renewable energy technologies, even though it can be better than fossil fuels. (The main points of disagreement among the experts is over how often and under what circumstances wood is better than fossil fuels.)
    - Global warming impacts of generating facilities that use wood can be reduced by improving the efficiency of those facilities, by carefully choosing feedstocks, and by managing forests well.
- Farm methane digesters and landfill gas electricity generators are highly beneficial from a climate change perspective, because they produce electricity from methane that would otherwise be emitted into the atmosphere. Methane is 20 times more potent a greenhouse gas than carbon dioxide.

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[25] Thomas Walker et al., *Biomass Sustainability and Carbon Policy Study* (Manomet, Mass.: Manomet Center for Conservation Studies, 2010). The study, along with the authors' response to critics of it, is available at http://www.manomet.org/node/322.

- Large-scale hydroelectric projects outside Vermont, such as those undertaken by Hydro-Quebec, produce inexpensive clean energy with low global warming. However, they can impact large areas of land, affecting natural habitats and the people who depend upon them, and contributing to methane release from inundation of trees and vegetation. There are differences of opinion among environmentalists and other observers about which large hydropower projects are desirable. When the Vermont legislature classified hydropower from Hydro-Quebec as renewable, it signaled that it had concluded that expanded production of hydropower in Quebec is, on balance, beneficial.
- Because nuclear power plants do not produce carbon dioxide or other greenhouse gas emissions, renewable energy is not better than nuclear power from a climate change perspective. Other factors need to be considered when deciding about the relative merits of nuclear power and renewables.
- The majority of Vermont's carbon dioxide emissions derive from transportation and heating, rather than the electrical sector.

Large Hydro Projects and Global Warming

At first glance, hydroelectric projects might appear to have no climate change impacts, since no carbon dioxide or other greenhouse gas emissions are produced when the electricity is generated. However, a lifecycle analysis of hydroelectric projects shows that they do indeed add to global emissions.

The main way in which a hydro project contributes to global warming is from the impacts related to creating a water reservoir behind a dam. When land is inundated to create a reservoir, the flooded vegetation and soil organic matter decompose, releasing methane and carbon dioxide. This release is greatest in the initial years after the land is flooded. Even after those early years, emissions can continue to be greater than would have occurred if the reservoir had never been created.

When scientists and environmentalists first focused on this phenomenon, there was considerable debate and some uncertainty about the total lifecycle global warming impacts of new, large hydroelectric projects. There were even suggestions that some hydro projects could have higher emissions than some fossil-fuel generating stations. That led to many scientific studies of particular reservoirs and of the general phenomenon.

This year, two comprehensive, peer-reviewed scientific reports have summarized what is currently known: the Intergovernmental Panel on Climate Change reviewed the environmental impacts of hydroelectric projects as part of a *Special Report on Renewable Energy Sources and Climate Change Mitigation* and an international team of researchers surveyed the various studies of carbon emissions from hydroelectric reservoirs.[26] Here are key points from these documents:

[26] Arun Kumar et al., "Hydropower," in *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation* (Cambridge: Cambridge University Press, 2011), available at http://srren.ipcc-wg3.de; and Nathan Barros et al., "Carbon Emission from Hydroelectric Reservoirs Linked to Reservoir Age and Latitude," *Nature Geoscience* (September 2011), pp. 593-596.

- The Intergovernmental Panel on Climate Change has concluded that “lifecycle assessments indicate [hydropower has] very low carbon emissions.”[27]

- The emissions from reservoirs in northern latitudes are much lower than those in the tropics.[28]

- Emissions are greatest in the first several years after a new reservoir is created. They fall rapidly and tend to reach equilibrium at a very low level after 10-15 years. This means that hydroelectric power from older facilities or run-of-the-river generating stations is proportionately responsible for fewer emissions than power from new dams.

- There is variation between hydroelectric facilities in their lifecycle emissions, mostly connected to the amount and type of land inundated to create a reservoir. The poorer performing projects have a low ratio of electricity generated to amount of land inundated. But a more typical hydroelectric project does much better than even the most efficient fossil fuel plant in terms of greenhouse gas emissions.

Scientists connected to Hydro-Quebec have studied the emissions from some of the hydro reservoirs in Canada. Their data appears to be credible and generally in line with that collected by other researchers in comparable locations elsewhere. A recent study by them of Eastman 1 Reservoir in Quebec compared its emissions to those from a natural gas combined-cycle power plant. It showed much higher emissions for the hydro project in the first year but less than one-quarter of the emissions by the tenth year. It took about five years for the accumulated carbon emissions from the hydro project to fall below the accumulated emissions from a natural gas plant.[29]

It is also worth keeping in mind that no generating source, no matter how clean, is entirely emissions-free over its entire lifecycle. In the case of solar and wind, for example, there are emissions associated with manufacturing and installing the solar panels and wind turbines.

Improve air quality. Unlike climate change, which is a global problem, Vermont’s concern with air quality is primarily a local matter. Switching away from burning fossil fuels can be an important way to improve air quality. The Vermont legislature, through its renewable energy goals (30 V.S.A. 8001) has identified protecting air and water quality through renewable energy programs as one of its goals.

If this is the state’s priority goal, it implies:

- Having an RPS that encourages the use of non-combustion technologies (e.g., hydro, wind, solar) regardless of the size or location of renewable energy projects.

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[27] Kumar, “Hydropower,” p. 5.
[28] Barros, “Carbon Emissions,” p. 594.
[29] Alain Tremblay et al., “Net Greehouse Gas Emissions at Eastman 1 Reservoir, Quebec, Canada,” Paper presented at the World Energy Congress, Montreal, September 12-16, 2010. Available at http://www.hydroforthefuture.com/docs/sizes/4cb733c207f1b/source/Tremblay_WEC-2010_FINAL-ANG_08-09-14-_2.pdf .

Factors to consider:

- It is important to be specific about the reasons for concern about air quality. Are there specific existing electricity-generation facilities that are causing air quality problems for people in Vermont? Is the primary concern that an increase in electricity use in the future will lead to the construction of more fossil fuel plants (likely natural gas) that will cause a decline in air quality? Is an RPS the most efficient way to address concerns about air quality? For example, will an RPS lead to retirement of the specific existing facilities that are perceived to be a problem and will the cost of achieving that be worth the benefit?
- The use of wood-burning technologies will not lead to significant improvements in air quality, although they may also not cause a significant decline in air quality. It depends upon the specific technologies that would be used and what they would displace. If air quality is a priority and biomass facilities are included in the RPS, there should be some restrictions on air pollution emission levels from wood-burning power plants.

Improve water quality, reduce water use, and/or protect fish habitat. This is comparable to improving air quality in that it is primarily a local issue that has been identified as important by the Vermont legislature. Here too switching away from fossil fuels can be beneficial. In this case, moving away from nuclear power can also be beneficial. But not all renewable energy technologies are equally benign in terms of their water impacts.

Although fossil fuels cause significant water pollution from oil spills and mining operations, there are few water pollution impacts from fossil fuel electricity generating facilities in Vermont. Instead, the bigger water-related problems from fossil fuels—as well as from nuclear power—relate to the use of water to deal with the heat produced by the electricity-generating process. A coal or nuclear plant, for example, may require between 20 and 60 gallons of water for every kilowatt hour of electricity it produces.[30] Even though that water is usually returned to the body of water from which it is taken, it is now warmer. Changing the temperature of a river or lake can disrupt its aquatic ecosystem. Moreover, the process of taking in and discharging water at a power plant can trap and kill fish and fish larvae.[31] Also, recent events in Vermont confirm that nuclear facilities can result in groundwater pollution and related surface water pollution from migration of hazardous substances.

Renewable energy technologies vary in their water impacts. During operation, photovoltaic and wind installations do not use or pollute water (although initial construction of wind facilities on ridgelines can result in stormwater runoff concerns), while large biomass power plants use technologies comparable to a coal or natural gas power plant and have a similar need of water for cooling. By definition, hydroelectric facilities require water and, depending upon the facility, the impact on both aquatic ecosystems and surrounding land can be quite significant or modest.

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[30] US Department of Energy, *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water* (Washington: Department of Energy, 2006). Available at http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf.

[31] For more on the relationship between electricity generation and water, see several linked pages on the Union of Concerned Scientists' webpage, starting with http://www.ucsusa.org/clean_energy/technology_and_impacts/impacts/energy-and-water.html.

While it is unlikely that large new hydroelectric facilities would or could be constructed in Vermont, there is the potential for some small facilities. In the case of existing facilities, there are several possible alternative futures, including retirement and upgrading with more efficient equipment.

If protecting Vermont's water quality, water supply and aquatic ecosystems is the state's top priority, it implies:

- Having an RPS that allows for and encourages out-of-state renewable energy development, since usually that would not have any negative impacts on water in the state.
- When it comes to in-state renewables development, giving some priority to solar and wind, and having strong rules on the water-related impacts of biomass and hydro facilities.

Factors to consider;

- In recent years, some environmental organizations have called for the removal of certain dams in order to protect fish habitat They have called for restrictions on further small hydro projects. Other environmental organizations have been more accepting of additional hydro development. And Vermont's Agency of Natural Resources has long addressed concerns with the effects on hydropower dams on fish habitat and river health.
- It is very site specific as to whether an existing dam or a new hydro facility causes environmental damage. This suggests that there is merit in designing an RPS policy that makes eligibility distinctions between facilities in order to weed out the problematic ones and allow the relatively benign ones.
- The Low Impact Hydropower Institute (LIHI) is a non-profit organization that seeks to reduce the environmental impacts of hydropower by evaluating and certifying individual projects. They have high standards and a rigorous methodology. It can be expensive for a small facility to get certified. State policymakers may not want to give a role to LIHI certification in an RPS, because that could, in effect, involve turning over some of the state's regulatory role to a private organization.
- There are situations in which the continued operation of a hydroelectric facility can be beneficial, because the owner of the dam can then afford to pay for the maintenance of that dam, which may be important for flood control, recreational use, or another purpose.

Preserve traditional land use patterns, natural resource areas, and the appearance of the Vermont landscape. This is a priority for many Vermont citizens and is embedded in various state policies and programs (e.g. Act 250). The most obvious, but not only, ways in which renewable energy development could affect natural resource areas and the landscape is through location of large wind farms on ridgelines and of large solar arrays on rural lands

If this is the state's priority goal, it implies:

- Having an RPS that discourages, or at least does not give a strong preference to the development of large wind projects in-state.
- In terms of wind development, the RPS should favor small in-state projects and/or out-of-state projects.

- The RPS should have biomass rules that help protect and ensure sustainable yields from forests.
- Providing meaningful incentives for the installation and ongoing use of farm methane digesters to help preserve and increase the economic viability of farms.
- Ensuring location of large solar arrays is consistent with traditional rural land uses and does not significantly reduce the agricultural potential of primary agricultural soils.

Factors to consider:

- Although the design of the state's RPS can have an impact on the development of large, in-state wind farms, the most important way to protect natural resource areas and the rural landscape from inappropriate wind development is through the state PSB permitting process and clear municipal plans that address wind siting. After all, whether or not there is a Vermont RPS, a large wind farm could be proposed to meet an RPS of another state.
- Effective biomass regulations under an RPS can help protect the health of forests. In part, this suggests that there might be rules on how RPS-eligible biomass is harvested. Beyond that, it is worth keeping in mind that, because 83% of Vermont's forest is in private hands, it is desirable to give forest owners reasons to preserve their land as forest rather than selling it off for development. The use of wood for energy, responsibly harvested, can provide an important income stream to forest owners who seek to preserve their forests.
- As the cost of energy from solar power declines, the possibility of very large solar-powered generation facilities becomes more real. Although small rooftop or stand-alone solar installations are unlikely to be controversial, Vermont should consider whether large solar facilities in rural locations represent an appealing addition or a threat to the rural landscape. An RPS should be designed accordingly.

3. Economic Goals

An RPS can aim to achieve broad-based economic development, as well as have more narrowly focused economic objectives. Among the possibilities are:

a. Maximize the number of VT organizations and residents who can deploy and benefit from distributed clean energy installations
b. Provide economic benefits to particular industries or sectors of the economy
c. Maximize the economic benefits of renewable energy development for the state

Maximize the number of VT organizations and residents who can deploy and benefit from distributed clean energy installations. A state can decide that it wants its residents, businesses, and institutions to be able to benefit from installing renewable energy. This can be done as a response to those organizations and individuals' expressed desire to help move society towards clean energy or based on a calculation that it would be good for electricity users to have the opportunity to lock in long-term energy costs and ultimately save money from installing renewable energy systems. For example, having lower, more predictable energy costs could make some businesses more competitive and feel more secure.

If this is the state's priority goal, it implies:

- Structuring the RPS in a way that emphasizes customer-sited distributed systems within Vermont, regardless of the technology.

Factors to consider:

- Distributed, customer-sited systems usually produce power at a higher cost per kilowatt-hour than larger power plants. That means that an emphasis on distributed generation does not maximize the quantity or minimize the cost of the renewable energy that gets produced.

Provide economic benefits to particular industries or sectors of the economy. A state may conclude that a specific industry is so important to its future well-being that it deserves special consideration in the design of its RPS. The Maryland RPS, for example, includes poultry litter incineration facilities in its RPS, in part as a way to aid the state's important poultry industry. The Connecticut RPS includes fuel cells powered by natural gas, in part to support the locally based fuel cell companies that make those products.

If this is a priority goal, it implies:

- Structuring the RPS in a way that gives advantage to technologies that are used by or otherwise benefit particular industries or economic sectors that are especially important to the state.

Factors to consider:

- Through the SPEED Standard Offer Program and the Clean Energy Development Fund, Vermont has provided support for farm methane projects that use farm waste, in significant measure to help support agriculture in the state. If the SPEED Standard Offer Program is replaced with an RPS distributed generation tier, the state should consider whether farm methane should be included on favorable terms. Conversely, the state should consider how the use of today's digester technology will affect any possible trend to increase the scale and agricultural product focus of Vermont's farms.

Maximize the economic benefits of renewable energy development for the state. Each state understandably wants to ensure that renewable energy development is carried out in a way that benefits the state economically. The Vermont legislature had this in mind when it wrote the first of its renewable energy goals: "Balancing the benefits, lifetime costs, and rates of the state's overall energy portfolio to ensure that to the greatest extent possible the economic benefits of renewable energy in the state flow to the Vermont economy in general, and to the rate paying citizens of the state in particular."

If maximizing economic benefits for the state is a top priority, it implies:

- Choosing RPS design features that will have the most economic benefits rather than those that will have the greatest environmental or energy benefits.
- Determining the specific ways in which Vermont has an economic advantage compared to other states in terms of renewable energy development.
- Directing renewable energy development in-state to the extent that that is economically advantageous.

Factors to consider:

- It is often assumed that creating the largest number of renewable energy jobs in-state is synonymous with maximizing economic benefits for the state. Although local job creation is *one* important measure of economic impact, it is not the only one. Impacts on electricity rates also need to receive close consideration. If it is more expensive to focus on in-state development than to purchase renewable energy from elsewhere, the resulting higher electricity rates could suppress local economic activity sufficiently to eliminate more jobs than are created by the in-state development. Economic analysis, such as that presented in section I of this report, is necessary to determine the economically best course for the state.
- As assessment of likely future electricity prices and the value of the price stabilizing features of renewable energy (see 1b above) should be part of the analysis of the most economically advantageous RPS design for the state.
- It is possible that, if a particular specific segment of the renewable energy industry grows in the region, a disproportionately large number of the jobs will be located in Vermont. It would be useful to identify any segments where that could be the case.

4. Technology Development Goals: Advance Emerging Technologies

A state that is thinking about the long term may conclude that, rather than focus solely on aiding the clean energy technologies that are least expensive, it would be desirable to advance promising emerging technologies. Although emerging technologies may currently be slightly or significantly more expensive, near-term support could help them become cost-competitive in the future.

If it is a priority to use an RPS to advance emerging technologies, it implies:

- Establishing a preference (carve-out or multiplier) within the RPS for the specific technology or technologies that the state wishes to aid.

Factors to consider:

- An RPS is a weak policy mechanism for aiding technologies that are still in the experimental or beta-testing stage. Direct support for research and development through a clean energy fund or economic development agency can be better targeted and be more efficient for early-stage technologies.
- The further a technology is from being widely commercialized, the harder it is to structure an RPS that will provide useful assistance at a reasonable cost. On the other hand, an RPS carve-out can work, as long as the technology is commercially available and there is evidence that there will be sufficient supply to meet the carve-out. Carve-outs and multipliers for solar have been used successfully in several states. A multiplier is the least risky approach but it has other disadvantages (see section H6 below for more on preferences).

5. Administrative and Political Goals

When setting up an RPS, a state can have goals beyond the ones already discussed. These can include:

a. Minimize administrative costs.
b. Build public support for renewable energy.
c. Make the state a visible leader in renewable energy.

Minimize administrative costs and complexity. A state may choose to make this goal a priority, either because of a general desire to reduce the administrative costs of state government or because there will be limited resources available for administering an RPS.

If this is a priority for Vermont, it implies:

- Keeping the RPS simple, with the fewest number of carve-outs, multipliers, and special features necessary to accomplish the RPS's other goals.
- Having clear-cut eligibility rules that are not subject to varying interpretations and do not require the PSB to certify or review whether individual facilities meet the qualifying standards for the RPS.

Build public support for renewable energy. A state may choose to design its RPS explicitly in a way that will ensure strong and increasing public support for renewable energy policy in the future.

If this is a priority for Vermont, it implies:

- Focusing on those technologies and types of projects that are most popular with Vermonters, while avoiding those projects that are perceived to be problematic (even if policymakers think they are beneficial).
- Focusing on technologies, such as solar, that all Vermonters can install.
- Making sure that the RPS will be perceived to be a success. This means having targets that are ambitious enough to be perceived to be meaningful, but not so aggressive that the state will fall short or that Vermonters will conclude that it costs too much for the state to support renewable energy through an RPS.

Factors to consider:

- The most aggressive or most cost-effective RPS will not necessary lead to the most renewable energy generation in the long run. A popular RPS that does not seem too costly and does not lead to controversial projects could lay the groundwork for stronger action in the future.

Make the state a visible leader in renewable energy. Vermont is rightly proud of the leadership role it has taken on many environmental and other social issues. The state may choose to use the establishment of an RPS to play a leadership role in advancing renewable energy and to provide concrete evidence to other states that Vermont is a leader.

If this is a priority, it implies:

- Either being more aggressive than other states, pioneering novel RPS design features that others states could emulate, or emphasizing public benefits that benefit the broader society rather than Vermont's narrow economic interests.

Factors to consider:

- The many other states with RPSs have had the opportunity to try out a wide range of different RPS designs. It could therefore be hard for Vermont to move into a leadership position without making the RPS expensive or experimenting with novel features that could make the RPS difficult to administer or might not accomplish their objectives. Among the more realistic ways in which Vermont might be able take a leadership role are:
  - Select a more aggressive long-term goal than other states, but without ramping up towards that goal so quickly that the RPS becomes a burden for the state. This would build on the fact that Vermont utilities already have considerable renewable energy under contract. The legislature appears to have considered this possibility, since it asked the PSB to estimate the costs and benefits of an RPS at both 75% and 100% of the total electricity load.
  - Direct and authorize the state's utilities to work with other utilities across the region to coordinate procurement of significant aggregated amounts of solar or offshore wind, for example, in order to advance significant demand needed to reduce the cost of these currently higher priced technologies
  - As noted in section E8 above, one of the weaknesses of the RPS as a policy mechanism is that it does not necessarily help projects to secure long-term financing and long-term contracts. Because Vermont's utilities remain vertically integrated, the state is in a better position than many other states to address long-term financing and long-term contracts. Vermont could therefore decide to become a leader in providing projects with the total package of incentives and help they need to make it to the finish line.
  - Rather than focus only on the RPS, the state could put together the best coordinated package of several policies to support renewable energy. This would build on the other renewable energy policies the state already has in place.

H. Analysis of Program Design Options

This section of the report identifies and describes major RPS design elements and practices that Vermont can consider if it decides to adopt an RPS. The section sets out the options open to Vermont, as well as the advantages and disadvantages of each option for Vermont. The design elements covered are:

1. Use of tradable Renewable Energy Certificates (RECs)
2. Size and timing of targets
3. Geographic eligibility and deliverability
4. Resource eligibility
5. Vintage eligibility
6. Preference mechanisms (carve-outs and multipliers)
7. Including energy efficiency in an RPS
8. Participation of some or all load-serving entities in the RPS
9. Reverse auctions
10. Mechanisms to limit ratepayer costs
11. Flexibility mechanisms
12. Contracting and financing
13. The central procurement approach

1. Use of Tradable Renewable Energy Certificates (RECs)

When considering the design of a possible RPS, the issue for Vermont is not whether there will be renewable energy certificates, but rather what their role would be and whether they would be able to be traded independently from the electricity to which they are connected.

Within the New England Power Pool (NEPOOL), there is a Generation Information System (GIS) that keeps track of all the electricity that is generated within the region. Every time a MWh of electricity is generated and registered with NEPOOL, an electronic GIS Certificate is created. NEPOOL does this for all generation, whether or not it qualifies for an RPS. But when it does qualify for an RPS, NEPOOL notes that and keeps track of the information. These RPS-related GIS certificates are called RECs. To ensure that an individual REC is not counted more than once, an entity that wishes to use it, retires it within the NEPOOL GIS; it can no longer be traded, sold or otherwise used. (The process of creating and keeping track of GIS Certificates is described in greater detail in section J below.)

Vermont has three main options related to RECs: (1) not require the retirement of RECs, (2) allow electricity and RECs to be sold separately but require RECs to be retired, and (3) require utilities to purchase electricity and RECs together (bundled).

REC retirement not required. This is the current approach Vermont takes with the SPEED Program and if the state wishes to continue this approach, it should retain the SPEED program and not transition to an RPS. Because RECs have become the common currency for renewable energy generation, there is not a feasible way to establish an RPS without including the tracking and retirement of RECs. The advantages and disadvantages of the current SPEED approach, which does not require REC retirement, are described above in section D.

Allow RECs and electricity to be sold separately. With this approach, utilities would be required to purchase and retire an appropriate number of RECs in order to meet their RPS obligations. They would be able to get those RECs through the REC marketplace from facilities other than the ones with which they have electricity contracts. This is the approach used by the vast majority of states that have RPSs.

Advantages of this approach:

- As noted in section E6 above, the experiences of other states with RPSs suggests that the use of tradable RECs has many advantages (refer to section E6 for those advantages).
- Keeping the sale of RECs separate from the sale of electricity increases the efficiency of the marketplace for renewable energy and reduces the cost of RPS compliance.
- Because of the existence of the NEPOOL GIS, it would not be administratively burdensome for either the PSB or for Vermont utilities to allow RECs to be sold independently from electricity. The RECs could be tracked easily.

Disadvantages of this approach:

- It can be confusing for people not involved with the creation, trading, and retirement of RECs to understand how the REC trading system works and why it is desirable.
- Vermont utilities may end up purchasing RECs from facilities with which they do not have contracts for power. That could be confusing for the public and would create a more complicated relationship between the utilities and renewable energy facilities.

Require electricity and RECs to be sold together. A few states require electricity and RECs to be bundled together. It is a straight-forward approach—easy to explain and easy to understand. Each utility would be required to have contracts with a sufficient number of renewable energy generators to purchase the right quantity of renewably generated electricity and RECs to meet its RPS obligation.

Advantages of this approach:

- It is simple and clean.
- Utilities and the state would easily be able to identify the specific facilities that are under contract to provide renewable energy to meet the RPS targets.

Disadvantages of this approach:

- This would make the cost of RPS compliance greater than with an approach where electricity and RECs are sold separately.
- It would be difficult for utilities to contract for exactly the right quantity of renewable energy. At the end of the year, they would likely end up with contracts for too much or too little renewable energy, and it would be hard for them to rectify the situation. That would increase the cost of RPS compliance.
- Without an independent market where RECs can be traded efficiently, the average price that utilities would have to pay for RECs would likely be higher.
- Utilities would not be able to purchase RECs from facilities that are connected to the ISO-NE system but whose electricity cannot be easily delivered into Vermont.

2. Size and Timing of Targets

The size and timing of targets for an RPS are probably the most important variables in RPS design. Will the renewables requirement go up 1% a year or 2% a year? Will the end goal be 25% or 75% renewables?

If the final target or the speed of reaching it is too modest, an RPS will appear be a meaningless policy that is not worth the time and effort to administer it. But if the target is too ambitious, the cost of the RPS can rise dramatically. Moreover, if there are regular shortfalls in RPS-eligible supply so that utilities fall short in meeting their obligations, the public will perceive the RPS to be a failure. To retain the RPS program, it will then be necessary for administrators to engage in time-consuming and disruptive revisions.

To illustrate the way in which unrealistically ambitious targets can lead to greatly increased costs for an RPS, consider these two scenarios:

1. In the first, a state establishes targets based on accurate projections of how much renewable energy can and will come online. During the fifth year of the RPS, 40,000 megawatts-hours of additional renewable electricity are needed to meet the target for that year. Because the projects being developed require a $30 per megawatt-hour RPS subsidy in order to be constructed, that is the price at which RECs are sold. The cost for the additional renewable generation that is added to the system in that year is therefore $1.2 million.
2. In the second scenario, the state establishes a target that requires 60,000 additional megawatt-hours of renewable electricity during the fifth year. Because of limitations on the speed at which projects can be developed, only 40,000 megawatt-hours ends up being added to the system. There is now a shortage of RECs to meet the 60,000 MWH requirements. The excess demand and short supply creates a competition in which buyers bid up the price for RECs to $50. Although the sellers only need $30 to develop their projects, they are able to ask for and receive the higher price. The total cost of the RPS for the additional generation added in that year is therefore $2 million, even though no more renewable energy is produced than in the first scenario. Moreover, the negative financial consequences of the shortfall in supply would not end there: projects built during the first four years of the RPS continue to sell their RECs into the market and they could now ask for additional money because the market price is $50. That means that the projects from the first four years may receive unnecessarily high payments, thereby further increasing the total cost of the RPS.

Because the RPS operates on market principles, some fluctuation in REC prices is to be expected and is not a cause of alarm. But the ideal is for the variations in price to be within a relatively narrow band on either side of the actual premium price that renewable energy facilities need to be built and to remain operating.

Although it is impossible to predict the future with total accuracy, the best way to determine the size and timing of RPS targets is to collect relevant data, conduct detailed analysis, and then choose targets realistically based on that data and analysis.

3. Geographic Eligibility and Energy Delivery Requirements

Although it is possible to design an RPS that allows the use of tradable RECs from any facility anywhere in the country, most RPSs limit qualifying facilities to those whose electricity is actually delivered to the RPS state or region. In the Northeast, the states with an RPS generally require that eligible systems be located within the region (either NEPOOL, PJM Interconnection,[32], or New York) or that energy from eligible systems be delivered into the region.

Specifically, Connecticut, Massachusetts, New Hampshire, and Rhode Island, all of which are served by ISO-New England, qualify those generators that are located in a control area adjacent to NEPOOL, as long as they deliver electricity into NEPOOL. Delaware, Maine, Maryland, and New Jersey do not restrict generators to an adjacent control area as long as energy is delivered to the state's regional control area.

Looking outside the Northeast, several states give preference to in-state generation. For example:

- Colorado has no restriction on generator location but provides credit multipliers for in-state projects.[33]
- Illinois requires in-state resources unless insufficient cost-effective resources are available. In that case, obligated entities may procure from adjoining states. If there are still insufficient cost-effective resources, they may procure from other regions. After 2011, however, equal preference will be given to in-state and adjoining states.
- North Carolina allows up to 25% of compliance with the RPS to be met with unbundled RECs from outside the state but the remainder must be from facilities located in-state or from facilities that deliver energy into the state.

It is common that states require customer-sited systems to be located within the state. This tends to be the case if the state has a separate RPS tier that focuses on customer-sited solar or distributed generation. For example, in Massachusetts, starting in 2010, retail suppliers were required to provide a portion of the required renewable energy under the Class I Standard from qualified in-state, interconnected solar facilities. Qualifying solar facilities are those up to 6 MW (direct current DC) that have become operational after December 31, 2007.

Advantages of geographic restrictions:

- A geographic restriction that requires energy delivery to a broad regional control area guarantees that the renewable power will replace some other generation in the region. To the extent that polluting fossil-fired generators are displaced, air quality in the broader region, including the state, will be improved. The jobs and economic activity associated with the generation will be focused on the region.
- Narrower state-focused restrictions provide support to local generation, focus the economic and environmental benefits on the state, and ensure that there will be visible evidence to the public of renewable energy.

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[32] PJM is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

[33] See section H6 below for a discussion of credit multipliers.

Disadvantages of geographic restrictions:

- By definition, limiting the location of eligible generators to certain geographic areas constrains where renewable energy gets developed and this can make it more difficult for a sufficient quantity of renewable energy to be installed quickly. Where the eligible region is large, such as all of New England plus adjoining areas, this may not be a significant constraint. But even in a geographically large area, there can be problems if the cumulative RPS demand in states within the region is high relative to available supply.
- As with any other design feature that limits the options for renewable energy development, the potential competition to supply renewable energy supply is reduced and the cost of compliance with the RPS can increase.
- A requirement or preference for in-state projects can conflict with the Commerce Clause of the US Constitution and lead to a legal challenge by an aggrieved party. (See sidebar on the Commerce Clause below.)

Factors to consider:

- Energy delivery requirements should be designed carefully to avoid hindering the market for renewable energy. When energy delivery is required to a state or region, it usually follows the applicable rules of the region's Independent System Operator (ISOs). For example, NEPOOL requires any generators importing energy into its system to schedule generation for each hour in day-ahead or real-time markets, and to meet those schedules as closely as possible. That is necessary for grid operators to control the system and match supply with demand. So when a state program requires energy delivery to an ISO such as NEPOOL, even without mentioning hourly matching, hourly matching is often a *de facto* result unless the state specifies otherwise.[34] The effect of these specific energy delivery requirements is particularly challenging for intermittent resources, such as wind and utility-scale solar, which are more difficult to schedule. The GIS, for example, will issue certificates for imports that are the lesser of scheduled energy delivery and the actual delivery. If a wind generator produces less than scheduled, it (or the importer) will receive certificates equal to actual generation delivered; if the generator produces more than scheduled, it will receive certificates equal to the scheduled delivery.

[34] The NEPOOL GIS tracking certificate tracking system hardwires this requirement into its operating rules, requiring evidence of a transmission reservation, a NERC tag, proof of generation, and settling the energy in the importing ISO.

Implications of the Commerce Clause for RPS Design

When establishing an RPS, a state often wants to accomplish economic development objectives, including building an in-state renewable energy industry. The Commerce Clause of the United States Constitution, however, prohibits states from taking economic protectionist measures that favor local businesses to the disadvantage of out-of-state competitors. When designing geographic and deliverability requirements for an RPS program, a state should therefore consider the constitutional limitations imposed by the Commerce Clause. Recent analysis performed for the Clean Energy States Alliance provides useful guidance.[35] Here are some of the key points:

First, requirements that a project be located in a state to qualify for the RPS discriminate on their face because they treat in-state and out-of-state projects differently solely for geographic reasons. Such location-based RPS requirements can avoid invalidation under the Commerce Clause *only* if the state can show that there are no other options available to achieve legitimate state goals.

As an alternative to an in-state location requirement, in some situations states can use *a neutral, in-state deliverability* or other functional eligibility requirement. For example, a state may argue that there is a legitimate reason for an in-state deliverability requirement because it ensures that "dirtier" generation within the region will be displaced. That is, to the extent that fossil-fired generators are displaced, the delivery requirement will improve air quality both locally and in the broader region and contribute to regional development. Without such a delivery requirement, there would be no certainty of local or even regional economic and environmental benefits. But where neutral alternatives are available to meet the state's legitimate objective, a location-based RPS violates the Commerce Clause.

Second, RPS statutes with functional eligibility requirements, such as in-state deliverability, interconnection or consumption, are facially neutral because any company, whether in or out of a state, can meet those requirements. While an out-of-state developer may face added costs to connect to an in-state distribution facility, the costs are a product of a project's distance to distribution facilities rather than geographic boundaries. Moreover, the added costs are not discriminatory; an in-state project located in a remote or transmission-constrained portion of a large state might also face increased costs in meeting an in-state deliverability or distribution requirement. It is generally believed by legal experts that in-state and regional delivery requirements will survive Commerce Clause review, while geographic or location-based requirements are vulnerable to legal challenges.

Third, location-based eligibility requirements for DG or solar carve-outs may raise Commerce Clause concerns. However, to reduce Commerce Clause challenges, a state can impose functional eligibility requirements, such as in-state deliverability or power displacement, which may accomplish nearly the same results as location requirements for DG. As a practical matter, the vast majority of DG or solar projects that are capable of meeting RPS functionality requirements will also be located in-state.

[35] Carolyn Elefant and Edward A. Holt, *The Commerce Clause and Implications for Renewable Portfolio Standard Programs* (Montpelier, Clean Energy States Alliance, 2011). Available at http://www.cleanenergystates.org/projects/state-federal-rps-collaborative/rps-resource-library/resource/cesa-report-the-commerce-clause-and-implications-for-state-renewable-portfolio-standard-programs-pdf.

Moreover, DG or solar carve-outs generally impose minimal burdens on commerce since they comprise only a small percentage of a utility's RPS obligation. The minimal burdens to commerce are further offset by states' compelling interest in DG as a way to meet certain legitimate state goals, such as improved reliability, diversity of supply, and avoidance of new transmission. Without DG carve-outs, a state has few alternatives to ensure that utilities will use DG or solar resources to comply with the RPS because utilities are more inclined to favor larger or lower-cost renewable projects to meet their RPS obligations. Given the minimal burden to commerce occasioned by carve-outs, strong state interest, and lack of alternatives to achieve legitimate state goals, functional-based eligibility requirements for DG carve-outs will likely pass muster under the Commerce Clause.

4. Resource Eligibility

Any RPS needs to decide which renewable energy resources will qualify for it in terms of energy source (e.g., biomass, solar), specific technologies (e.g., biomass gasification, photovoltaic), size (e.g., facilities less than 200 MW), and type (e.g., distributed generation). The best way for a state to select which resources to make eligible for its RPS is to take a step-by-step approach:

1. Decide on the primary goals for the RPS and the relative priority of those goals.

2. Create a matrix in which the resources that match each goal are listed, as well as the relative importance for each of those resources for the goal. (For example, as shown in section G2 above, if addressing global warming is selected as a priority goal, both wind and biomass may be listed as appropriate technologies, but wind would rank higher.)

3. Decide which resources should be included in the RPS.

4. Project the likely resource mix that will occur if all the eligible resources are allowed to compete equally in a single tier RPS. Those projections should be made based on solid data.

5. Analyze the projected results to determine whether the anticipated results would actually achieve the RPS's primary goals. (For example, if the even-playing-field, single-tier RPS would likely be met 50% by hydro but only 10% by wind and virtually no solar, would that be a satisfactory result?)

6. Adjust the list of qualifying resources or introduce preference mechanisms (see section H6 below) into the RPS, if necessary.

In Vermont's case, the legislature made a careful determination of eligible resources when establishing the SPEED Program. That list of resources could be an appropriate one for an RPS. All things being equal, it would good to have continuity in resources from the SPEED Program to the RPS. Nevertheless, should Vermont decide to adopt an RPS, it would be good to go through the exercise above to make sure that the SPEED resources are indeed the ideal ones for Vermont and to determine whether any preference mechanisms should be included to address likely results that would be less than optimal. It would also be good to consider some resources that may not have gotten attention when the SPEED Program was established. For example, to the extent that distributed generation is a priority, it might be good to consider including fuel cells powered by natural gas.

Beyond the big picture question of which resources should be eligible for the RPS, there is the more technical, but still quite important issue of how exactly those resources get defined. When the definitions are poorly crafted or imprecise, it can lead to confusion, unintended consequences, and the need to engage in complicated and time-consuming clarifications. On the other hand, precise definitions ease RPS administration and provide clear guidance for potential project developers.

Although the resources identified by the SPEED Program may be an important starting point for a Vermont RPS, there are ways in which some of the specific definitions used may be problematic.

In 2008, the Clean Energy States Alliance developed a set of model resource definitions. This document is a valuable tool for Vermont if the state adopts an RPS and therefore would need to write resource definitions for it.[36] It is included as an Appendix to this report.

5. Vintage Eligibility

When designing an RPS, a state needs to determine whether there will be a cutoff date for the age of renewable energy facilities that qualify for the RPS, and if there is such a cutoff what it should be. Most states' RPSs include a cutoff date, because they want their RPS to focus explicitly on stimulating new renewables rather than supporting existing facilities. As noted in section G1 above, some states have tried to use an RPS to protect endangered older facilities, but, as discussed there, making all older facilities eligible for an RPS is an inefficient and often ineffective policy mechanism for accomplishing that goal.

Assuming that Vermont would want to have a cutoff date for an RPS, with projects that went online before that date not eligible, there are two logical cutoff dates for Vermont to consider:

January 1, 2005. This is the eligibility date for Vermont's SPEED Program.

Advantages of this approach for Vermont:

- By using the SPEED date, it would make the transition from SPEED to an RPS smoother and more complete.
- Utilities that have contracts to purchase RECs from a SPEED facility, but have been selling those RECs for another state's RPS, would now be able to retain those RECs for use in Vermont. This could make RPS compliance easier for the utilities. (Even though the RECs would be used for facilities that are already built, it would still lead to the

[36] The "Model Resource Eligibility Definitions" were included as Appendix B in Edward A. Holt, *CESA State RPS Policy Report: Increasing Coordination and Uniformity among State Renewable Portfolio Standards,* (Montpelier: Clean Energy States Alliance, 2008). Available at http://www.cleanenergystates.org/assets/Uploads/Resources-pre-8-16/CESA-Holt-RPS-policy-report-dec2008.pdf.

construction of additional renewables in the region. The RECs that are no longer being sold in another state would leave a REC shortage in that state, stimulating the development of additional renewables to meet the shortage.)
- 2005 is coincidentally the cut-off date for the RPSs in Maine and New Hampshire. If Vermont uses the same date, it would make REC trading between those states easier and the cost of RPS compliance smaller for some generators.

Disadvantages of this approach:
- Starting with a date in the past, means that some of Vermont's RPS funding would go to projects that are already built that are already receiving sufficient support through the RPS of another state and likely do not need that additional support. (On the other hand, it is important to note that just making those projects eligible for the Vermont RPS does not necessarily give them additional support. The amount of support may remain the same, with only the state that is the source of that support changing.)

The first year of RPS compliance. If hypothetically the first year in which Vermont utilities need to meet an RPS target is 2013, then the cutoff date for a project to qualify for the RPS would be January 1, 2013.

Advantages of this approach:
- The RPS would represent a clean start. It would be clear that all the generation that is used to meet the RPS is entirely new generation.

Disadvantages of this approach:
- The status of the SPEED projects constructed between 2005 and the start of the RPS would remain somewhat ambiguous and awkward. As long as the RECs from those projects continue to be used to meet the RPS of another state, Vermont utilities and the state of Vermont would not be able to claim that they are getting or using renewable energy from those facilities. They could only claim that they provided important support that helped to get those facilities built.

6. Preference Mechanisms: Carve-Outs and Multipliers
In order to accomplish goals other than simply maximizing the total quantity of renewable energy generation, a state may choose to give a preference to some technologies or types of projects over others. There are two general ways to accomplish this: carve-outs and multipliers. Each approach has advantages and disadvantages.[37]

Carve-outs (which are also called set-asides) distinguish between different technologies or types of projects, and set different targets for each. To acknowledge that some of the technologies or types of projects will be more expensive than others, any cost control mechanisms, such as alternative compliance payments, are set at different rates for the different technologies or types

[37] Our discussion of carve-outs and multipliers draws on the analysis in Wiser et al., *Supporting Solar Power in Renewable Portfolio Standards*, pp. 6-8.

of projects. They are sometimes placed into different tiers or classes of the RPS, each with its own rules.

A carve-out can be expressed and calculated in a variety of ways: As examples of carve-outs, the Arizona RPS requires that 30% of its RPS in 2025 must be met by distributed generation, the New Jersey RPS mandates that there be 5,316 gigawatts of solar electricity by 2026, and the Connecticut RPS establishes three different classes within the RPS.

Advantages of carve-outs:

- They increase certainty about how much of different types of renewables will be developed. This makes it relatively easy to focus on and achieve specific RPS goals.
- It is possible to calculate the maximum cost to ratepayers of each carve-out.

Disadvantages of carve-outs:

- It is more expensive per megawatt-hour of renewables than letting all technologies and projects compete equally on price.
- Depending upon the technology, a carve-out can be quite expensive in terms of cost per megawatt-hour of electricity produced.
- Compared to a multiplier, it picks winners more directly.
- Because there are multiple targets for different types of renewables, RPS designers are, in effect, making multiple projections about the future. This increases the likelihood that some of the targets will turn out to be either too ambitious or too easily met, and therefore require adjustment over time.
- If the carve-out is established through legislation, it can be difficult to adjust it in response to changing market circumstance.

Credit multipliers assign extra or reduced credit towards meeting the RPS target to different technologies or certain types of projects. A Lawrence Berkeley National Lab report describes how a credit multiplier works: "generation from the designated technologies or applications, although issued one REC for each MWH, may be credited as more than one REC (depending on the multiplier) for RPS compliance purposes."[38] A credit multiplier can also be designed to give less than one REC for RPS compliance purposes for each MWH of production.

Examples of credit multipliers include: Maine offers a 1.5 credit multiplier for eligible community-based projects, Nevada has a 2.4 times multiplier for photovoltaic projects, and Massachusetts' new biomass rules provide biomass facilities that achieve exactly 40% efficiency with one-half the standard RPS credit. Some multipliers can be quite narrowly targeted, such as one in Colorado that gives double credit for projects smaller than 30 MW that are connected to transmission or distribution lines owned by a cooperative or municipal utility.

Advantages of multipliers:

- They allow a state the opportunity to express precisely how much more or less valuable it thinks one technology is than another.

[38] Ibid, p. 6.

- This approach does not pick winners as directly as a carve-out does, since it does not mandate exactly how many megawatts of a particular type of project will be built.
- Unlike a carve-out, a state does not need to set or worry about multiple targets.
- Even if the results are significantly different than expected, a state does not necessarily have to make adjustments or revisions to the RPS targets or rules. It can simply accept the unexpected results.

Disadvantages of multipliers:

- Like other preference mechanisms, including carve-outs, they are more expensive per megawatt-hour of renewables than letting all technologies and projects compete equally on price.
- Compared to a carve-out, the results are less predictable. Depending upon the size of the multiplier, more or less of a technology or project type may be built than the RPS designers anticipate.
- It is impossible to predict the total amount of renewable energy that will be developed, because the total will vary depending upon the number of credit multipliers that are used.
- As projects take advantage of a credit multiplier, the total RPS percentage of electricity generation is reduced.

Some states have combined a carve-out with a credit multiplier for the same technology.

7. Integrating Energy Efficiency into a Renewable Portfolio Standard

Among the states with mandatory RPS policies, four—Hawaii, Nevada, North Carolina, and Ohio—allow demand-side energy efficiency to qualify for a portion of the state RPS requirement, enabling utilities to substitute energy efficiency for renewable energy as a portion of its RPS compliance.

Hawaii, for example, allows up to 50% of the RPS target to be met with energy efficiency, defined as heat-pump water heating, ice storage, ratepayer-funded efficiency programs, and use of waste heat from combined-heat-and-power systems. Nevada allows up to 25% of the RPS target to be meet with energy efficiency, defined as utility-subsidized efficiency measures installed after 2004, and district heating power by geothermal hot water. Energy efficiency receives a multiplier of 1.05 for non-peak savings and 2.0 for peak savings. Utilities can purchase energy savings credits from third parties.

Two other states, Connecticut and Pennsylvania, have a combined RPS/energy efficiency program with separate targets for renewable resources and for other resources, including energy efficiency.

The advantages of integrating energy efficiency into an RPS include:

- From both an economic development and environmental improvement perspective, energy efficiency and renewable energy are both valuable.
- Combining efficiency and renewable energy targets can broaden public support for mandatory targets

- Including efficiency can address concerns that there are not sufficient viable renewable energy projects in a state to make an RPS practical and cost effective.

The disadvantages are:

- Since energy efficiency is generally a lower-cost resource than renewable energy, integrating the two into a single RPS tends to slow the growth of renewable energy unless energy efficiency is placed in a separate tier from renewables and there is a defined minimum renewable energy requirement.
- Renewable energy resources face different and more difficult challenges to deployment than energy efficiency measures, including regulatory and market barriers, high costs, lack of ready financing mechanisms, long pay-back periods, and lack of public understanding. An RPS is a critical tool to support promising renewable energy technologies that might otherwise be shut out of the market because of higher costs and other market barriers. The RPS policy framework is diluted with a competing focus on energy efficiency procurement.
- There are often other well-established and more efficient delivery mechanisms for energy efficiency. In the case of Vermont, Efficiency Vermont is popular and effective. There may not be a compelling reason to replace or supplement it with an efficiency RPS.

8. Participation of some or all load-serving entities in the RPS

When a new RPS is established, there is sometimes a question of whether it should apply to all of the load-serving entities in a state or only to some of them. Absent some especially compelling reason, it generally makes sense to apply an RPS to all suppliers of retail load. As the State-Federal RPS Collaborative explained in its *Recommended Principles and Best Practices for State Renewable Portfolio Standards*, "State RPS program costs should be shared as fairly and as broadly among all ratepayers as possible, as the benefits of increased renewable energy production will accrue to all energy customers and the public at large." The Collaborative enunciated as a recommended principle that "An RPS program should apply to all load serving entities—investor owned, municipal, and electric cooperatives, including suppliers of last resort."[39] Vermont would likely be well-served to use this principle.

Some states have restricted their RPSs to investor-owned utilities. They have either excluded municipal utilities and cooperatives, because those utilities are predominately self-regulated, or given municipal utilities and cooperatives the option to join the RPS voluntarily. The special treatment of municipal utilities has been most frequent in states, such as Massachusetts, with restructured electricity systems where competitive retail supply only applies to the service territory of investor-owned utilities.

Even if an RPS is applied to all utilities, there is the issue of how to treat their existing contracts with renewable energy facilities. In Vermont, there is considerable variation among utilities in terms of the percentage of their load that is supplied by renewable energy. There is also variation in the share of the load that is supplied with electricity from large-scale hydro from Hydro Quebec. In addition, the utilities have not all participated the same way in the voluntary SPEED

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[39] State-Federal RPS Collaborative, *Recommended Principles and Best Practices*, p. 3.

program. And the termination dates of all the utilities' existing and new renewable energy contracts vary significantly.

Although those many differences among Vermont utilities can be identified, it is difficult to answer the question in the abstract of whether the differences should be taken into consideration when applying an RPS to the utilities. The answer needs to be informed by an understanding of the implications of the RPS's specific provisions. For example, the answer might be different if hydro projects over 200 megawatts are included in the RPS than if they are not, and it might be different if older facilities are included in the RPS than if they are not. The specific RPS targets and the timelines for meeting them would also make a difference.

For these reasons, if Vermont chooses to establish an RPS, the state should defer answering the question of how to weigh the utilities' varied existing RPS portfolios until after the basic structure of the RPS is determined—especially the size and timing of targets, geographic eligibility, resource eligibility, and vintage requirements. After those things are decided, the state can assess whether any inequities or unfairness would be created by applying the RPS's targets and requirements equally to all utilities without any special provisions. If it then seems like there would be inequities, specific provisions can be incorporated into the RPS to account for the problems that might be created by the variability in utilities' existing contracts with renewable energy generators. This would likely be a complicated issue requiring careful deliberation.

Factors to consider:

- If tradable RECs are allowed as part of an RPS, a utility will have the option, where appropriate, to retain some or all its existing contracts with electricity generators and simply purchase RECs, but not power, from other facilities. In other words, a utility could continue to receive electricity from older renewable energy generators and Hydro Quebec while still contributing to the development of new renewable energy generation.
- Beyond the issue of how large a share of each utility's load is already being served by renewable energy, it may be relevant to know the price at which power is being sold to a utility under its existing contracts with renewable energy generators. For example, if a utility has a long-term contract to purchase renewably generated power from an old facility at significantly below current market prices, that may not be a sufficient reason to exclude that utility and its ratepayers from sharing fully in the program costs associated with an RPS.

9. Reverse Auctions

A reverse auction is a mechanism to competitively distribute government or utility contracts and subsidies to private entities. In essence, a reverse auction requires private firms to submit bids that stipulate the minimum price or subsidy level that they will accept for an eligible output. The entity tasked with managing the reverse auction – typically a governmental agency – then reviews all bids and accepts the lowest one(s). As a mechanism for procuring renewable energy, the reverse auction approach requires developers to compete against one another on a cost basis. The lowest price bid(s) into the auction, expressed in kWh generated per dollar, would win the auction. One of the benefits of the auction approach is that it helps to ensure that the RPS program deploys as much capacity as possible given any cost caps, increasing the cost effectiveness of the program.

A reverse auction is typically carried out in several steps. First, the purchaser defines the product to be procured with sufficient specificity that developers can compete primarily on the basis of price. Second, the qualifications of potential sellers are evaluated and unqualified ones are screened out of the auction process. Finally, the auction is conducted, often over the internet.

Reverse auctions have been conducted for over 20 years. Several government entities in the US, including the Department of Defense, the Postal Service, and some state governments, have established successful reverse auction programs and used the mechanism to achieve substantial reductions in program costs. Other countries have applied this approach specifically to promote clean energy development. For example, the United Kingdom used a series of reverse auctions in the 1990s to distribute subsidies for non-fossil fuel electricity. The auctions are credited with helping to stimulate significant cost reductions in the renewables sector.

Several state and municipal governments have used reverse auctions to procure electric power supplies, including the state of Connecticut and the cities of Worcester and Springfield, Massachusetts. The State of Minnesota and the Pennsylvania Department of General Services have used the mechanism to procure other products. Finally, power providers have used reverse auctions to procure power supplies for standard offer default services in several states – New Jersey, Pennsylvania, Illinois, Delaware, Connecticut, Ohio, and Maryland.

Recently, the California Public Utilities Commission (CPUC) issued guidelines to establish a reverse auction for small-scale solar power projects (1-20 MW scale). Under the California program, the state's investor-owned utilities will be required to hold biannual auctions for power purchase agreements with small, ready-to-build solar energy projects. The California PUC believes that the approach eliminates any potential conflicts with FERC's exclusive authority to set wholesale power prices under the Federal Power Act and PURPA. According to the CPUC, California's Renewable Auction Mechanism (RAM) "streamlines the procurement process for developers, utilities, and regulators. It allows bidders to set their own price, provides a simple standard contract for each utility, and allows all projects to be submitted to the CPUC."[40]

Design of the California Renewable Auction Mechanism

The primary design elements of the California RAM are:

- Initial authorization to utilities to procure 1000 MW of distributed generation projects of up to 20 MW on the system side of the meter.
- A minimum of two auctions per year per utility.
- Future capacity authorizations will reflect each utility's need for system-side DG under 20 MW.
- Projects must be online within 18 months of contract execution, with one allowable 6-month extension for regulatory delays.
- Development deposits for projects 5 MW and smaller = $20/kW. For larger projects, deposits = $60/kWh for intermittent resources and $90/kWh for baseload resources.

[40] For more information, see the CPUC's webpage on "Renewable Action Mechanism." Available at www.cpuc.ca.gov/PUC/energy/Renewables/hot/Renewable+Auction+Mechanism.htm.

- Performance deposits for projects < 5 MW, with conversion of deposit to performance deposit. For larger projects, performance deposit = 5% of expected total project revenues.
- Bids are selected by least-cost price first until the auction capacity is reached.
- Projects will be compared against similar product type: baseload, peaking, intermittent.
- Price and contract is not negotiable and paid as bid.
- Project eligibility: (a) 100% site control (ownership, lease or option to lease or purchase); (b) development experience by one member of team; (c) commercialized technology; and (d) filed interconnection application.

As with any auction, the design of the reverse auction process is important to ensure that it functions effectively. There are several design elements that are critical to success. First, auction participants should be required to submit bids in the form of a price per kWh which should reflect the price needed to get the project built and that is not negotiable.

Second, regarding eligibility, rules should be established specifying the qualifications needs by bidders to participate in the auction. In addition to minimum project size, bidders can be required to submit a project development plan that demonstrates the ability to meet certain development milestones in a timely fashion. This ensures that auction participants are serious bidders capable of building and operating the proposed projects in a timely and effective manner.

Third, the entity administering the auction should make provisional awards to the lowest priced qualifying bid or bids. The provisional awards represent a binding commitment by the utility but contingent on the bidder meeting the milestones in the project's development proposal.

Fourth, if appropriate, a predetermined cap on the auction price may be established to help ensure that the auctions functions properly.

Finally, the auction administrator may want to develop rules to verify that adequate development progress is made toward the in-service dates and to penalize failure to make adequate progress, including possible loss of any award commitments. These requirements place the uncertainty associated with project compliance and performance on the bidder, where it most appropriately belongs.

Advantages of Reverse Auctions:

- An effective mechanism to maximize output per ratepayer dollar spent to procure renewable energy.
- Fosters private sector competition among renewable resource developers.
- Drives down technology costs.
- In contrast to a fixed incentive price that will either be inefficient (because the incentive is higher than needed) or ineffective (because it is too low to deploy particular renewable resource), a reverse auction allows the level of incentive to reflect the lowest cost renewable projects first, while not paying more than necessary.
- Auction design can minimize underbidding since the price, once accepted, is not negotiable. That is, bidders receive the price they bid, so the bid should reflect the price needed to get the project built.

- Transaction costs are reduced for the developer, utility, and regulator.
- Avoids the risk associated with feed-in-tariffs under Federal Power Act and PURPA.
- Particularly suitable as a procurement tool for system-side renewable distributed generation.
- The regulator and utility can target renewable development in specific locations.
- Setting authorized revenue caps can provide cost containment for ratepayers. Revenue requirement caps can be determined by how much renewable capacity each utility needs within an integrated resource plan, compared to their other renewable procurement strategies.
- Auction rules and design can be readily adjusted based on lessons learned from prior auctions.

Disadvantages of Reverse Auctions:

- An auction requires careful design.
- Tends to favor technologies that represent the least-cost option today, rather than newer technologies that may have the potential to achieve significant performance improvements and cost reductions with economies of scale in the future.
- Large, sophisticated firms may dominate reverse auction markets because of their size and experience.
- Some developers may be discouraged from planning projects or participating in the market because of uncertainty about whether they could win an auction at the price they need to proceed with construction.
- Requires safeguards to ensure that winning projects are actually completed on time.

10. Mechanisms to Limit Ratepayer Costs

Most states with an RPS include at least one mechanism to limit the cost effect of RPS compliance. They use a wide variety of approaches, including annual cost caps on retail rates or utility annual revenue requirements, alternative compliance payments (ACP), a price cap on renewable energy contracts, and use of agency discretion. In addition, a number of states have established *force majeure* mechanisms to allow electricity suppliers to limit their renewable energy purchases if they can demonstrate to regulators that those purchases would unduly raise electricity rates.

In a 2008 report, researchers at LBNL translated the different types of cost caps used by states into the maximum possible incremental retail rate increase caused by RPS policies for the year in which each state;s RPS achieves its highest percentage target. LBNL found that, "though a sizable range exists, the majority of states have capped incremental rate impacts at well below 10%, and in seven states rate impacts are capped at or below 2%."[41]

Alternative Compliance Payment. Many states with RPSs, including the five in New England, primarily rely on an alternative compliance payment. ACP policies generally allow electricity suppliers that cannot meet their RPS obligations by retiring a sufficient number of RECs to

[41] Ryan Wiser and Galen Barbose, *Renewables Portfolio Standards in the United States: A Status Report with Data Through 2007* (Berkeley: Lawrence Berkeley National Laboratory, 2008), p. 30. Available at http://eetd.lbl.gov/ea/ems/reports/lbnl-154e.pdf.

instead make financial payments to meet their obligation. This creates a de facto cost cap. ACPs are distinct from financial penalties as they are considered a lawful form of compliance, and, typically, suppliers are allowed to recover the costs of an ACP from ratepayers.

ACP prices vary by state and are established by statutes or by state regulators. In some states, the legislature has established statutory guidelines for ACPs but allows state regulators to actually set the price through rule-making.

Within New England, Massachusetts, Maine, New Hampshire and Rhode Island all use the same ACP payment levels. Massachusetts first established the ACP level at $50 in 2003 and it has been adjusted upwards annually in line with the Consumer Price Index. The ACP rate is currently $58.58. Having the same ACP in these four states has been beneficial, because the states all procure RECs from the same market. If one state set its ACP lower than the rest, the REC market would be distorted as obligated suppliers in the other states would have to pay more to ensure compliance when supply is short. This would mean that, if REC demand in the region exceeds supply, the state with the lower ACP would be less likely to see its targets met.[42]

When a state has a solar carve-out, it typically establishes a higher ACP rate for the solar carve-out than for general RPS obligations, to reflect the higher cost of solar electricity.[43] Solar ACPs should be set at a level above the expected market price for solar RECs to be effective in achieving set-aside targets. Given the expectation that solar electricity costs will decline in future years, several states, including Maryland and New Jersey, have established schedules of declining solar ACP rates over time. For example, Maryland's current solar ACP is $400 but will decline by $50 every two years. A gradually decreasing solar ACP helps put downward pressure on REC prices and on the cost of solar installation.

Advantages of an ACP:

- Sets an ultimate, clear price ceiling on compliance. The total maximum cost of the RPS can be estimated with reasonable accuracy.
- Used by most of the New England states, leading to less market distortion among the states if they were using different cost containment measures.
- Allows utilities another means to comply with an RPS in addition to REC or renewable generation procurement.
- Serves as an important mechanism for consumer protection where the cost of RECs or renewable generation procurement is unknown or prohibitively high.
- Money collected via an ACP can be used to fund renewable projects, thereby increasing the likelihood that there will be a sufficient supply of renewable generation in future years.
- Eliminates the need to establish or adjudicate enforcement penalties.

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[42] For a discussion of this point, see Edward A. Holt, *CESA State Policy Report: Increasing Coordination and Uniformity Among State Renewable Portfolio Standards* (Montpelier: Clean Energy States Alliance, 2008). Available at http://www.cleanenergystates.org/resource-library/resource/cesa-state-rps-policy-report-increasing-coordination-and-uniformity-among-state-renewable-portfolio-standards.

[43] See Wiser, *Supporting Solar Power in Renewable Portfolio Standards.*

Disadvantages of an ACP:

- The ACP level must be properly set to ensure the integrity of an RPS. If set too low, utility suppliers are discouraged from procuring renewable energy. If set too high, the RPS can become very expensive.
- Unless used to fund renewable projects, ACP payments do not help ensure that the actual goals of the RPS are achieved.
- If different states in a region use different ACP levels, then generators, developers and REC providers will be incentivized to sell their RECs in states with more severe consequences of non-compliance, creating market balkanization.

Rate and Revenue Caps. An RPS rate cap limits RPS compliance expenditures to an amount that raises the rates of different customer classes by a set percentage over a specified time period. An annual rate cap sets the allowable rate increase for a given year. For example, Colorado's RPS authorizes its utilities to collect up to 2% of its customers' bills annually to meet the RPS (1% for cooperatives). New Mexico's rate cap ramps up to 3% of customers' aggregated electric bills through 2015.

In general, states that use rate caps have specified them for the entire RPS policy and include the cost of complying with any solar or DG carve-out. However, the states of Delaware, Maryland, and New Jersey have established retail rate-based cost caps that are specific to their carve-outs and separate from the overall RPS cost caps. Delaware and Maryland have established a 1% cap on retail rates for their solar set-asides, while the New Jersey solar retail cap is 2%.

A related but distinct cost cap mechanism is an annual utility revenue expenditure cap. Several states cap utility expenditures for RPS compliance at a set percentage of a utility's retail revenue requirements.

The most challenging issue related to revenue caps is how to calculate the incremental costs of renewable resources. Ohio, Oregon, Kansas, and Washington all use a revenue cap mechanism that allows utilities to count the levelized annual incremental costs of obtaining eligible renewable resources against the cap. However, each state uses a different approach to calculating those costs. As an example, Washington defines incremental cost as the difference between the cost of the renewable resources and the levelized delivered cost of an equivalent amount of reasonably available substitute non-renewable resources with the same contract length or facility life. Oregon 's law goes further by stating that levelized annual incremental costs should capture the costs of capital, operating, financing, transmission and distribution, ancillary services, and R&D.

In addition to the costs of the renewable generation development, there are additional costs that can be considered to count towards a revenue cap, including costs of RECs, power purchase agreements, and ACPs. States differ on whether these costs count in the cap. For example, Oregon's 4% annual revenue requirement cap includes the costs of RECs and ACPs as well as the incremental levelized costs of developing renewable projects. In Ohio, however, utilities are not allowed to count ACPs toward the cap (or to recover ACPs from ratepayers). Further complicating cost cap decisions, Oregon and Washington provide that only "prudently incurred costs" are recoverable.

Advantages of Cost Caps:

- Limit RPS compliance expenditures.
- Can be a valuable consumer protection mechanism when the cost of RECs or renewable generation procurement is unknown or prohibitively high.

Disadvantages of Cost Caps:

- Can be administratively complicated and burdensome to apply.
- The annual process of determining the cap is time consuming.
- Requires clear rules on what costs of compliance count toward the cap and what are the avoided costs against which the costs of renewables are compared.
- If different states in a region use different types or levels of cost caps, then generator developers and REC providers will be attracted to states with more severe consequences of non-compliance, creating market balkanization.

Cap on Contract Price. Montana and Hawaii use a cost containment limit on a per-contract basis. In both states, utilities may petition the utility commission if they are not able to meet the RPS obligation because contracts for procuring generation or RECs are above the market price for other available resources. For example, in Montana, a utility is not required to take electricity from an eligible renewable resource unless the price premium per kWh is less than or equal to 15% of the cost of power from other alternate available generating resources.

Advantages of Individual Contract Caps:

- Highly cost protective for consumers, limiting the cost of compliance to close to the cost of alternative, non-renewable resources (e.g., natural gas).
- A strong mechanism for consumer protection in situations where the cost of RECs or renewable generation procurement is unknown or prohibitively high.

Disadvantages of Individual Contract Caps:

- Can be administratively burdensome to apply.
- Requires clear rules on what are the avoided costs against which the renewable contract is compared.
- Can significantly limit the ability to achieve RPS targets as the price of renewable are often higher than non-renewable resources.

Regulatory Agency Discretion. In several RPS states, excessive RPS-related costs are controlled by using utility commissions' traditional responsibility and authority to ensure just and reasonable rates. In a regulated state such as Vermont, the public utility commission could readily employ its statutory authority to ensure just and reasonable rates in rate cases and to approve individual utility renewable energy contracts as an alternative to a specifically defined rate cap. RPS states that do not have a defined cap include Iowa, Minnesota, Nevada, and Wisconsin.

Advantages:

- Relies on traditional regulatory and administrative practices of a public utility commission in a regulated state, which are familiar to utilities, stakeholders, and legislators.
- Utilities recover costs that are reasonable and justified to meet the RPS.

- Does not rely on an arbitrary cap but on actual rate impacts and relevant case-specific considerations.

Disadvantages:

- Requires case-by-case decision-making with a degree of uncertainty and risk for utilities and ratepayers.
- Can create a significant regulatory burden.

11. Flexibility Mechanisms

Some states have incorporated flexibility mechanisms into their RPSs to make it easier for obligated entities to meet their RPS obligations, both financially and administratively. The three basic flexibility mechanisms that have been used are REC banking, REC borrowing, and compliance waivers. Because flexibility measures help to smooth out annual fluctuations in REC prices, they can make the implementation of an RPS proceed more smoothly and can decrease the overall cost to ratepayers of renewable energy development.

REC Banking. REC banking allows utilities or other obligated entities to purchase excess RECs during a year when there is a surplus and to use those RECs to meet their RPS obligation in a future year. All of the New England states with RPSs allow REC banking and take a similar approach. RECs purchased to comply with a New England state's class one or "new" RPS requirement can be banked and then used in the subsequent two years. The maximum bankable quantity of RECs is 30% of an entity's current year obligations.

Advantages of REC banking:

- Smooths out year-to-year fluctuations in REC prices by reducing the number of years in which there is a large REC surplus or shortage.
- Would make it easier for Vermont utilities to manage their RPS obligations. They could prepare ahead by purchasing extra RECs if they think that there will be a future year with a shortage of RECs. In addition, they do not have to try to guess the exact number of RECs they will need; they do not waste money if they inadvertently purchase too many RECs, since they can bank the extra.
- Removes a reason for utilities to avoid contracting for RECs.
- Reduces the risk that a renewable energy project will not be able to sell its RECs in a year in which there is a REC surplus or that there will be a REC price crash.
- Reduces the incentive for a developer to delay bringing a project online in a year in which there could be a REC surplus.
- To the extent that REC banking encourages faster development of renewable energy, it provides modest additional environmental and climate change benefits.
- By adopting this approach and using the formula applied in the other New England states, Vermont would harmonize its RPS with those states.

Disadvantages of REC banking:

- Would produce a modest additional administrative tracking burden for the PSB.

- Makes the annual increased renewable energy percentage in the state's RPS plan a less accurate predictor of how much increased renewable energy would actually come online in a given year for Vermont.

REC Borrowing. This is the reverse of REC banking. Utilities or other obligated entities that are unable to purchase a sufficient number of RECs in a given year can defer the shortfall to a future year—usually no later than the second subsequent year. This has some of the same advantages as REC banking but it also has some additional disadvantages. The practice has therefore been less widely adopted by states with RPSs, although some have done so. In the case of Colorado, to anticipate the hiccups associated with a new policy, borrowing has been allowed during the first four years of the RPS but not after that.

REC borrowing benefits utilities and other obligated entities, but provides few advantages to renewable energy developers or generators. From the ratepayer's perspective, it can reduce the overall cost of RPS compliance.

Advantages of REC borrowing:

- Smooths out year-to-year fluctuations in REC prices by reducing the number of years in which there is a large REC surplus or shortage.
- Make it easier for utilities to manage their RPS obligations. If they are unable to find and purchase a sufficient number of RECs in a given year, they can defer their obligation to a future year. In addition, they do not have to worry about paying a penalty or the ACP price if they miscalculate their needs and inadvertently purchase too few RECs.
- Reduces the risk that there will be a REC shortage in a given year and that REC prices will rise to the ACP price or to whatever maximum is set by the state.

Disadvantages of borrowing:

- Would increase the administrative burden for the PSB.
- It can encourage utilities to delay taking action to contract with renewable energy projects.
- It would delay the PSB's ability to deal with a utility that may be ignoring its RPS obligation.
- To the extent that it delays renewable energy projects from coming online, it modestly reduces the environmental benefits of the RPS.
- Makes the annual increased renewable energy percentage in the state's RPS plan a less accurate predictor of how much increased renewable energy will actually come online in a given year for Vermont.

Compliance waivers. This is a different type of flexibility mechanism than either REC banking or borrowing. It allows a utility to request a waiver of its obligation in a particular year because it has been unable to purchase sufficient renewable energy. Many states allow utilities to apply for a compliance waiver.

As with REC borrowing, compliance waivers provide benefits to utilities and other obligated entities, but provide few advantages to renewable energy developers or generators. They reduce the overall cost of RPS compliance.

Advantages of allowing compliance waivers as part of an RPS:

- Reduces the risk that utilities will have to pay high REC prices or ACP payments in a year in which there is a significant shortage of renewable energy generation beyond the utilities' control.
- Can avoid significant increases in REC prices which provide renewable energy generators with much higher price premiums than they need and drive up the cost of the RPS for ratepayers.
- Introduces considerable flexibility into the administration of the RPS, acknowledging the uncertainties associated with attempts to predict the pace of future renewable energy development.

Disadvantages of compliance waivers:

- Makes the RPS seem less predictable, certain, and stable, which can discourage renewable energy developers from proceeding with projects and making it more difficult for them to secure financing.
- Can encourage utilities to focus their attention on securing compliance waivers rather than on procuring renewable energy.
- Could significantly increase the administrative burden for the PSB and involve it in lengthy, acrimonious regulatory proceedings.

Compliance waivers generally work best when the system for administering them is made specific and clear ahead of time. For example, a state can specify exactly when and how a utility can apply for a waiver, and can be explicit about the circumstances under which a waiver may be granted and for how long. But, as a recent report by NREL found, the provisions related to compliance waivers in most of the states that have them:

> tend to be vague as to when and how a waiver is to be granted. For example, the Arizona statute allows a utility to request a waiver from any provision, "for good cause." And in Hawaii, the Public Utilities Commission has, "the option to either grant a waiver from the renewable portfolio standard or an extension for meeting the prescribed standard." Some waivers are based on, "economic and competitive pressure" (Minnesota), or whether renewable resources are, "reasonably available" (Pennsylvania).[44]

12. Contracting and Financing

As noted in section E8 above, a main weakness of some RPSs is that they are not sufficient to lead to the long-term contracts that many renewable energy projects need to receive financing. States have used a variety of approaches to overcome this problem, focusing either on long-term contracts for power or price guarantees for RECs.

It is easier for a regulated market, like Vermont's, to address this problem than a restructured electricity market. The SPEED program has been one attempt to encourage long-term contracts with renewable energy generators, albeit without the purchase of the renewable energy attributes from those facilities.

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[44] Cory and Swezey, *Renewable Portfolio Standards in the States*, p. 15.

Advantages of implementing RPS design features that seek to overcome the financing barriers to renewable energy development include:

- Given that this is the single biggest limitation of an RPS and Vermont is in a good position to address it, it seems desirable for the state to include an appropriate solution(s) in any RPS.
- Because other New England states have restructured electricity markets, Vermont can more easily implement policies that help large-scale wholesale renewable energy projects get financing. This would be a valuable service to the region.

Disadvantages of implementing RPS design features that seek to overcome financing barriers:

- Any additional design features add complexity to an RPS and is accompanied by some administrative burden.

Among the approaches that Vermont could consider taking through an RPS to assist project financing are:

- Combine the features of a mandatory SPEED program with an RPS that requires the purchase and retirement of RECs. What this means is that utilities would not view the purchase of electricity and RECs as two separate transactions with power contracts coming from one set of facilities (often fossil-fuel generators) and RECs coming from a different set of generators. Instead, utilities would be required or encouraged to enter into extended with renewable energy generators in which they purchase the power ***and*** the RECs from those facilities, and then retire an appropriate number of RECs.
    - Of course, requiring this bundling of power and RECs eliminates some of the flexibility associated with the use of RECs and could modestly increase utilities' costs. Therefore, to provide renewable energy facilities with the benefits of long-term contracts while still giving utilities flexibility, Vermont may want to consider a hybrid approach in which utilities are required to meet an RPS partly but not completely with RECs that are bundled with the power from the same generating units.
- Include a requirement that all or some renewable energy power and/or REC contracts be for a specified minimum duration.
- For smaller-scale, distributed generation contracts, include a standard offer REC purchase program. Several states have taken this approach specifically for photovoltaic installations as part of a solar carve-out.
- Require utilities to own certain distributed generation assets.

Although Vermont is in a good position to help solve the long-term contracting problem, it is important to acknowledge that other states in the region understand the importance of the issue and are taking steps to address it. Massachusetts, for example, in 2009 began requiring each of the distribution companies in the state to "conduct at least two separate solicitations for long-term contract proposals from renewable energy developers" and gave them the option of conducting additional solicitations.[45] The distribution companies' obligation is capped at 3% of

[45] Massachusetts DPU Order Adopting Regulations, DPU 08-88-1 Appendix A.

their customers' total energy demand and the companies may receive remuneration equal to 4% of the cost of the contract. In August 2011, for example, NStar entered into long-term contracts with Hoosac Wind in Massachusetts, Groton Wind in New Hampshire, and the Blue Sky East wind project in Maine. Other states will likely increasingly take similar steps.

13. Central Procurement Approach

Central procurement is another approach for addressing contracting and financing while also dealing with other issues related to an RPS. Illinois and New York are the only two states to use this model, in which a procurement agent, rather than individual utilities, is given responsibility for meeting the state's RPS obligation.

In the case of New York, investor-owned utilities collect a surcharge through end-users' electricity bills and turn the money over to NYSERDA. NYSERDA issues periodic RFPs to solicit RECs from new renewable energy projects and enters into long-term contracts with the project developers for those RECs. In addition, NYSERDA uses some of the money for a rebate and grant program for small-scale distributed generation. In the case of Illinois, the Illinois Power Agency (IPA) develops a state-wide RPS compliance and procurement plan, but the individual utilities contract with the bidders who respond to IPA's solicitations.

For Vermont, central procurement would be a parallel and comparable approach for renewables to the one that the state uses with Efficiency Vermont.

Advantages of the central procurement approach:

- It can make it easier for projects to receive financing, because the state would offer guaranteed REC contracts at a pre-determined price for a period of years.
- It can reduce the cost of adding renewable energy to the system. Because project developers receive a guaranteed REC contract for a period of years, they may be willing to accept a lower price for RECs than they would require and receive in an open competitive-market RPS. An evaluation of the New York RPS suggests that this is likely the case, since NYERDA paid much smaller REC prices in the years up to 2009 than were common in the New England states with conventional RPSs.[46] (As a caveat, because of declines in REC prices in New England, the gap between New England and New York REC prices has diminished since 2009.)
- It can be easier to direct RPS support to in-state projects.
- It is easier to include factors other than the price of the RECs in the decision about which projects receive RECs. In New York, projects submit information about the number of jobs they will create in-state and other economic development benefits, and that becomes a factor in determining which projects should receive support through the RPS.

Disadvantages of this approach:

- It makes the state a direct player in the marketplace.

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[46] Liz Hicks et al., *New York Main Tier RPS: Impact and Process Evaluation* (Burlington, Mass.: KEMA Inc., 2009), p. 6-2.

- It would increase the administrative complexity of the RPS for the state, because the state would need to conduct periodic solicitations, review proposals, and enter into contracts. A NYSERDA staff member who works on that state's RPS estimates that Vermont would need 2-3 staff members working full-time to implement the central procurement approach.[47]
- It could be difficult for a small state with a need to purchase a relatively modest number of RECs to identify and contract with the right number and size of projects to meet that need.
- It would prevent Vermont from harmonizing its RPS with those in the other New England states.

[47] Conversation with Kevin Hale, June 21, 2011.

I. Scenarios and Scenario Analysis Results

In its request to the Public Service Board, the Vermont legislature asked for an evaluation of the cost impacts of a wide assortment of potential RPS and SPEED policy options. This section provides a quantitative evaluation of a range of potential RPS and SPEED designs. The primary focus of this analysis is the potential cost implications of such policy options. The market dynamics and economic drivers affecting each policy case have been considered through the construction and operation of a detailed cost modeling tool, which will be provided along with this report. As part of this analysis, the cost of each scenario is compared to a "5% of 2005 Load" Reference Case. A review and discussion of the potential emissions impacts and economic benefits is also provided. The review of benefits or costs related to these secondary issues is based largely on existing data, as the scope, budget and timeframe of this study did not allow for primary research and the consensus-driven modeling approach taken in recent year-long studies[48].

When reviewing the results of this analysis, it is important to keep the following in mind:

1. The percentage targets of the current SPEED program refer to the required percentage of ***new*** renewable energy. By comparison, the percentage targets described by the legislature and used in this analysis refer to the percentage of the ***entire portfolio*** that is to be served by ***both new and existing*** renewable energy.
2. The availability of new renewable energy supply to meet a potential future RPS may vary from the supply curve forecast used in this analysis based on changes in regional RPS regulations, the ability of future projects to successfully identify sites and obtain permits, and other factors.
3. The price of new renewable energy supply may vary from the forecast used in this analysis based on the availability of long-term contracts, the availability and terms of project financing, the dynamics of the global equipment supply chain, and the future wholesale price of energy and capacity in New England.

Before presenting the results, this section explains the cost modeling methodology, describes selected inputs, defines the universe of scenarios considered, and presents several quantitative result metrics for each modeled scenario. The principal variables used in the modeling are:

A. Vermont's renewable energy target as a percentage of the state's total portfolio,
B. The eligibility of renewable energy resources larger than 200 MW,
C. The policy's design as either an RPS- or a SPEED-type program, and
D. The policy's design with respect to distributed resources.

The legislature directed the Public Service Board to evaluate the cost of adopting an RPS or SPEED program at 25%, 50%, 75% and 100%. Based on our discussions with the Board staff and participating stakeholders, this analysis assumes that 25%, 50%, 75% and 100% represent

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[48] For example, Economic & Policy Resources, Inc. et al., *Consensus Economic and Fiscal Impact Analyses Associated with the Future of the Vermont Yankee Power Plant* (Williamstown, VT: Kavet, Rockler & Associates, LLC and Economic & Policy Resources, Inc., 2010).

percentages of Vermont's total electricity demand.[49] All RPS and SPEED policies assessed are assumed to take effect in 2013 and achieve their appointed targets 20 years later, in 2032. While the policy targets are assumed achieved in 20 years, the cost analysis is conducted over a 30-year time horizon, to 2042. This is done in order to account for the fact that facilities coming on-line to meet the final target increases will operate well beyond 2032. Conducting the analysis through 2042 is intended to account for these continuing costs. In other words, ending the analysis at 2032 would underestimate the cost of compliance. Assessing all scenarios on the same timescale is intended to facilitate comparison among the modeled scenarios. Of course, policymakers could choose a longer or shorter time horizon to distribute the program costs over a different period of time.

For RPS and SPEED cost modeling purposes, existing renewable energy supplies are assumed to include two categories of resources: (1) Qualifying SPEED Resources that have a commercial operation date no later than December 31, 2004 and are currently either owned by or under contract to a Vermont utility, and (2) renewable energy resources (with commercial operation on or before December 31, 2004) conveyed from Hydro Quebec in proportion to their contribution to the HQ system mix. When only HQ hydro facilities less than 200 MW are included, these two categories are estimated at 18.6% of Vermont's 2013 load. When pre-2005 HQ hydro facilities larger than 200 MW are included, the two categories are estimated at nearly 39% of Vermont's 2013 load. These existing renewable energy commitments are counted towards the total renewable energy policy targets.

The policy assumes that over time, any remaining supply necessary to meet the target percentage in each year must be sourced from "New" renewable energy facilities – defined as those having achieved commercial operation on or after January 1, 2005. Multiple scenarios are run to explore the potential impact of allowing New hydro resources over 200 MW to be eligible. The modeled 20-year trajectory for each percentage target is shown in the table on the next page.

[49] As opposed to a percentage of the difference between the state's existing renewable energy supplies and total load.

Table 11. Evaluated RPS / SPEED Policy Targets, by Year

Evaluated RPS / SPEED Policy Targets, by Year				
Compliance Year	25% Case	50% Case	75% Case	100% Case
2013	18.6%	20.0%	20.0%	20.0%
2014	18.9%	21.6%	22.9%	24.2%
2015	19.3%	23.2%	25.8%	28.4%
2016	19.6%	24.7%	28.7%	32.6%
2017	19.9%	26.3%	31.6%	36.8%
2018	20.3%	27.9%	34.5%	41.1%
2019	20.6%	29.5%	37.4%	45.3%
2020	21.0%	31.1%	40.3%	49.5%
2021	21.3%	32.6%	43.2%	53.7%
2022	21.6%	34.2%	46.1%	57.9%
2023	22.0%	35.8%	48.9%	62.1%
2024	22.3%	37.4%	51.8%	66.3%
2025	22.6%	38.9%	54.7%	70.5%
2026	23.0%	40.5%	57.6%	74.7%
2027	23.3%	42.1%	60.5%	78.9%
2028	23.7%	43.7%	63.4%	83.2%
2029	24.0%	45.3%	66.3%	87.4%
2030	24.3%	46.8%	69.2%	91.6%
2031	24.7%	48.4%	72.1%	95.8%
2032	25.0%	50.0%	75.0%	100.0%

The legislature requested an evaluation of both RPS and SPEED policies at these targets. The commitments represented by an RPS and SPEED differ in only one respect. An RPS requires the acquisition and retirement of Renewable Energy Certificates (RECs). The SPEED program does not require the acquisition and retirement of RECs. When two otherwise comparable scenarios are compared in this analysis, the RPS scenario is assumed to retain the minimum quantity of RECs necessary for RPS compliance (liquidating any remainder into other New England RPS markets to generate off-setting revenue), while the SPEED scenario is assumed to liquidate all RECs.

Regional and Distributed Renewable Energy Supply

During the Board staff's June 2011 workshop and ensuing comments and discussions with stakeholders, a recurring preference was expressed to create a policy that balances the acquisition of regional renewable energy supply at the lowest available cost with the development of in-state, distributed generation resources. The scenario analysis reflects these comments in two ways. First, the analysis assumes that 20% of each RPS or SPEED policy (including all target levels) would be met with in-state distributed generation (with a sensitivity showing the outcome of a policy with a 10% DG requirement). Distributed generation is defined as installations smaller than 2.2 MW, as in the current SPEED program. Second, the scenarios look at two potential approaches to distributed generation – the Standard Offer program, or a DG carve-out within an RPS. The Standard Offer program approach assumes the availability of long-term contracts at specified rates. Rather than establishing a capacity (MW) cap, however, this analysis apportions 20% of the incremental renewable energy demand in the selected target case to the Standard Offer program. Resources are allocated among technologies as long as additional resource potential is estimated to exist. Among available technologies, solar and wind are assumed to have the least constrained resource potential and are used to fill the remaining DG requirement after other resources are saturated. The DG Tier uses the same set of technologies and resource availability inputs, but assumes a market-based "least cost wins" approach to determining which facilities are built to satisfy the DG requirement. As with the larger resources, the RPS distributed generation cases assume that RECs are acquired and retired, and the SPEED cases assume that all RECs are sold for RPS compliance in other markets[50].

Another question raised at the June 2011 workshop was the potential cost impact of the requirement that woody biomass facilities achieve a specified rate of operating efficiency in order to maintain eligibility. While such a requirement now exists for the Vermont Standard Offer and is being finalized for the Massachusetts RPS, insufficient data on both the resource potential and the cost of installing and operating such facilities is available to include a specific high-efficiency biomass CHP resource block in our supply curve analysis.

Scenario Definitions

After taking into account the legislature's directives to the Board as well as dialogue with the Board staff, Department of Public Service staff, utilities and other stakeholders, a wide range of potential RPS and SPEED modeling scenarios was developed. A subset of this universe was identified for modeling purposes, with the intension of providing the most useful and representative data to support informed decision-making. The entire list of potential scenarios is included in the table below. The scenarios that have been modeled as part of this analysis are given a scenario abbreviation in the table on the next page.

[50] The current standard offer program allows farm methane projects to retain the RECs. However, given the small the small number of RECS associated with these projects, this scenario was not separately modeled as it would have negligible impacts on the model results.

Table 12. RPS and SPEED Cost Modeling, Matrix of Potential Scenarios

RPS and SPEED Cost Modeling, Matrix of Potential Scenarios				
Scenario Abbreviation	**Policy Type** (RPS or SPEED)	**Target for RE as % of VT Portfolio**	**Eligibility of Resources > 200 MW**	**DG Approach** (20% of Target met with DG)
Reference Case	Reference Case (SPEED)	5% of 2005 Load	All Except Hydro	Standard Offer
R.25.AEH.DG20	RPS	25%	All Except Hydro	DG Tier
R.50.AEH.DG20	RPS	50%	All Except Hydro	DG Tier
R.75.AEH.DG20	RPS	75%	All Except Hydro	DG Tier
R.100.AEH.DG20	RPS	100%	All Except Hydro	DG Tier
	RPS	25%	All	DG Tier
R.50.ALL.DG20	RPS	50%	All	DG Tier
R.75.ALL.DG20	RPS	75%	All	DG Tier
	RPS	100%	All	DG Tier
	RPS	25%	All	Standard Offer
R.50.ALL.SO20	RPS	50%	All	Standard Offer
R.75.ALL.SO20	RPS	75%	All	Standard Offer
	RPS	100%	All	Standard Offer
	RPS	25%	All Except Hydro	Standard Offer
R.50.AEH.SO20	RPS	50%	All Except Hydro	Standard Offer
R.75.AEH.SO20	RPS	75%	All Except Hydro	Standard Offer
	RPS	100%	All Except Hydro	Standard Offer
S.25.AEH.SO20	SPEED	25%	All Except Hydro	Standard Offer
S.50.AEH.SO20	SPEED	50%	All Except Hydro	Standard Offer
S.75.AEH.SO20	SPEED	75%	All Except Hydro	Standard Offer
S.100.AEH.SO20	SPEED	100%	All Except Hydro	Standard Offer
	SPEED	25%	All	Standard Offer
	SPEED	50%	All	Standard Offer
	SPEED	75%	All	Standard Offer
	SPEED	100%	All	Standard Offer
R.50.AEH.DG10	RPS	50%	All Except Hydro	DG Tier @ 10%

During the initial discussions leading up to this analysis, a third option – "None" – was contemplated for the input "eligibility of resources > 200 MW." The determining factor with respect to the impact of the eligibility of facilities larger than 200 MW is whether large hydroelectric facilities from adjacent control areas are eligible. During the modeling process, it was determined that from a market dynamics perspective, the distinction between "All Except Hydro" and "None" had no practical difference. Whereas the eligibility of hydro facilities larger than 200 MW would have a definitive effect on both compliance and price – since hydro > 200 MW is not eligible for any other RPS market – limiting the eligibility of other resources types over 200 MW (which are eligible in all other New England RPS markets) would not have a material effect on the compliance cost of a potential Vermont RPS. There will be relatively few projects larger than 200 MW within New England. There are likely to be several wind projects in Maine and, eventually, offshore wind. While these may ultimately become the marginal, price-setting, resources, they are unlikely to impact the quantity or price of qualifying renewable energy needed for policy compliance in Vermont in any significant, adverse way.

Assumptions and Methodology

This section provides a brief description of some of the assumptions and methodological decisions supporting the cost model associated with this analysis. First, with respect to the energy supplies currently serving Vermont, the cost of the existing portfolio is assumed to be both constant and present in all scenarios. Therefore, this cost is excluded from the analysis. To this end, this analysis looks only at the potential cost of new renewable energy additions and the non-renewable power (if any) required to fill the gap between all committed resources, new renewable additions, and total Vermont load. This gap-filling power is assumed to have the composition of the New England system mix, and is priced at the Vermont load-weighted energy and capacity prices forecasted in the 2011 Avoided Energy Supply Cost Study. Also with respect to existing resources, the analysis assumes the Vermont Yankee nuclear power plant discontinues its deliveries of energy to Vermont utilities in 2012, and that a new contract with the existing biomass facility in Ryegate is established – albeit at a somewhat reduced quantity compared to historic levels.[51]

Looking toward the future and the strategy for achieving renewable energy policy objectives, the model assumes that all RPS or SPEED procurement is done on a long-term basis by the Vermont utilities. For modeling purposes – and to represent the regulated and vertically integrated nature of Vermont utilities, renewable energy purchases are assumed to be bundled (energy, capacity and RECs purchased together) and RECs are assumed to be resold in the Reference Case and all SPEED scenarios. As a practical matter, we expect that Vermont utilities would also make separate energy and REC purchases when they believed it to be most cost effective.

The policy approach modeled here takes the difference between the total renewable energy target (25%/50%/75%/100%) and the total existing (pre-2005) renewable energy resources to derive the New renewable energy supply required to meet the target in each year. This obligation was then allocated 80% to a "Main Tier" to be served from least-cost, regional, post-2004 qualifying renewable energy supply, and 20% to a "Distributed Generation Requirement" to be met either through a continuation of the Standard Offer program or the establishment of a least-cost-wins "DG Tier." Any REC surpluses (and all RECs in the SPEED scenarios) are assumed resold at estimated then-current market prices.

The estimation of supply available to meet these two requirements is based on an analysis of regional RPS demands compared to a proprietary supply curve analysis performed by SEA. The estimation of available supply includes not only the resource potential in New England, but also current and expected future imports of RPS-qualified renewable energy supply from New York, Quebec, and the Maritimes over existing ties. These supply curves define the estimated available future capacity for each fuel type category, establish limits on how much supply can enter the market in each year, and sorts this supply from least to highest cost. This approach is replicated for both the Main Tier and Distributed Generation tier. For the DG supply curve, and based on a

[51] Assumed futures levels are consistent with the Vermont Power Cost and Emissions model.

review of available data and discussions with stakeholders, the future quantities of landfill gas-to-energy, biomass, farm methane and hydroelectric capacity are assumed to be extremely limited. By comparison, distributed wind and solar are not assumed to be resource constrained, and therefore play an increasingly significant role in the satisfaction of the DG requirement over time. Production from DG resources is treated as grid-connected power; in other words, it is assessed at the wholesale market value of energy. If actual projects happen to be net-metered generators, then it is assumed that any avoided transmission and distribution costs are shifted to other market participants (a transfer payment) and are ignored for RPS/SPEED cost modeling purposes.

The cost analysis is conducted over a 30-year period, ten years beyond the 2032 target dates in order to account for the continuing cost of resources acquired in later years. It is assumed that after the initial investment horizon (e.g. 20 years for a wind project) the production from facilities built for RPS/SPEED compliance continues to be available and is provided at a 20% discount to market prices.

Some modeling inputs remain static throughout all scenarios. Examples include:

1. The composition of the Hydro Quebec system mix;
2. The treatment of New renewable energy within the HQ system mix – which was counted toward Vermont RPS/SPEED targets under the assumption that HQ would develop an attribute accounting system (comparable to the NEPOOL GIS) sufficient to ensure that any unit-contingent sales made now or in the future would not be also counted in the system mix.
3. The expected build-out, in eastern Canada, of hydro larger than 200 MW;
4. The available transfer capacity over existing ties between control areas;
5. The Federal PTC and ITC, which were assumed to phase-down to 50% of their current face value by 2018.
6. The composition of the Main Tier and DG supply curves.

Results

The RPS and SPEED cost modeling portion of this analysis includes 15 potential policy scenarios plus one Reference Case. The Reference Case includes the current mandate to serve “5% of 2005 Load” with renewable energy resources, plus the current 50 MW distributed generation obligation under the Standard Offer program. The Reference Case assumes the re-sale of all RECs eligible for RPS programs in other states.

All of the modeled scenarios are found to be more costly than the Reference Case. A summary of the scenario cost and environmental (emissions) impact analysis is provided in Table 13 below. These results are sorted from least to highest cost of compliance:

Table 13. Summary of RPS/SPEED Policy Cost and Environmental Impact

Summary of RPS/SPEED Policy Cost and Environmental Impact				
Scenario Abbreviation	Policy Cost Above Reference Case (NPV M$)	% Cost Increase Over Reference Case	Billed Rate Impact Above Reference Case (30-Yr Levelized cents/kWh)	CO2 Impact vs. Reference Case (tons)
S.25.AEH.SO20	$2	0%	0.00	0
R.50.ALL.DG20	$35	1%	0.03	(10,453,913)
R.25.AEH.DG20	$52	1%	0.05	(8,316,313)
S.50.AEH.SO20	$62	1%	0.06	0
R.50.ALL.SO20	$78	2%	0.07	(10,453,913)
S.75.AEH.SO20	$141	3%	0.14	0
R.50.AEH.DG10	$179	4%	0.17	(16,116,259)
S.100.AEH.SO20	$206	4%	0.21	0
R.75.ALL.DG20	$208	4%	0.19	(18,677,894)
R.50.AEH.DG20	$221	5%	0.21	(16,137,055)
R.75.ALL.SO20	$297	6%	0.27	(18,677,894)
R.50.AEH.SO20	$325	7%	0.30	(16,137,055)
R.75.AEH.DG20	$490	10%	0.46	(25,875,808)
R.75.AEH.SO20	$610	13%	0.57	(25,875,808)
R.100.AEH.DG20	$762	16%	0.72	(35,852,320)

All cases assume linear escalation to the 2032 targets. The 25% Case starts at the estimated level of existing renewable energy supply (18.6% assuming that hydro facilities > 200 MW are not eligible, and 38.9% when they are). Collectively, the Vermont utilities have already committed to enough New renewable energy supply to meet the 25% target in 2032. As demand continues to grow slowly thereafter, it is expected that all RECs currently in Vermont's portfolio will be used for RPS compliance by 2042. The remaining cases are assumed to start at 20%, in order to create slightly more demand tension than the 25% case.

In the RPS cases, and depending on resource eligibility requirements, the retirement of RECs currently in Vermont utility portfolios occurs slowly over time until all cases eventually consume New RECs from current commitments and create demand for incremental New renewable energy resources. In the 50% Case with 200+ MW hydro ineligible, New renewable energy purchases beyond current commitments are not required until 2020. Such purchases are not required until 2018 in the 75% Case and not until 2016 in the 100% Case. In the 50% Case with 200+ MW hydro eligible, New renewable energy purchases beyond current commitments are not required until 2029. Such purchases are not required until 2023 in the 75% Case and not until 2020 in the 100% Case. See Tables 13 and 14, and Figure 7. Note that these tables and the figure focus on the *Main Tier* policy target and do not include the 20% Vermont-based DG requirements.

Table 14. Incremental New Renewable Energy Purchases Necessary (Hydro over 200 MW Not Eligible)

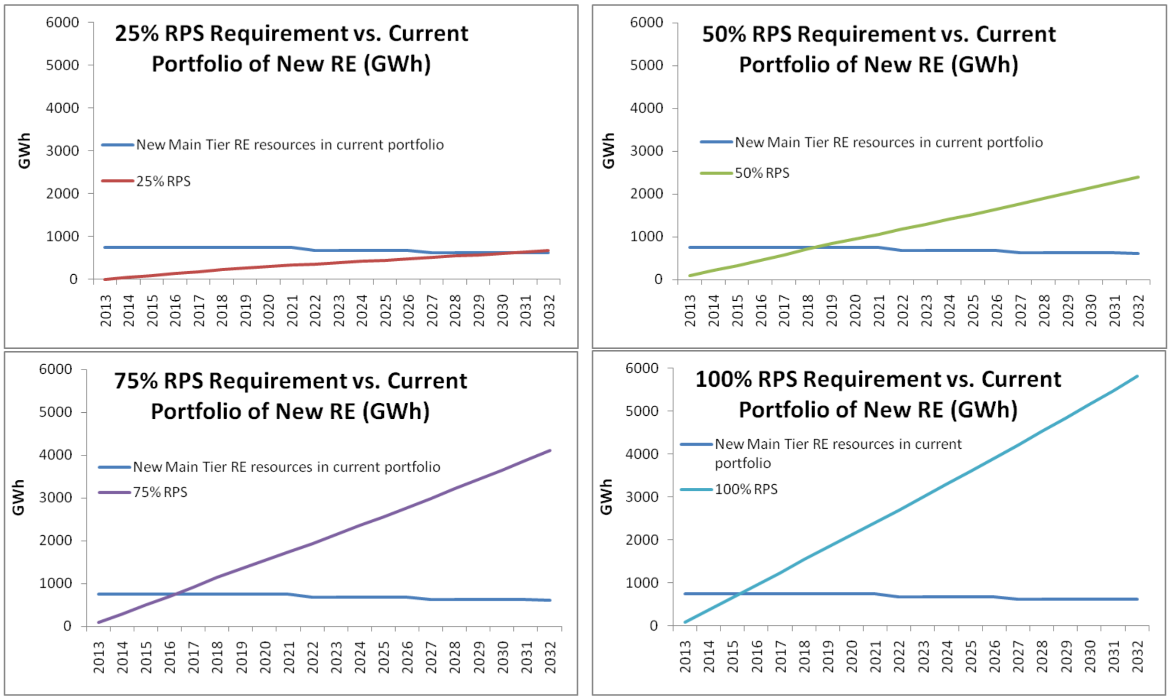
Incremental New Renewable Energy Purchases Necessary (Beyond Current Commitments) to Meet Policy Targets (*GWh*)

Assumes Hydro Facilities Over 200 MW are NOT Eligible

	25% Case	50% Case	75% Case	100% Case
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	11
2017	0	0	0	240
2018	0	0	159	491
2019	0	0	320	721
2020	0	11	481	951
2021	0	103	644	1,184
2022	0	252	864	1,476
2023	0	346	1,030	1,714
2024	0	441	1,198	1,954
2025	0	537	1,367	2,197
2026	0	634	1,539	2,443
2027	0	788	1,768	2,748
2028	0	887	1,943	3,000
2029	0	987	2,121	3,254
2030	0	1,089	2,300	3,511
2031	0	1,191	2,481	3,771
2032	0	1,294	2,664	4,034

To further elaborate on the timing of Vermont utilities' collective need to enter into additional contracts with renewable energy generators in the modeled RPS scenarios, in Tables 4 and 5, years in which a zero appears denote that Vermont utilities (collectively) already have enough New RECs within current commitments to both meet the modeled RPS and sell surpluses to generate offset revenues. During those years, no action would be required by Vermont utilities to meet the modeled policy other than to retire a slowly increasing portion of the New RECs already owned or under contract. Years in which a GWh demand for New renewable energy appears denotes a need for RECs beyond current commitments. These circumstances are also presented graphically below. The relatively flat line denotes the quantity (GWh) of new Main Tier renewable energy supply already in the current portfolio. Each of the escalating lines represents the named RPS case and shows the rate at which Vermont would redirect its current REC portfolio toward in-state RPS compliance. No contracts for incremental new RECs above the current portfolio are required until the area graph crosses the current portfolio line. (Refer to the discussion and tables above for the exact years in which this occurs and the associated quantities).

Figure 7. Ramp-Up of RPS to Level of New Renewables Already Owned or Contracted



It is important to keep in mind that, even in the years when Vermont utilities would not need to enter into additional contracts with renewable energy generators, the Vermont RPS would still be helping to expand the renewable energy supply in the region. To the extent that utilities retire RECs that are already in their control, rather than sell those RECs for use in satisfying the RPS in another New England state, they create the need for more RECs for that other state's RPS. That should induce developers to bring additional renewable energy online to fill the gap in the REC supply. What this means is that, during the first years of an RPS, the utilities would have a relatively easy transition whereby they could gradually retire RECs in their control, yet Vermont would still be incentivizing the construction of additional renewable energy in the region.

Table 15. Incremental New Renewable Energy Purchases Necessary (Hydro over 200 MW Eligible)

Incremental New Renewable Energy Purchases Necessary (Beyond Current Commitments) to Meet Policy Targets (*GWh*) — *Assumes Hydro Facilities over 200 MW are Eligible*				
	25% Case	50% Case	75% Case	100% Case
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	0
2017	0	0	0	0
2018	0	0	0	0
2019	0	0	0	0
2020	0	0	0	51
2021	0	0	0	285
2022	0	0	0	577
2023	0	0	131	815
2024	0	0	299	1,055
2025	0	0	468	1,298
2026	0	0	640	1,544
2027	0	0	869	1,849
2028	0	0	1,045	2,101
2029	0	88	1,222	2,355
2030	0	190	1,401	2,612
2031	0	292	1,582	2,872
2032	0	395	1,765	3,135

Several factors differentiate the scenario results from the Reference Case and from each other. The cost of the Reference Case is based entirely on the assumed cost of buying short-term wholesale energy to serve the gap in between Vermont load and committed resources. A portion of these costs are offset with revenue from the resale of RECs in the current portfolio. As the RPS or SPEED target percentages increase, short-term wholesale purchases are reduced and long-term renewable energy contracts are increased. These long-term renewable energy purchases occur at a varying premium to assumed wholesale spot market prices. In the SPEED scenarios, all RECs are resold, reducing the cost of the policy. In the RPS scenarios, the minimum number of RECs required to comply are retained. The scenarios in which hydro facilities larger than 200 MW are eligible show a cost reduction compared to similar scenarios in which all facilities over 200 MW except hydro projects are eligible. This is because Vermont's committed portfolio includes substantial purchases of Hydro Quebec system power – comprised mostly of large hydro facilities[52]. If these facilities were eligible for the Vermont RPS, the

[52] The HQ system mix includes both existing and new hydro, most of which – but not all – is over 200 MW. In 2013, the HQ system mix is expected to include approximately 70% pre-2005 hydro over 200 MW, 4% pre-2005

demand for incremental renewable energy purchases would be delayed and Vermont utilities would be able to continue to resell their RECs into other RPS markets.

The tables below reproduce the Table 3 results, but separated into SPEED results and RPS results, and then sorted by target, DG Tier v. Standard Offer, and eligibility of large hydro.

Table 16. Summary of SPEED/RPS Policy Cost and Environmental Impact

Summary of SPEED Policy Cost and Environmental Impact			
Scenario Abbreviation	Policy Cost Above Reference Case (NPV M$)	Billed Rate Impact Above Reference Case (30-Yr Levelized cents/kWh)	CO2 Impact vs. Reference Case (tons)
S.25.AEH.SO20	$2	0.00	0
S.50.AEH.SO20	$62	0.06	0
S.75.AEH.SO20	$141	0.14	0
S.100.AEH.SO20	$206	0.21	0
Summary of RPS Policy Cost and Environmental Impact			
Scenario Abbreviation	Policy Cost Above Reference Case (NPV M$)	Billed Rate Impact Above Reference Case (30-Yr Levelized cents/kWh)	CO2 Impact vs. Reference Case (tons)
R.50.AEH.SO20	$325	0.30	(16,137,055)
R.75.AEH.SO20	$610	0.57	(25,875,808)
R.25.AEH.DG20	$52	0.05	(8,316,313)
R.50.AEH.DG20	$221	0.21	(16,137,055)
R.75.AEH.DG20	$490	0.46	(25,875,808)
R.100.AEH.DG20	$762	0.72	(35,852,320)
R.50.ALL.SO20	$78	0.07	(10,453,913)
R.75.ALL.SO20	$297	0.27	(18,677,894)
R.50.ALL.DG20	$35	0.03	(10,453,913)
R.75.ALL.DG20	$208	0.19	(18,677,894)

If hydro facilities larger than 200 MW are <u>not</u> eligible, Vermont-based renewable energy projects (that are able to successfully complete the permitting process) will present viable opportunities when their output is sold to local utilities, which can benefit from busbar pricing and avoided wheeling charges. Independent Power Producers are also attracted to Vermont because of the ability to contract with utilities on a long-term basis and understand that creating long-term price benefits is important to the approval process. If hydro facilities larger than 200 MW <u>are</u> eligible, supply would be expected to exceed demand, and very little incremental renewable energy

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hydro under 200 MW, 15% post-2004 hydro over 200 MW, 1% post-2004 hydro under 200 MW, 0.25% pre-2005 wind, 3.75% post-2004 wind, and 6% other resources.

capacity would likely be built in Vermont (or elsewhere in response to Vermont RPS demand) beyond the DG requirement.

Stakeholder comments provided at the June 2011 RPS Workshop helped to guide the modeling assumption that 20% of any new renewable policy target would be derived from in-state distributed generation, as well as the need to test the sensitivity of policy cost impact using a distributed generation target of 10%. A comparison of these two scenarios – highlighted in Table 8 below – demonstrates the fact that the policy cost results are not only highly sensitive to the percentage of the requirement met by distributed generation, but also that the DG requirement accounts for a disproportionate amount of the total policy cost.

Table 17. Sensitivity of Cost to DG Approach and Percentage Target

Sensitivity of Cost to DG Approach and Percentage Target			
Scenario Abbreviation	Policy Cost Above Reference Case (NPV M$)	Billed Rate Impact Above Reference Case (30-Yr Levelized cents/kWh)	CO2 Reduction vs. Reference Case (tons)
R.50.AEH.DG20	$221	0.21	(16,137,055)
R.50.AEH.DG10	$179	0.17	(16,116,259)
R.50.AEH.SO20	$325	0.30	(16,137,055)

As the policy scenarios continue upward to 75% and 100%, the cost of compliance with the modeled DG requirement is increasingly the dominant cost driver. This occurs in part because the policy cases with higher percentage targets work their way through the distributed generation supply curve faster than policy cases with lower targets. In other words, new development potential among the lower cost distributed resources (landfill gas, hydro and farm methane) is in short supply, and as a result the majority of the distributed generation tier – particularly in the higher target cases – is derived from wind and solar resources. As the distributed generation mix trends towards wind (some of which is small wind) and solar, the weighted-average cost per MWh of DG trends from the low $100s to over $200 per MWh. This dynamic is unaffected by the potential eligibility of hydro facilities over 200 MW for the Main Tier.

The DG requirement is implemented either as a DG Tier or a Standard Offer. The DG Tier approach results in lower DG compliance costs because *available* resources are selected entirely on the basis of price. When resources become limited, wind and solar are assumed to fill the gap in a 75:25 ratio. The Standard Offer, by comparison, is driven more by resource diversity and therefore allocates the required GWhs more equitably among the available resources. This results in a higher weighted-average cost. When resources become limited, wind and solar are assumed to fill the gap in a 50:50 ratio, which also contributes to a higher weighted cost of compliance.

Table 9 shows the total distributed generation capacity (MW) constructed by 2022 and 2032 for both the 20% and 10% DG cases.

Table 18. Build-Out of Distributed Generation Capacity

Build-Out of Distributed Generation Capacity				
(MW)	R.50.AEH.DG20		R.50.AEH.DG10	
Fuel Type	2022	2032	2022	2032
Biomass < 2.2 MW	0	5	0	5
Farm Methane < 2.2. MW	0	2	0	0
Hydro < 2.2. MW	3	3	0	0
Landfill Methane < 2.2. MW	3	3	0	3
Solar < 2.2 MW	0	0.2	0	0
Wind ≤ 100 KW	0	0	0	0
Wind > 100 kW - 2.2. MW	32	119	0	24
Total DG (MW)	**38**	**132**	**0**	**32**

The following figures show the composition of DG production in 2032, for each scenario. Figure 8 shows production (GWh), and Figure 9 shows the percentage allocation among technologies.

Figure 8. Composition of DG Production in 2032

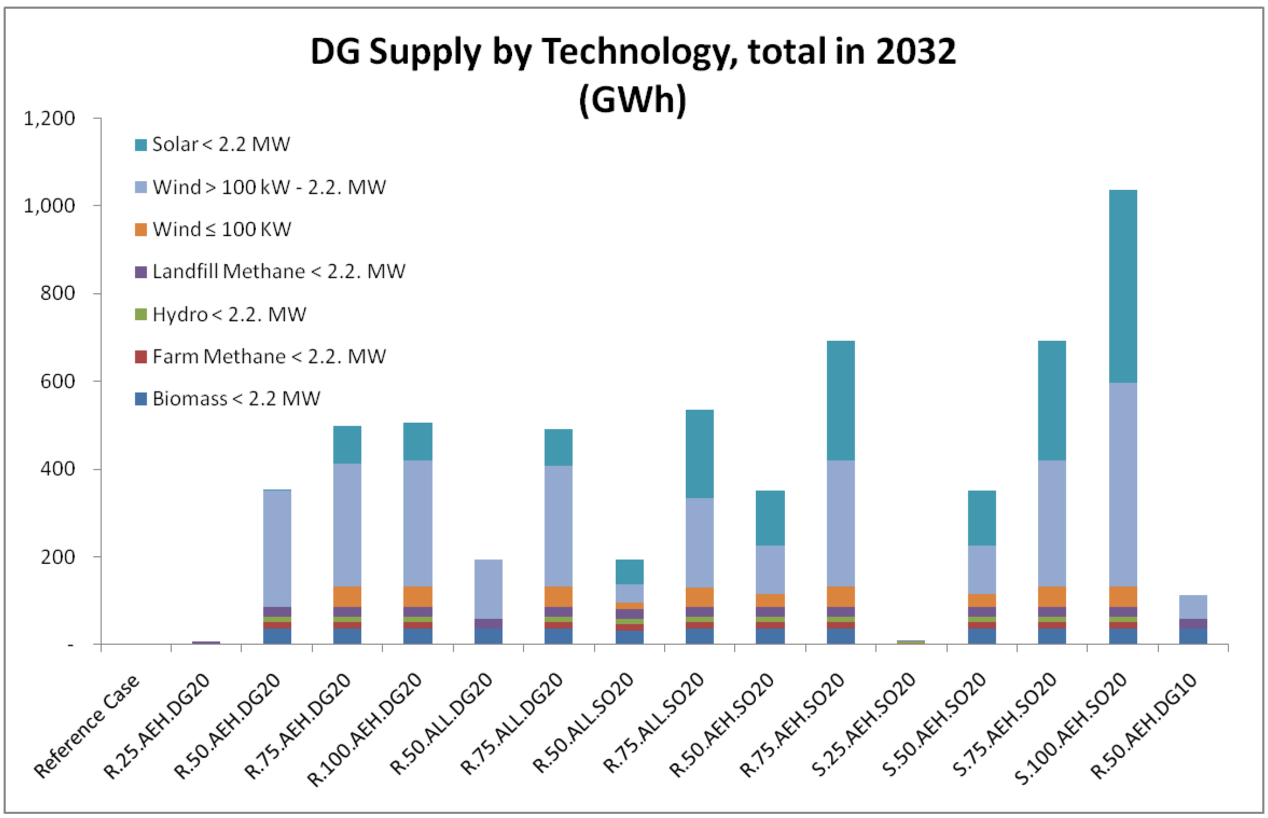
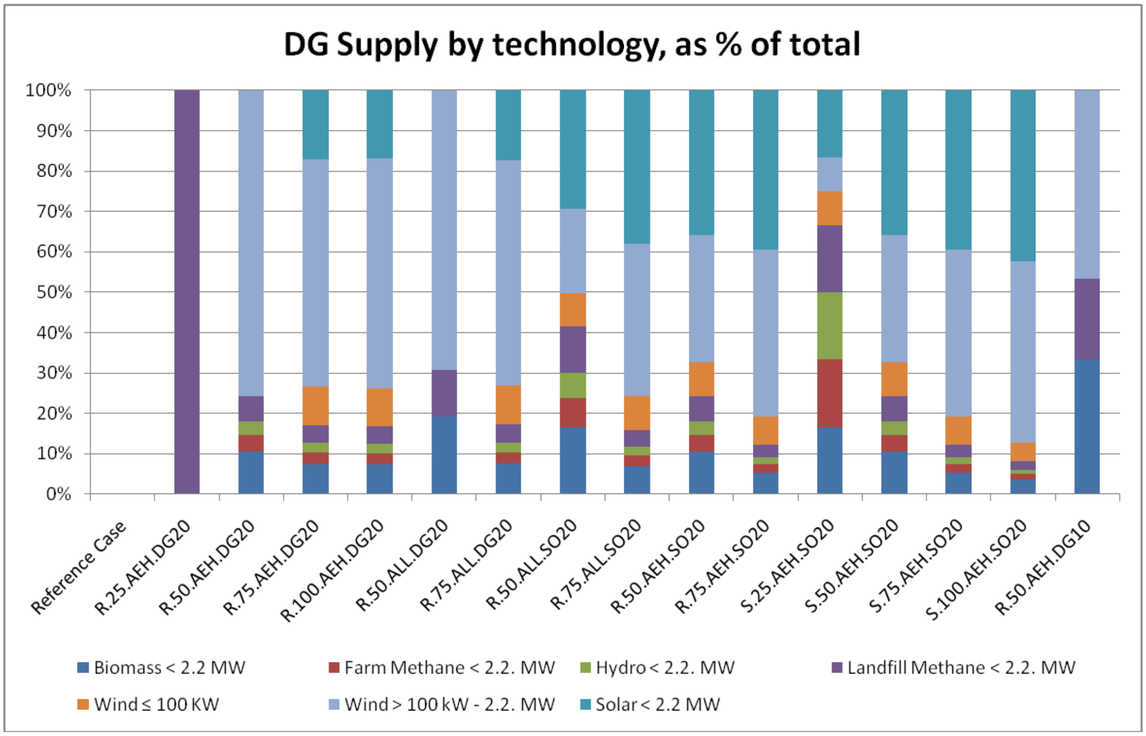
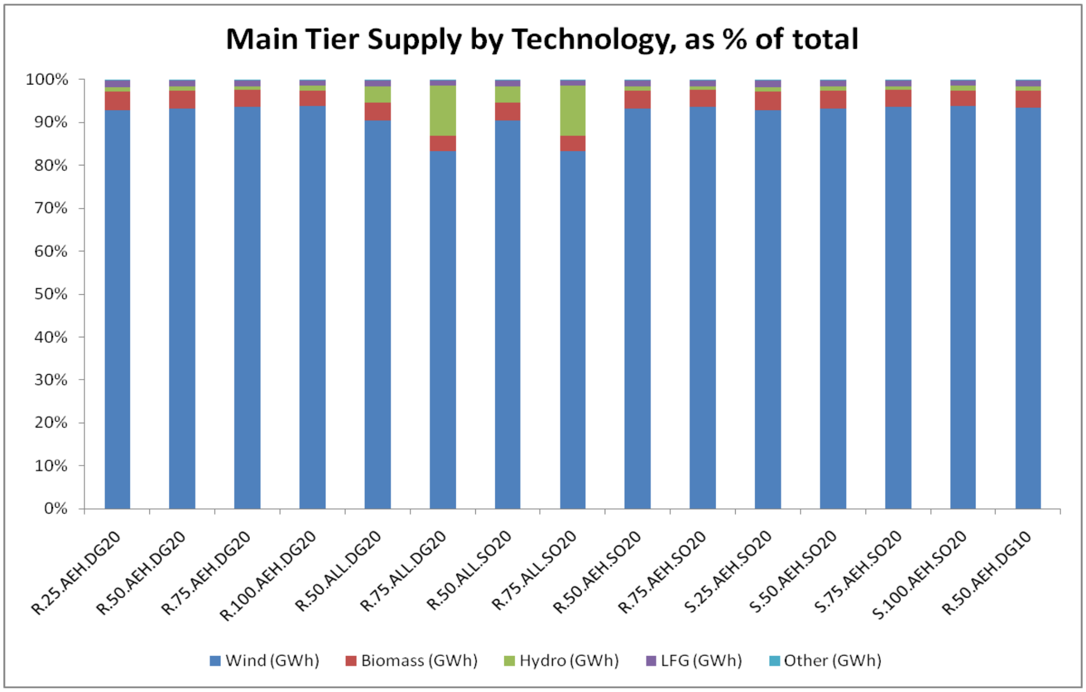


Figure 9. Percentage Allocation among DG Technologies, 2032



In contrast to the DG requirement, the Main Tier Vermont renewable energy policy would be part of a regional market. Supplies of, and demands for, new renewable energy overlap to a great degree. As a result, it is not possible to know exactly which RPS-eligible RECs will go to meet each state demand. Figure 4 offers a snapshot of the composition of resources clearing the New England regional supply curve in 2032. The allocation of resources to Vermont would depend on its eligibility criteria and utility procurement strategy. The exception to this is the relatively narrow set of facilities which meet only one state's RPS eligibility criteria. In Vermont, it is possible that all large hydro will fall into this category. The small amount of hydro generation shown in the "all except hydro" eligibility cases represents very small (usually sub 5 MW) facilities that are eligible in multiple RPS markets. The larger amount of hydro that appears in the "hydro over 200 MW is eligible" cases is only eligible in Vermont and cannot be used to serve other markets.

Figure 10. Composition of Renewable Energy Supply 2032



Comparison of Results to Public Service Board Staff Draft Recommendations

The scenario that most closely matches the PSB staff's initial draft recommendations, released on August 30, 2011, is the R.75.ALL.DG20 scenario. Both that scenario and the PSB staff recommendations assume an RPS program with REC retirement, a target of 75% of Vermont's total load from all renewable sources (including both pre- and post-12/31/2004) by 2032, and eligibility of both pre- and post- 12/31/2004 hydro over 200 MW. The cases differ, however, in their assumption of the percentage requirement of Distributed Generation. The PSB staff proposed that 5% of the total portfolio come from DG. The R.75.ALL.DG20 scenario in this analysis assumes that 20% of the ***incremental new*** renewable energy obligation comes from DG. Based on current commitments by Vermont utilities (to both large regional and Vermont DG resources), the ***incremental new*** renewable energy obligation in this case is projected to be 3,317 GWhs on a statewide basis in 2032. This means that 536 GWhs (20%) would be required to come from new DG resources not yet in operation or under contract at the time of this analysis and report. This 536 GWhs translates to 7.8% of total VT load in 2032, compared to the PSB staff's proposed 5%.

As described at the beginning of this section, the potential future cost of any RPS will be impacted by changes in regulation, permitting success rates, global supply chain dynamics, and future wholesale energy and capacity prices. To quantify some of these possible impacts, the table below shows the results of the R.75.ALL.DG20 scenario as initially modeled (AESC energy and capacity prices) compared to the same scenario substituting three different energy and capacity forecasts from the Integrated Resource Plan (IRP) of Green Mountain Power (GMP). Here is how GMP titled and described their three market outlooks:

- Gas is Greener: low energy market prices, characterized by relatively low natural gas prices, no major price on greenhouse gas emissions in the electric sector, and general inflation of less than 2%.
- Economies of Efficiency: higher energy prices, driven by relatively high natural gas prices, a moderate carbon price, and relatively high inflation of around 2.5%.
- Muddling Along: a down-the-middle energy outlook with relatively moderate natural gas prices, no major price on greenhouse gas emissions, and inflation of about 2%.[53]

The table below shows that all three of the GMP substitute forecasts provide lower energy and capacity futures and higher RPS compliance costs than in the initially modeled R.75.ALL.DG20 scenario.

Table 19. R.75.ALL.DG20 with Alternative Energy and Capacity Price Assumptions

R.75.ALL.DG20 Scenario with Alternative Energy and Capacity Price Assumptions			
Scenario Abbreviation	Policy Cost Above Reference Case (NPV M$)	Billed Rate Impact Above Reference Case (30-Yr Levelized cents/kWh)	CO2 Reduction vs. Reference Case (tons)
GMP IRP: "Gas is Greener"	$1,189	1.07	(18,677,894)
GMP IRP: "Economies of Efficiency"	$570	0.51	(18,677,894)
GMP IRP: "Muddling Along"	$508	0.46	(18,677,894)
R.75.ALL.DG20	$208	0.19	(18,677,894)

The key market value assumptions associated with the R.75.ALL.DG20 scenario are included in the following table:

[53] A more detailed description of these three market outlook scenarios can be found in GMP's 2011 Integrated Resource Plan at http://greenmountainpower.com/data/Unsorted/2011GMPIntegratedResourcePlan-21137-1.pdf.

Table 20. Assumptions Supporting R.75.ALL.DG20 scenario

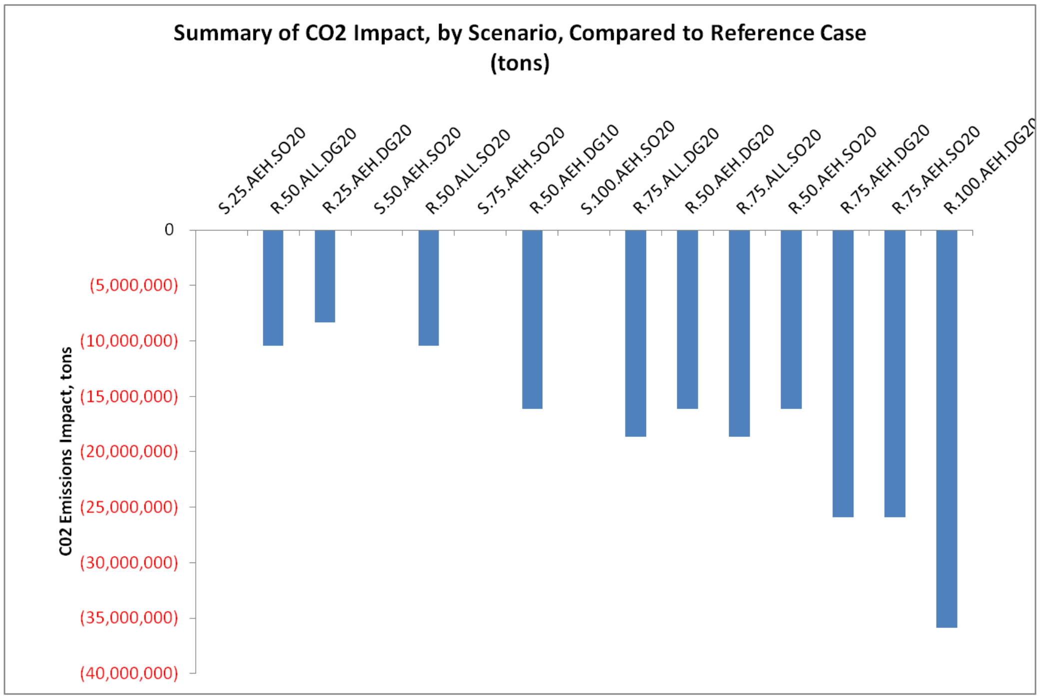
Calendar Year	VT Load-Weighted Energy Forecast ($/MWh)	Capacity Forecast ($/kW-yr))
2013	$53.63	$35.42
2014	$56.25	$36.13
2015	$62.34	$36.84
2016	$64.99	$15.43
2017	$66.65	$23.16
2018	$75.96	$32.97
2019	$78.39	$37.77
2020	$79.95	$53.86
2021	$83.83	$56.02
2022	$87.76	$85.76
2023	$94.05	$105.43
2024	$98.51	$117.58
2025	$101.98	$124.43
2026	$106.84	$129.71
2027	$108.97	$132.31
2028	$111.15	$134.95
2029	$113.37	$137.65
2030	$115.64	$140.40
2031	$117.96	$143.21
2032	$120.31	$146.08

Benefits

Emissions. Avoided carbon dioxide emissions attributable to Vermont are estimated for each scenario. As with the cost of the current portfolio, the emissions of the current portfolio are assumed to be both constant and present in all scenarios. Therefore, these emissions are excluded from the analysis. To this end, the analysis looks only at emissions of the non-renewable power (if any) required to fill the gap in between all committed resources, new renewable additions, and total Vermont load – and, for the SPEED cases, the emissions characteristic assigned to the energy for which the RECs have been sold for RPS compliance in other markets. Both gap-filling power and attributes assigned to SPEED energy are assumed to have the composition and average CO2 emissions profile of the New England system mix. All new renewable energy additions necessary to meet potential RPS programs are assumed to be either non-emitting or CO2 neutral.

All of the RPS cases produce net emissions reductions compared to the Reference Case. In the SPEED Cases, no net change in emissions occurs. This is because the sum of gap-filling power and liquidated RECs is the same as the Reference Case for the entire analysis period.

Figure 11. Comparison of CO2 Impact, by Scenario



In general, as renewable energy concentrations increase, greater CO2 reductions are achieved. This is because each GWh of (zero emission) incremental renewable energy directly offsets a GWh with assumed New England average emissions (750 lbs per MWh in 2013). This impact is apparent and intuitive in the 25%, 50%, 75% and 100% RPS cases. One area which deserves separate observation is the emissions impact of the scenarios in which hydroelectric facilities over 200 MW are eligible. While these scenarios use hydro (an emissions-free resource) to comply with the modeled policy, this supply is largely already present in current commitments. When large hydro is deemed eligible, it is counted toward the policy target but does not reduce the gap between the committed portfolio (of which is it a part) and total load. Therefore, the scenarios in which hydro is eligible continue to require significant New England system power purchases in order to fill this gap. The emissions associated with these purchases reduce the overall CO2 emissions benefit associated with the hydro scenarios.

Table 21. Summary of CO2 Emissions Impact

Summary of CO2 Emissions Impact	
Scenario Abbreviation	CO2 Impact vs. Reference Case (tons)
S.25.AEH.SO20	0
R.50.ALL.DG20	(10,453,913)
R.25.AEH.DG20	(8,316,313)
S.50.AEH.SO20	0
R.50.ALL.SO20	(10,453,913)
S.75.AEH.SO20	0
R.50.AEH.DG10	(16,116,259)
S.100.AEH.SO20	0
R.75.ALL.DG20	(18,677,894)
R.50.AEH.DG20	(16,137,055)
R.75.ALL.SO20	(18,677,894)
R.50.AEH.SO20	(16,137,055)
R.75.AEH.DG20	(25,875,808)
R.75.AEH.SO20	(25,875,808)
R.100.AEH.DG20	(35,852,320)

Portfolio Increases in New Renewable Resources Create Price Suppression Benefits. While the majority of this analysis focuses on the potential cost of renewable energy policies in Vermont, it should also be noted that increases in the penetration of new renewable resources also creates a somewhat offsetting economic benefit through electricity and capacity price suppression. This is particularly true of non fuel-based resources like wind energy. Once commissioned, such facilities generally operate as "must run" units. They bid into the wholesale market as a price-taker and in so doing sometimes displace production at the top of the stack. If this occurs in sufficient quantity, then a lower-cost unit becomes the marginal, price-setting resource in that hour. This reduction in the cost of marginal energy and capacity, as a result of the operation of renewable resources, is the price suppression benefit.

Both Vermont and the region benefit directly from energy and capacity price suppression. The estimated benefits directly to Vermont ratepayers are summarized below in Table 20, in thousands of dollars:

Table 22. Summary of Energy & Capacity Price Suppression Benefits to VT Ratepayers

Summary of Energy & Capacity Price Suppression Benefits to VT Ratepayers (Nominal $000)								
Case:	**25%**	**50%**	**75%**	**100%**	**25%**	**50%**	**75%**	**100%**
	Hydro > 200 MW *Not* Eligible				Hydro > 200 MW *Is* Eligible			
NPV @ 4.5%	$0	$18,722	$39,782	$61,051	$0	$5,082	$24,697	$45,283
Cost of RE Policy Case	$52,000	$222,021	$491,465	$2,007,874		$36,479	$205,431	
% of Cost Offset by Price Suppression Benefit	0%	8.43%	8.09%	3.04%		13.93%	12.02%	

The energy and capacity price suppression benefits calculated for this analysis are based on the estimates of energy and capacity demand reduction induced price effects (DRIPE) estimated in the 2011 Avoided Energy Supply Cost Report. Energy and capacity price suppression benefits are calculated annually based on the expected incremental demand for new renewable energy, which is assumed to reduce the demand for energy and capacity at the margin. The estimated benefits to Vermont are weighted for season and time of day. Both energy and capacity benefits are estimated through 2042 (30 years from the assumed policy start date). Although shown in aggregate above, it should be noted that capacity price suppression benefits start several years after energy price benefits. Table 21 shows the expected benefits on an annual basis in four cases:

Table 23. Energy & Capacity Price Suppression Benefits to VT Ratepayers

Energy & Capacity Price Suppression Benefits to VT Ratepayers Year-by-Year Benefits - (Nominal $000)				
Case:	**50%**	**75%**	**50%**	**75%**
	Hydro > 200 MW *Not* Eligible		Hydro > 200 MW *Is* Eligible	
2013	$0	$0	$0	$0
2014	$0	$0	$0	$0
2015	$0	$0	$0	$0
2016	$0	$0	$0	$0
2017	$0	$0	$0	$0
2018	$0	$322	$0	$0
2019	$0	$664	$0	$0
2020	$23	$1,040	$0	$0
2021	$222	$1,510	$0	$0
2022	$556	$2,099	$0	$0
2023	$798	$2,627	$0	$293
2024	$1,097	$3,182	$0	$684
2025	$1,420	$3,661	$0	$1,113
2026	$1,739	$3,986	$0	$1,639
2027	$2,222	$4,702	$0	$2,322
2028	$2,497	$5,144	$0	$2,926
2029	$2,687	$5,482	$222	$3,571
2030	$3,011	$5,757	$490	$4,160
2031	$3,354	$6,016	$784	$4,573
2032	$3,539	$6,155	$1,145	$5,193
2033	$3,416	$5,844	$1,237	$5,265
2034	$3,169	$5,461	$1,352	$5,164
2035	$2,864	$5,009	$1,454	$4,908
2036	$2,676	$4,618	$1,414	$4,546
2037	$2,344	$4,087	$1,280	$4,000
2038	$1,992	$3,504	$1,245	$3,391
2039	$1,628	$2,894	$1,132	$2,757
2040	$1,329	$2,412	$1,035	$2,256
2041	$1,177	$2,155	$983	$1,984
2042	$844	$1,577	$648	$1,382
NPV @ 4.5%	**$18,722**	**$39,782**	**$5,082**	**$24,697**

Other regional RPS programs have been creating price suppression benefits for Vermont since new renewable energy projects began coming on-line to meet these demands. Similarly, were Vermont to establish a policy that contributed to the incremental demand for new renewable energy, such a policy would bring price suppression benefits not only to Vermont but to the rest of the region as well. These benefits are estimated at $372M in the "50%, Hydro > 200 MW not eligible" case, $696M in the "75%, Hydro > 200 MW not eligible" case, $89M in the "50%, Hydro > 200 MW is eligible" case, and $432M in the "75%, Hydro > 200 MW is eligible" case.

Other Economic Benefits. Beyond price suppression, there are other ways in which the development of renewable energy would benefit the Vermont economy. For example, to the extent that renewable energy projects would be located in state, it would lead to additional jobs and increased local economic activity. A 2009 economic analysis by the Department of Public Service indicated that the existing SPEED Standard Offer program would increase the total number of jobs in the state and increase capital investment. The report indicates that the number of jobs would be modest, but there would nevertheless be a positive jobs result.[54] There is no reason to think that an analysis of additional DG spending in the state, beyond the 50 MW Standard Offer program, would lead to a dramatically different result. Moreover, larger, non-DG projects that would be built in Vermont because of an RPS or extended large SPEED program would also create jobs.

On the other hand, the higher electricity costs associated with an RPS or expanded SPEED program would have a negative economic impact. It is beyond the scope of this report to be able to do a comprehensive assessment of how all the positive and negative economic impacts of renewable energy policy would balance out. But it is important to keep in mind that the cost numbers for RPS or SPEED do not tell the entire story. There would be some positive economic benefits that would counterbalance at least some of the costs.

Market and Policy Uncertainties Will Impact the Ultimate Cost of Policy Compliance

The assumptions, methodology and results in this analysis are based on current market conditions and forecasts of the potential future environment for renewable energy development. Energy market dynamics are complex, however, and it is important to understand the major areas in which deviations from the assumptions made in this analysis could impact the future cost of renewable energy policies.

Overall, the manner in which the market interprets and responds to regulatory risks and related uncertainties may represent the single largest variable with respect to future policy compliance costs. The presence of long-term, or recurring, uncertainties may lead to pipeline attrition and a shortage of resources to meet policy objectives. The leading examples of such uncertainty include the potential future expiration or extension of the federal production tax credit and investment tax credit, the potential for carbon dioxide emissions regulation, and – at the regional level – future public and private decisions with respect to regional transmission.

Table 22 provides a list of selected market and regulatory factors that may influence the cost of renewable energy policy compliance, and groups these factors based on whether they would be expected to increase or decrease policy compliance costs.

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[54] Vermont Department of Public Service, *Economic Impacts of Vermont Feed in Tariffs*.

Table 24. Factors Influencing the Future Cost of RE Policy Compliance

Factors Influencing the Future Cost of Renewable Energy (RE) Policy Compliance	
Market and Regulatory Factors Subject to Potential Variation	**Implication for RE Policy**
• A decrease in energy, carbon or FCM prices • Project or financing costs increase • PTC and ITC expire or are reduced below modeled levels • Projects are delayed • Demand increases at a higher rate than projected • Transmission expansion is delayed • Offshore wind is delayed • Renewable Energy imports are less than forecasted	Cost of RE Policy Compliance Increases
• An increase in energy, carbon or FCM prices • Project or financing costs decrease • PTC and ITC levels are higher than modeled levels • Demand shrinks, or increases at a slower rate than projected • Regional transmission is built faster than expected • New inter-control area ties are approved and built • Offshore wind appeals are resolved • Renewable Energy imports are higher than forecasted	Cost of RE Policy Compliance Decreases

J. Demonstrating RPS Compliance

A successful RPS program provides as much clarity regarding the demonstration, verification, and enforcement of RPS compliance as it does for eligibility, certification, and annual target obligations. This section of the report discusses how RPS compliance and reporting practices would work if Vermont chooses to adopt an RPS.

RPS compliance begins with the certification of eligible resources. Generator applications are submitted to the applicable regulatory authority (in this case the Public Service Board), and a detailed review is conducted based on predetermined eligibility criteria. All eligible resources must go through the state certification process regardless of whether they are located in Vermont, the rest of ISO New England Inc. (ISO-NE), or in an adjacent control area. Projects certified in other states must also complete the certification process in Vermont if they wish to serve the Vermont RPS. Certified projects may then sell the attributes of their generation resource[55] to any entity obligated to comply with the RPS.

In the case of small hydro, several New England states look to the Low Impact Hydro Institute (LIHI) for certification that the hydro project in question does not create undue environmental impact. With LIHI, the projects must apply for, pay for, and navigate the third-party process separately from their state application for RPS certification.

Although the contractual sale of generation attributes occurs through bilateral negotiation or broker-based placements or auctions, the transfer of title for the generation attributes occurs within the NEPOOL Generation Information System (NEPOOL GIS, or GIS), which is managed by ISO-NE. For all generation sources located within the New England Power Pool (NEPOOL), an electronic GIS Certificate is created upon each MWh generated and registered with the NEPOOL GIS. GIS Certificates carry information including the descriptive characteristics of that generator (e.g., generator type, location, *actual* emissions), as well as a series of check-boxes to indicate eligibility for various programs, including the "Attribute Laws" - primarily the state Renewable Portfolio Standards.

For generators using the ISO-NE market settlements system, production quantities from the MSS are fed into the GIS. For small generators – including those interconnected behind a retail customer meter – which may not use the MSS, validation by a third-party meter reader of the MWh produced each month at that generator is typically required. Generators located in adjacent control areas may also earn GIS Certificates if they meet NEPOOL GIS energy import requirements.

The NEPOOL GIS creates one GIS Certificate for each MWh of production regardless of fuel type. Once a renewable generator becomes certified for a particular RPS, the applicable state regulator contacts the GIS and the GIS System Administrator makes a designation on all Certificates from that generator, verifying its RPS eligibility.

[55] Once a generator completes the sale of its environmental attributes, the attributes of the NEPOOL GIS system mix – including emissions characteristics – are then assigned to that generator.

The presence of RPSs (and to a lesser extent voluntary purchases) creates value for GIS Certificates from RPS-certified renewable energy generators. These particular GIS Certificates are referred to casually in the market as Renewable Energy Certificates, or RECs. While the definition of a GIS Certificate is technically narrower than that of a REC, the two terms are used interchangeably and their reciprocal meaning is commonly understood. RECs do not inherently include the *benefits* of the generation which they represent – which may include displaced emissions and tradable emission commodities (e.g. allowances, offsets, etc), for example. Such secondary or indirect attributes (if they should exist at present or in the future) may be contractually attached to the REC through bilateral negotiation, however. All RPS states require the use and retirement of NEPOOL GIS certificates in order to demonstrate RPS compliance. By using this central, independently administered system, New England regulators can verify RPS compliance and ensure that no obligated entity is allowed to use a single GIS Certificate to comply with more than one state RPS requirement.

When GIS Certificates are in short supply or have otherwise not been obtained by obligated entities, RPS compliance can be achieved in some states through an Alternative Compliance Payment (ACP). An ACP is a cash payment to a designated entity in lieu of the provision of GIS Certificates. ACP levels are typically set at prices just above the minimum REC price level expected to be necessary to facilitate renewable energy project financing, and are adjusted each year for inflation. Since the ACP is a valid form of compliance, actual noncompliance with RPS requirements is extremely rare. Given these options, it is expected that obligated entities will comply each year, particularly since regulators have the authority to impose penalties or – in restructured markets – rescind the entity's license to participate in the market.

RPS compliance is demonstrated annually by each obligated entity through the submission of a compliance report. Once the transfer period for GIS Certificates from the fourth quarter of the applicable compliance year[56] has ended (June 15th of the following calendar year) obligated entities typically have approximately 30 days to submit a series of NEPOOL GIS reports, attestations, and other information which together constitutes its compliance report. With these materials, regulators can validate RPS compliance for the specified year, as well as conduct an overall evaluation of the degree to which the program has been effective in making progress toward policy objectives. For example, RPS compliance data can be aggregated to gain insights into the fuel type, location and other characteristics of the resources used to comply. These data are then published (in aggregate) in order for the market at large to better understand market dynamics and trends. For example, the Massachusetts Department of Energy Resources has been publishing annual RPS compliance reports since 2003. These reports, which have provided increasingly useful summary data over time, are available on-line.[57] Similar reports have been provided by the Rhode Island PUC and are also available on-line.[58]

[56] In all New England RPS markets, compliance years and calendar years are aligned.
[57] For the Massachusetts compliance reports, see http://www.mass.gov/?pageID=eoeeaterminal&L=4&L0=Home&L1=Energy%2c+Utilities+%26+Clean+Technologies&L2=Renewable+Energy&L3=Renewable+Energy+Portfolio+Standard+%26+Alternative+Energy+Portfolio+Standard+Programs&sid=Eoeea&b=terminalcontent&f=doer_rps_aps_ann..
[58] For the Rhode Island compliance reports, see http://www.ripuc.org/utilityinfo/res.html

The Role of Third-Party Certification

The Legislature asked the Board to consider the role of third-party certification in an RPS program or mandatory SPEED program. The following paragraphs discuss the two main ways that third-party certification could come into play in Vermont, both of which are mentioned in the immediately preceding report section.

1. *New England Power Pool (NEPOOL) certification of REC retirements*. Vermont is not in a position to track all the sales and retirements of RECs. Like other New England states, Vermont would inevitably and appropriately rely on the NEPOOL GIS. ISO-NE has established the NEPOOL GIS precisely to keep track of the production and use of electricity in the region. This is an appropriate task for ISO-NE to handle, as it is the independent, nonprofit, regional system operator, authorized by the Federal Energy Regulatory Commission (FERC). NEPOOL GIS certifies the number of RECs that each renewable energy generator produces and how many of those RECs are retired and by whom. This information is essential for Vermont to rely on if it chooses to have an RPS, and there is no better alternative for obtaining the information.

2. *Low Impact Hydro Initiative (LIHI) certification of hydro facilities*. LIHI is a national non-profit organization based in Maine. As the organization explains, it aims to reduce "the impacts of hydropower generation through the certification of hydropower projects that have avoided or reduced their environmental impacts pursuant to the Low Impact Hydropower Institute's criteria."[59] Like some other New England states, Vermont could require small hydro facilities to get LIHI certification in order to qualify for an RPS.

Given that the environmental benefits and harms of small hydropower projects can be controversial, there are some reasons why Vermont may want to require LIHI certification:

- It ensures that projects are carefully vetted before being declared eligible for an RPS. LIHI has high standards and uses a rigorous methodology.
- It relieves state officials from having to make value judgments about the environmental desirability of a type of facility that can be controversial.
- Some other states in the region rely on LIHI and seem to be satisfied with using the organization.
- Some environmental organizations and other stakeholders recommend that LIHI certification be required of small hydro facilities.

But there are also reasons not to require LIHI certification:

- Because the process of getting certified can be time-consuming and expensive, some small projects, especially the smallest ones with the slimmest potential profit margins, might find it so onerous that they would feel that they could not proceed.
- Giving a role to LIHI certification in an RPS would, in effect, turn over some of the state's regulatory role to a private organization.

Vermont could also choose to take a mid-range position relative to LIHI certification, making it one of several routes for small hydro projects to be authorized for the RPS.

[59] "About Us," Low Impact Hydropower Institute website, http://www.lowimpacthydro.org/about.html.

Appendix: Model Resource Eligibility Definitions

NORTHEAST AND MID-ATLANTIC STATES COLLABORATIVE ON RPS IMPLEMENTATION–MODEL RESOURCE ELIGIBILITY DEFINITIONS

States have multiple policy objectives for enacting renewable portfolio standards (RPS) and these objectives often vary from state to state. States are interested in taking advantage of some or all of the various benefits associated with renewable energy, such as obtaining environmental benefits, improving resource diversity, advancing technologies, promoting in-state economic development, and responding to public support for renewable energy.

Each of these objectives, however, can inform different definitions of renewable resources that are eligible for the RPS. In designing an RPS, policy makers seek to match their goals with the characteristics of the different renewable resources. As a result, there is substantial variation between state RPS programs in the definitions of eligible resources.

While there is no single, ideal way to define eligible RPS resources, there is merit in establishing some clear, common definitions of renewable resources for states to consider as RPS programs evolve and mature. To that end, the members of the ***Northeast and Mid-Atlantic States Collaborative on RPS Implementation*** have developed a set of model resource eligibility definitions. In developing these definitions, members took into consideration each state's current definitions as a starting point; selected definitions where there was substantial commonality between states already; crafted new definitions when warranted that are clear, specific, and consistent with the major RPS policy objectives of the states; and considered special issues associated with specific technologies and fuels (i.e. unique characteristics of hydropower and biomass).

The following recommended model definitions are based on the experience of RPS administrators participating in the Northeast and Mid-Atlantic States Collaborative. They are based on identification of best practice design elements and broad policy design principles. These standard definitions can be productively used to guide successful RPS policy design both at the states and federal level. However, designing an effective RPS often requires balancing sometimes-conflicting goals. Therefore, while these recommended definitions can guide state RPS definitions, considering policy tradeoffs will remain important.

There are several reasons why common RPS eligibility definitions have merit for consideration by policymakers at the state and federal levels.

First, these definitions can assist state policymakers as they develop new, or amended, RPS policies so that they include clear, well-crafted definitions of resource eligibility.

Second, use of common definitions by states serves the overriding goal of an RPS—to advance renewable energy resources *in the most efficient and low cost manner possible.* Today, variations in state specific definitions of renewable energy or REC eligibility tend to segment renewable energy markets across the region and the nation. This results in smaller, less liquid markets that can increase the cost of RPS compliance by limiting the types and sources of renewable energy that can be used to meet compliance. A common definition of renewable resources would allow states to more readily integrate their markets and increase the liquidity of RECs.

Third, the recommended common definitions are designed to allow states to avoid vague and unclear terms when crafting eligible resource definitions. In order to support investment in renewable facilities, developers need to know with certainty whether or not a facility will qualify before making significant financial commitments and must have confidence that definitions are sufficiently clear so that the universe of possible competitors is known. Developers and investors also are more likely to pursue new renewable projects if there are multiple state market outlets for the project output.

Fourth, the use of common and clear definitions will reduce administrative complexities and costs by avoiding debates over sometimes vague resource eligibility definitions. It will help to free regulators from the burden of holding time-consuming regulatory proceedings to determine whether a particular facility qualifies towards an RPS mandate.

Finally, use of common definitions by states will allow for the development of RPS reciprocity between states, i.e. a renewable energy generator that registers in one state RPS would automatically be eligible in other states with RPS policies. Reciprocity will help ease RPS administration; make it easier for renewable energy generators to register for multiple states' RPS policies; and thereby help contribute to a larger, more regional market for renewable energy generation.

For these reasons, the following definitions are crafted to provide a common RPS eligibility foundation while providing flexibility to allow for technology advancement and development. The definitions are technology and fuel inclusive and attempt to avoid discrimination against any one renewable resource. The definitions also are crafted to minimize the need for policymakers to determine the forms of technology that should receive market preference or to continuously revise the mandate to include new technologies that may be developed.

Energy vs. Electricity: Each definition begins with the phrase "Electricity derived from…" because, unless specified by a state as electricity generation, renewable resources can mean energy from eligible resources that have not been converted to electricity. Such energy, for example, could come from geothermal heat pumps, solar water heating systems, biomass used as a heating fuel, and landfill gas that is upgraded and supplied in a gas pipeline.

Because most existing state RPS policies seek to achieve increases in the quantity of renewable resources in the portfolio of a retail electricity seller, the recommended definitions restrict eligibility to resources and technologies that generate electricity. While some states include energy efficiency resources in their RPS, the model common definitions are focused on renewable energy electricity generation. This approach provides consistency and ensures that each resource definition is geared towards electricity production, rather than avoided consumption.

Below is a suggested model definition of each renewable energy resource and the rationale for the definition.[60]

MODEL RESOURCE ELIGIBILITY DEFINITIONS

Resource: Wind

Definition: *Electricity derived from wind energy.*

Rationale: Existing state definitions vary from the very generic—"wind"—to the more specific—"wind turbines", and include other variations without policy significance, such as "wind power", "wind energy", and "electricity derived from wind energy". The concept of wind power is universal and simple as defined by the states. The recommended fuel-based wind standard, "electricity derived from wind energy" is specific, inclusive of all wind-based electricity-production technologies, consistent with or implied in the various existing state "wind" definitions, and does not conflict with respective state policies or affect differing political realities. States could adopt the proposed definition with no significant alteration in the meaning of how any specific state defines wind-based electricity as an eligible resource in their RPS.

Resource: Solar

Definition: *Electricity derived from solar energy.*

Rationale: All states include solar power in their RPS policies. However, the definitions vary greatly, with some states not specifying any particular form of solar technology and other states listing specific eligible solar technologies. Existing definitions range from the very generic "solar" to the very specific "radiant energy, direct, diffuse, or reflected, received from the sun at wavelengths suitable for conversion into thermal, chemical, or electrical energy." Some states list solar technologies and photovoltaic technologies as two separate fuel sources.

The recommended definition of "electricity derived from solar energy" is specific, universal, and inclusive of all solar-based technologies that create electricity using a technology that employs solar radiation. It includes photovoltaics and solar thermal *electric* technologies. The inclusive definition is not significantly different from what is included, or implied, in the majority of state solar-based definitions (except for those few states that limit eligibility to PV or states that include solar thermal energy).

The recommended model definition also provides a broad fuel-based definition that affords states the flexibility to incorporate new solar electric technologies as they are developed without requiring legislative or regulatory changes.

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[60] These recommendations do not address other eligibility issues such as whether existing renewable facilities should be included, should generators be required to meet location requirements, should states establish resource tiers, etc.

Resource: Fuel Cells

Definition: *Electricity derived from any electrochemical device that converts chemical energy in a hydrogen-rich fuel directly into electricity without combustion.*

Rationale: Currently, there is little consensus among state RPS policies regarding whether certain kinds of fuel cells powered by natural gas and other “non-renewable” fuels should be included in the definition of technologies eligible for RPS compliance purposes. Only a few states qualify fuel cells as eligible technologies without imposing renewable fuel requirements. In contrast, the majority of states include only fuel cells that operate on renewable fuel in their RPS as eligible resources.

The disparity of approaches by states regarding fuel cell eligibility is limiting the ability of RPS policies to promote fuel cell technology advancements. Because fuel cells represent an advanced energy technology that is vital to the transition to a clean energy future, the recommended definition includes fuel cells as eligible RPS resources, regardless of fuel source. This “technology-based” definition would allow fuel cells to participate in RPS markets, irrespective of fuel source. The definition encourages the use of the technology, rather than a specific fuel, with the intent of helping fuel cells to “compete” with other technologies in RPS compliance.

From a policy perspective, the definition is based on the recognition that, with their low emissions profile and advanced energy character, fuel cells are important for environmental and climate reasons and their potential to act as a zero-emissions technology.

The recommended definition also is consistent with the major policy goals that states are trying to achieve through an RPS, including technology advancement, environmental benefits, in-state generation, distributed generation, and resource diversity.

Resource: Geothermal

Definition: *Electricity derived from geothermal sources.*

Rationale: Most states include geothermal fuel resources in their RPS. While the definition of geothermal power varies among states, the different definitions are fairly broad, have no major policy significance and are not mutually exclusive. For example, some states not do define geothermal power while others use particular phrases in reference to this type of power, such as “steam turbine”, “hot water or steam”, “earth’s crust”, or “heat of the earth”. Since the definitions are all very similar and often identical in meaning, states could adopt the proposed definition with no significant alteration in the scope of eligibility under current state-specific definitions.

The recommended geothermal power definition is inclusive and is consistent with the major state

RPS policy objectives – obtaining environmental benefits, advancing renewable energy technologies, and promoting energy diversity.

Resource: Oceans, Lakes and Rivers

Definition: *Electricity derived from the tidal currents, thermal gradients and waves of oceans, lakes or rivers.*

Rationale: Ocean-based technologies are eligible under several state RPS policies. However, most of the states with ocean-based resource eligibility do not clearly specify the three types of ocean-based technologies that might be eligible: tidal current, wave, and ocean thermal. For the most part, the various definitions used by states are general in nature and are not intended to restrict specific forms of ocean energy.

No state lists tidal currents, thermal gradients, and waves *in lakes and rivers* as eligible resources. Many of the aforementioned technologies will operate in all bodies of water. The recommended ocean/lake/river definition is intended to be inclusive of all the types of ocean, lake, and river-based energy technologies, with the exception of hydropower. Broadening the definition to include all three technology applications in oceans, lakes and rivers provides states with the flexibility to take advantage of these new, evolving technologies in all viable water-based locations. The definition also makes this resource category relevant to all states, allowing even non-coastal states to receive the in-state benefits of multi-state RPS support for wave, current and thermal energy.

Resource: Biomass

Definition: *Electricity produced by the direct combustion or co-firing of solid, liquid and gaseous fuels derived from organic, non-fossil materials, not to include:*

a) Construction and demolition waste;
b) Black liquor from pulp and paper mills;
c) Mixed municipal solid waste;
d) Old-growth timber.

Also included is methane from the anaerobic decomposition of organic materials from sources such as:

a) Landfills;
b) Wastewater treatment;
c) Agricultural operations;
d) Sewage treatment facilities;
e) Food and beverage processing, sales or distribution facilities.

Eligible biomass fuels may be co-fired, or blended, with fossil fuels, provided that only the renewable energy fraction of production from multi-fuel facilities shall be considered eligible. The facilities must meet or exceed current federal or state air emission standards, whichever is *more stringent. Biomass facilities must meet the emission limits of the state whose market it is selling into, rather than just the state that it is operating in, unless the emissions regulations in the operating state are more stringent.*

Rationale: The term "biomass" is very general and can be interpreted to include a wide variety of resources, such as primary biomass resources (whole trees and crops grown for energy purposes), forest and agricultural wastes, urban wood wastes, municipal solid waste, landfill gas, and black liquor (a by-product of pulp and paper production). Methods of converting biomass to electricity also vary and include direct combustion, co-firing with coal, gasification, anaerobic digestion, and pyrolysis. Each of these technologies has varying emission rates and energy conversion efficiencies. As a result, the various state RPS definitions for biomass eligibility exhibit a high degree of complexity, variation, and ambiguity.

There are a number of policy-based restrictions placed on the eligibility of biomass involving such factors as air quality, a desire to support new biomass projects, and concern over the potential over-harvesting of forests and overuse of farm lands for energy crops. Furthermore, the use by some states of terms such as "non-hazardous", "sustainable" and "low-emission" introduces substantial uncertainty over which biomass fuels and facilities do and do not qualify. For example, there is no generally agreed upon standard to ensure sustainable biomass harvest and cultivation. Regardless of the policy rationale, these eligibility restrictions can make it difficult for biomass energy projects to benefit from RPS policies.

Therefore, crafting a standard biomass RPS-eligibility definition which allows for adding more biomass capacity and addresses the range of state biomass restrictions poses a significant challenge. Faced with this challenge, the recommended definition does not use descriptive restrictions such as "non-hazardous", "sustainable" and "low-emission" because these terms do not have commonly accepted definitions, only introduce ambiguity, and are difficult to enforce. Instead, the recommended biomass definition excludes those specific biomass resources that many states have excluded on policy grounds due to environmental concerns—black liquor, construction waste and mixed municipal solid waste. The exclusions also include old growth forests because of the significant sustainability problem facing this resource and recognized public interest value in maintaining the remaining old growth forest.

The proposed biomass definition also includes a broad, inclusive category for methane gas resources—including landfills, sewage and wastewater treatment facilities, food and beverage wastes, and wastes from agricultural operations, including animal and crop wastes. This reflects the strong merits of this renewable resource and its consistency with state environmental, local generation, climate change and fuel diversity goals. Of particular importance, methane-based facilities significantly reduce emissions that contribute to climate change. Methane is a potent greenhouse gas, with a heat-trapping capacity of about 21 times that of carbon dioxide. An inclusive definition of methane gas resources does not raise any air emission, public health, hazardous substance, or sustainability issues of consequence (as compared to other biomass resources discussed above).

The model definition further addresses the eligibility of mixed-fuel facilities (co-firing), such as coal facilities that also burn biomass fuels. The definition allows only the energy generated from the qualifying biomass fuels to benefit under an RPS. Rather than ban the eligibility of such facilities altogether, the definition allows for efficient combinations of fuel usage while providing benefits for the use of biomass-based eligible fuels.

Finally, to address air quality concerns, rather than using a qualitative term such as "low-emission", the model definition refers more specifically to emission rates as specifically defined by the state which is receiving out-of-state-generation, or the federal EPA standard, whichever is more protective of human health and the environment. This acknowledges the regional nature of air pollution and respects the legitimate efforts of states to protect their air quality.

Resource: Hydropower

Definition: *Electricity generated by a hydroelectric facility that:*

a) operates as a run-of-river facility, or has been repowered without the use of new impoundments,*
b) has a maximum design capacity of 30 megawatts or less,
c) uses flowing water as the primary energy resource, with or without a dam structure or other means of regulating water flow,
d) is not located at a facility that uses mechanical or electrical energy to pump water into a storage facility, and
e) meets all relevant environmental standards as determined by the state environment department.

** "Run-of-river" refers to a hydropower facility that releases water at the same rate as the natural flow of the river – outflow equals inflow.*

Rationale: The unique characteristics of hydropower, such as its technological maturity and extensive development, many states have restricted the RPS eligibility of hydropower. Taking these characteristics into account, the proposed definition incorporates the most common elements of state definitions on hydropower eligibility. The definition allows for RPS economic support for small-scale hydropower facilities that have operational characteristics designed to address the major environmental concerns associated with hydropower dam operation—damage to watersheds and fisheries.

The recommended definition avoids the use of vague terms and restrictions such as requiring certification as a "low-impact" hydropower facility, which would require a time-consuming case-by-case review for environmental acceptability. Instead, the definition relies on compliance with established state environmental standards to ensure that RPS-supported hydropower projects are environmentally acceptable.

The most significant feature of the recommended definition is that it is designed only to support small-scale hydropower, by establishing an eligibility ceiling of 30 MW or less of aggregate capacity. This capacity cap was selected because it is the most common limit used by states. The small hydro eligibility focus also is designed to provide financial support to those projects that are likely to be less economically stable. Furthermore, the small-scale hydro focus is designed to avoid the environmental drawbacks associated with larger hydropower facilities with impoundments, as compared to smaller dams that operate under run-of river conditions.

Finally, the definition establishes RPS eligibility for incremental hydropower repowering at existing small-scale hydro sites to provide support to additional generation achieved through increased efficiency or use of new equipment that will further a state's technology advancement goals.