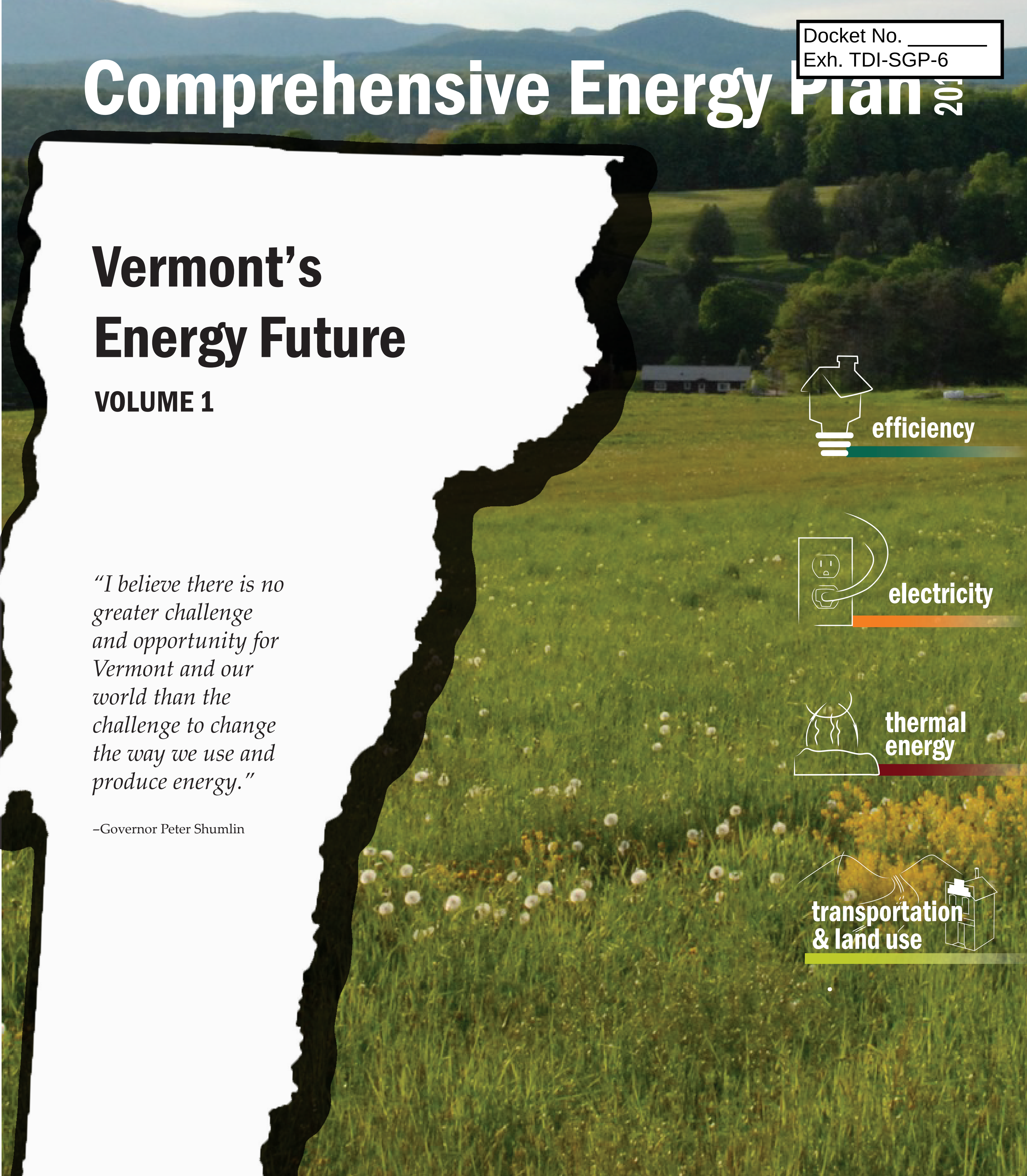
Docket No. _______
Exh. TDI-SGP-6

Comprehensive Energy Plan 201



Vermont's Energy Future

VOLUME 1

"I believe there is no greater challenge and opportunity for Vermont and our world than the challenge to change the way we use and produce energy."

–Governor Peter Shumlin

www.vtenergyplan.vermont.gov

December 2011

VERMONT
DEPARTMENT OF PUBLIC SERVICE

The Vision for Vermont's Energy Future

With those facts in mind, what energy vision should we set for our future, and what short-term steps should we take to support it?

We intend to set Vermont on a path to attain 90% of its energy from renewable sources by mid-century. We have chosen a comprehensive approach, requiring action in all sectors regarding all energy sources.

90% of our energy needs from renewable sources by 2050.

The goal is underpinned by this strategy: to virtually eliminate Vermont's reliance upon oil by mid-century by moving toward enhanced efficiency measures, greater use of clean, renewable sources for electricity, heating, and transportation, and electric vehicle adoption, while increasing our use of natural gas and biofuel blends where nonrenewable fuels remain necessary. The moves must be deliberate and measured to ensure overall energy costs for our businesses and residents remain regionally competitive.

Oil costs are perhaps the most volatile and troubling aspect of the energy future. Political instability is a significant threat to supplies; the continued industrialization of major populations around the world is increasing the rate of use and cost of this resource. Rising prices at the pump and the increased cost of heating our homes have placed further strain on Vermonters' pocketbooks. Oil also presents environmental costs not fully captured in the price of a barrel, and contributes to the challenge of climate change.

It is imperative that we take more control over our energy future. Vermont's dependence upon oil for a large portion of our heating and the vast majority of our transportation needs is a vulnerability that we should work aggressively to address in the next 20 years—by taking what we have learned from our electric efficiency efforts and applying it to heating efficiency improvements; by supporting the use of renewable sources for heating, including biomass and blended biofuels; by helping to transition our local transportation and heating fuel companies and workers to the new energy future; and by planning for the infrastructure changes required to move part of transportation energy onto the electric grid.

In considering the goal that we have set, consider also the acceleration curve caused by innovation. Computing and communications technology tell the story—small steps in early years leading to major, unforeseeable changes in later years. The overlay of communications technology onto our electric grid, the acceleration of renewable technology and concomitant lowering of price, and the emerging electric vehicle industry mean that we are on the brink of large changes in the energy industry, pushing us toward bold goals.

But near-term, smaller, and tangible steps are required now. We have no illusions that our march toward our mid-century goal will be, or should be, linear. The next decade is a time for focusing on heating efficiency as effectively as we've focused on electric efficiency in the past decade. We also must plan for the transportation funding and infrastructure changes that will be required as we transition to plug-in electric vehicles (PEVs). We must establish a smart grid capable of managing load and distributed generation so that we can expand renewable projects here, increasing our energy security and jobs. Investments in renewable energy, including Vermont-based projects, will lead us to greater energy independence and reduced costs for all Vermonters. We must also integrate more energy generation into our working agricultural landscape, to support our farmers and our energy future at the same time.

We are aiming to enhance our state infrastructure—the energy infrastructure for the 21st century. Making these choices will create well-paying jobs, reduce total costs for Vermonters, and support a better quality of life.

Why We Must Achieve Our Goal

There are *four key benefits* obtained by achieving our ambitious goal.

1. Foster economic security and independence.

Focusing further efforts on efficiency will create jobs, enhance local economic activity, and reduce total costs for Vermonters. Enhancing Vermont's use of renewable resources will reduce our dependence on oil and other fossil fuels, which are subject to price volatility and uncertain supply. The goal will be to keep more of Vermonters' dollars in state and in region, and to keep energy affordable for the long term by significantly curtailing our reliance on fossil fuels.

2. Safeguard our environment.

Our move toward renewable energy sources must be strongly coupled with enhanced energy efficiency programs and conservation education, in keeping with our state's long-standing environmental leadership. Some may ask, "what can the small state

Action Step: Investigate Alternative Economic Progress Indicators

In our Energy Plan meetings, we heard from Vermonters concerned that traditional economic progress measures do not adequately account for real economic benefits and harms associated with the choices we make—for example, loss of habitat caused by development. The administration is investigating adding such measures to our current economic measures, including Genuine Progress Indicators already in use elsewhere, and already the subject of research by UVM's Gund Institute.

efficiency training, building upon the success of the Central Vermont Community Action Council's recent stimulus-funded program.

- Support greater efforts by the Vermont School Energy Management Program to document current school building conditions, recommend energy improvements that will lead to savings, and then help implement all cost-effective improvements in our school buildings.

- In the context of Efficiency Vermont screening processes and the all-fuels efficiency research discussed above, consider the need to expand the health and safety measures presently used for efficiency projects delivered to low-income Vermonters to include the improved quality of life and better building integrity certain measures may provide. If an affordable home can be made significantly more comfortable to live in and durable by replacing windows that otherwise frost over every winter, we should account for that benefit in choosing investments even if such a project would otherwise not present the lowest bottom-line improvement that could be put in place, to keep our stock of affordable housing and ensure homes meet the needs of residents.

- Continue to work with the Vermont Energy Climate Action Network and others to deepen the town energy committee impact in Vermont. Many towns are undertaking great projects with significant impact. *See VNRC, VLCT Communities Tackling Vermont's Energy Challenge*, April 2011. Ensuring that such committees continue to thrive, and are used in even more towns throughout Vermont, will help bring energy efficiency and conservation to the grassroots. Town energy inventories and challenges, among other initiatives, should be encouraged and the successes loudly trumpeted.

The Strategy for Electricity and for Renewable Energy

Vermont policies and utility choices have already put us in a very good position. While maintaining a regionally competitive electricity rate for Vermonters, we have attained nearly half of our present electricity needs from renewable resources, including large-scale hydro. At the core of our energy strategy in the next two decades and beyond must be an effort to continue our progress on renewable electricity, not only to meet our present electricity needs but also to allow our other energy needs to transition to electricity to the maximum extent possible—largely trading volatile, high-cost, and environmentally harmful petroleum-based fuels for renewable electricity. In order to achieve our long-term vision of allowing Vermonters to virtually replace petroleum-based fuels with renewable fuels, including biofuels and renewably generated electricity, we must encourage further growth of the renewable energy sector of our economy and also make strategic regional decisions to ensure that progress accelerates. Our goal is to bring local and regional renewable generation to a point of ubiquity and greater affordability compared to the fuels it will replace.

Here are some of the ways we recommend driving this transformation:

Regulatory Policies and Structures

Currently, we are on a pace to increase in-state renewable generation by about 13% by 2013, compared to 2005 levels. If the present voluntary Sustainably Priced Energy Enterprise Development (SPEED) program were to remain in place unchanged—seeking 20% qualified renewable resources by 2017—our pace would have to remain at least as fast to reach our goal. *See Vol. 2, Sec. 5.*

Action Step: Investigate a Total Energy Standard

Our vision for Vermont's future requires significant renewable energy usage in all sectors—not just electricity generation. Although we have policies in place to drive renewable resources in the electric sector, we have not yet effectively addressed Vermont's heavy reliance on fossil fuels in other sectors. Innovative programs to encourage greater efficiency and usage of renewable energy sources in transportation and heating would help Vermont meet its goals, and would address concerns raised by many Vermonters during this planning process that present policies do not adequately address heating and transportation energy uses. We recommend an interagency and stakeholder working group to develop a plan for a Total Energy Standard, based upon a picture of Vermont's total energy usage of 154 TBTUs, of which 23% is presently renewable. Targets for efficiency and total renewable energy should be investigated, along with mechanisms to achieve steady progress in thermal and transportation fuels. Such an innovative program would further Vermont's national energy leadership.

www

sources that meet the definitions used in this scenario. Additions between 2012 and 2031 were modeled to include wind projects currently under development, 60 MW of biomass, additional wind deployment (whether in-state or out-of-state) that would roughly double the amount of wind electricity used in Vermont, and continued growth in net metered solar PV.

(2) DSM case ("High Efficiency"): Assumes incremental DSM is implemented in Vermont throughout the CEP period (2012–31) following the current DPS proposed budget, including the ongoing impacts of prior-year DSM spending. Efficiency funding is directed at both electric and thermal efficiency (electric efficiency is funded by electric ratepayers and thermal efficiency is funded by FCM and RGGI revenues). Investments in new renewables are decreased relative to the Base Case because of the smaller amount required to meet minimum assumed renewable portfolio requirements commensurate with decreased energy use in Vermont, but still constitute 25% of the portfolio by 2025. As with the Base Case, 9% of Vermont's 2012 electricity is expected to be produced from renewable sources that meet the definitions used in this scenario. Renewable technologies deployed between 2012 and 2031 are similar to those in the Base Case, but new wind deployment is reduced by approximately half due to reduced demand.

(3) High renewables and DSM case ("High Efficiency + High Renewables"): Includes all DSM in Scenario 2, and includes new renewable energy resources to reach the goal of meeting 75% of Vermont's electricity use with renewables, including hydropower and existing biomass. Forty-eight percent of Vermont's 2012 electricity is expected to be produced from renewable sources that meet the definitions used in this scenario. Additions between 2012 and 2031 were modeled to include substantially similar renewable deployment as the High Efficiency scenario, with the following changes: an additional 50 MW of solar using an expanded Standard Offer; additional Hydro-Quebec purchases including off-peak periods; and additional out-of-state large hydropower.

For all scenarios, only the projects already proposed, Standard Offer projects, distributed generation, and biomass were required to be deployed in Vermont. A complete description of each electric portfolio's parameters, assumptions, and modeling results are found in Appendix 4—Modeling Study. The energy and economic impacts of the DSM case (Scenario 2, "High Efficiency") and the combined DSM and high renewables case (Scenario 3, "High Efficiency + High Renewables") are summarized below.

3.3.2.2 Load Forecasts and Projections of Demand-Side Management (DSM) Resources

For all three modeled scenarios, the New England and Vermont load forecasts were based on the CELT (capacity, energy, loads, and transmission) forecasts published by the New England ISO.[19] For this study, the CELT forecast was adjusted to reflect Vermont DSM investments in 2011 and all prior years. In the Base Case, these investments were modeled to cease in 2011. This results in a decreasing DSM impact through the study

[19] http://www.iso-ne.com/trans/celt/report/index.html

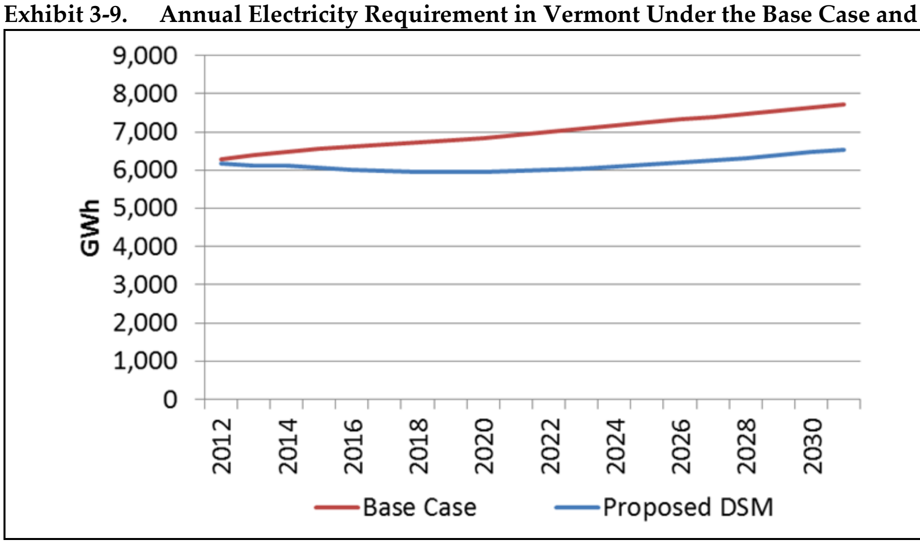
period as the impact of those investments decays over time; the average measure life is 11 years. Modeling the Base Case without efficiency investments allows quantification of the costs and benefits of efficiency programs.

For the DSM cases (Scenario 2, "High Efficiency," and Scenario 3, "High Efficiency + High Renewables"), the model assumed the level of energy efficiency program funding for Vermont recommended by the DPS and (for 2012–14) approved by the Public Service Board (PSB) beginning in 2012 and continuing through 2031. This results in increasing DSM impact through the study period, although the efficiency yield per dollar of program spending is modeled to decrease.

Other assumptions required for modeling the electricity market and costs for consumers in Vermont include fuel price forecasts, emissions prices (including the future cost of greenhouse gas emissions), transmission interface limits, and resource additions and retirements during the study period. The renewable electricity requirements and portfolios in each scenario are described above.

The resulting annual electricity requirements for Vermont under the Base Case and DSM cases—both Scenario 2 and Scenario 3—are shown below.

Exhibit 3-9. Annual Electricity Requirement in Vermont Under the Base Case and Proposed DSM Scenarios



Source: Appendix 4—Modeling Study, Exhibit 4

3.3.2.3 Economic Modeling

Synapse and the DPS collaborated in the use of the PI+ model (formerly Policy Insight) developed by REMI (Regional Economic Models Inc.) to estimate the economic impacts of the modeled electricity policies. The PI+ economic model's dynamic functionality captures structural changes in the regional economy that result from economic inputs and costs. Its built-in baseline forecasts of economic activity are calibrated to Vermont. The modeled policy changes result in changes to this forecast economic activity. In this study, such changes include alterations in consumer spending, in businesses' energy costs, and in additional commercial activity and industry demand related to energy efficiency investments. The model results presented below illustrate the

Recommendation

The DPS should facilitate VSPC consideration of efficiency as a least-cost resource to defer or avoid transmission and distribution infrastructure development.

4.3 ISO-New England and Forward Capacity Market Participation

Although there is currently more than adequate generation capacity to serve the region, that was not the case a few years ago. The ISO-New England (ISO-NE) Forward Capacity Market (FCM) was developed to ensure the region would have sufficient generating capacity to meet its needs by providing advance revenues to entities that commit to providing or avoiding a particular amount at a particular date. The FCM allows not only generators, but also demand reduction, to bid into the market—so that ISO-NE may rely on either more capacity or less use in meeting demand. Vermont's portfolio of efficiency savings is submitted to the FCM, and it is used to help meet the region's need for capacity. Costs for participating in the market, including compliance with rigorous measurement and verification standards, are far exceeded by the revenues received. These revenues have been directed by the Vermont General Assembly to be used to support heating and process fuel efficiency programs (see Section 7—Thermal Energy Efficiency).

In planning for the region's capacity requirements, ISO-NE forecasts annual and peak energy consumption 10 years into the future. Regional discussions are under way between ISO-NE, the New England States Committee on Electricity (NESCOE), and public utility commissions to enable regional transmission planning to better reflect the region's collective investment in energy efficiency resources and the resulting reduction in load. Better efficiency forecasting will lead to better FCM structure and lower costs for regional ratepayers.

Recommendation

Increase the Department of Public Service's participation in ISO-NE efficiency forecasting efforts to ensure efficiency is appropriately reflected in ISO-NE's long-term planning.

4.4 Impact of Electric Efficiency Investments

In addition to significantly reducing the amount of electricity Vermont utilities need to purchase in order to serve ratepayers, the savings acquired by the EEUs provide numerous benefits to Vermont's electric grid, Vermont ratepayers, and the Vermont economy. Benefits include:

- Deferring or avoiding local or regional distribution or transmission projects (as described above). Infrastructure construction is expensive—and if targeted appropriately, energy efficiency can be an effective alternative to such construction.
- Reducing Vermont's share of the Regional Network Service (RNS) Charge. The New England states share the benefits and costs of reliability transmission projects completed in the region. These costs are significant, especially in the near term—in-progress, permitted, or planned transmission projects

are projected to cost approximately $5 billion regionally (in addition to the more than $4 billion of investment Vermont ratepayers are already funding).[27] Vermont pays these costs based on its contribution to the peak New England load. Investments in energy efficiency serve to reduce Vermont's share of the peak. Even small reductions in Vermont's load at the time of the New England peak create significant benefits for Vermont ratepayers. For 2012, avoided RNS costs are expected to be approximately $.015 per kWh saved.[28] In addition, the need for ancillary services provided by ISO-NE is shared across the region—another $.0066 per kWh saved to Vermonters based upon 2012 expected efficiency measures. Taken together, each kWh saved avoids more than 2 cents in RNS and ancillary charges alone.[29]

- Reducing the overall cost of purchased electricity. Energy efficiency investment lessens the need for the next, more expensive generating unit to be dispatched to serve the energy demand in the region. Because all generating units are paid the market clearing price, reductions due to energy efficiency cause lower costs to be applied to all generating options. This so-called "demand resources–induced price effect" directly lowers the cost of all market kWh sold in Vermont, and indirectly lowers the cost of long-term electricity contracts.

- Generating local jobs. Energy efficiency programs rely on local contractors, distributors, and retailers to facilitate service delivery. These stakeholders all benefit from increased private investment leveraged by efficiency.

- Reducing the carbon emissions from electricity generation. Although Vermont has a relatively clean portfolio of electricity generation, energy efficiency reduces the need to purchase electricity from the regional market. These generating units that run to deliver kWh required at the time of peak usage, often from natural gas or oil-fired generation of electricity, have significant carbon emissions associated with them. Efficiency investments reduce the need for these marginal generating units to be dispatched. The societal cost of carbon dioxide emissions was recently estimated at approximately $80 per ton of CO_2 equivalent.[30]

- Significantly reducing electric bills for customers who participate in programs, providing greater cash flow for commercial customers to reinvest in other business opportunities or needs, and providing more disposable income for residential customers to reinvest in the economy.

- Securing revenues from the ISO-NE Forward Capacity Market (FCM) for the benefit of Vermont (discussed above), to be used for thermal efficiency investments.

[27] *ISO-NE Regional System Plan Transmission Projects April 2011 Update, presentation, April 14, 2011.*

[28] *The RNS charges are based on kW rather than kWh. However, a kWh value is reported here for ease of use.*

[29] *Appendix 5—Economic Impacts of Energy Efficiency Investments, page 17.*

[30] http://www.synapse-energy.com/Downloads/SynapseReport.2011-07.AESC.AESC-Study-2011.11-014.pdf

- Creating other, non-quantified benefits for participants, such as increased productivity, safety, and comfort.

This list of electric efficiency benefits is compelling. However, the public investment is significant and is made up front—and there is a real initial rate impact associated with the energy efficiency charge. This rate impact must be acknowledged when considering efficiency investments made by the state's EEUs, and the savings and economic activity expected to result must be netted against this impact to ensure real and tangible benefit. To help understand and quantify these costs and benefits, the Department of Public Service commissioned Optimal Energy and Synapse Energy Economics to conduct a modeling analysis to determine the economic impact, in terms of both dollars and jobs, to Vermont of mandated electric energy efficiency investments. Many of the above factors were included in the analysis, as were the immediate negative economic effects of the rate impact caused by the state's energy efficiency charge. The study is included as Appendix 5—Economic Impacts of Energy Efficiency Investments.

The study found that energy efficiency investments generate significant net positive economic activity throughout Vermont in the form of purchase and installation of energy efficiency goods and services, administration of the program itself, and net energy savings to ratepayers and participants. Households that participate in the program save on energy costs and, therefore, can spend additional money in the local economy, spurring job growth. Businesses have lower energy costs that improve their bottom line, which enables them to be more competitive and to expand production and related employment. The investment in efficiency in itself also generates economic activity to the extent that equipment is produced, sold, installed, or maintained by Vermont businesses.

As noted above, these efficiency investments also cost participants money for their part of the efficient equipment and installation costs. Further, all ratepayers participate in funding the program. These costs are taken into account in the analysis, in that participants are negatively affected through their additional spending on the energy efficiency goods and services (constricting their ability to spend elsewhere), and all ratepayers are negatively impacted by the inclusion of energy efficiency program costs on their energy bills.

These negative impacts offset part of the positive impacts from savings and investment. However, the net results remain hugely positive for all Vermonters. Using a single year of electric efficiency investments based on the approved 2012 EEU budget, the study found that for every $1 million of public electric efficiency investment by the EEUs, $4.6 million of present value benefit is returned to the state. In terms of employment, the net change in employment in Vermont attributable to the program's total spending was approximately 46 job-years per $1 million (including direct, indirect, and induced economic activity that impacts employment). In addition, the study found that every dollar spent on EEU delivered electric efficiency that increased gross domestic product by a multiple of more than five. These results are unequivocal: Public investments in electric efficiency are beneficial to the Vermont economy.

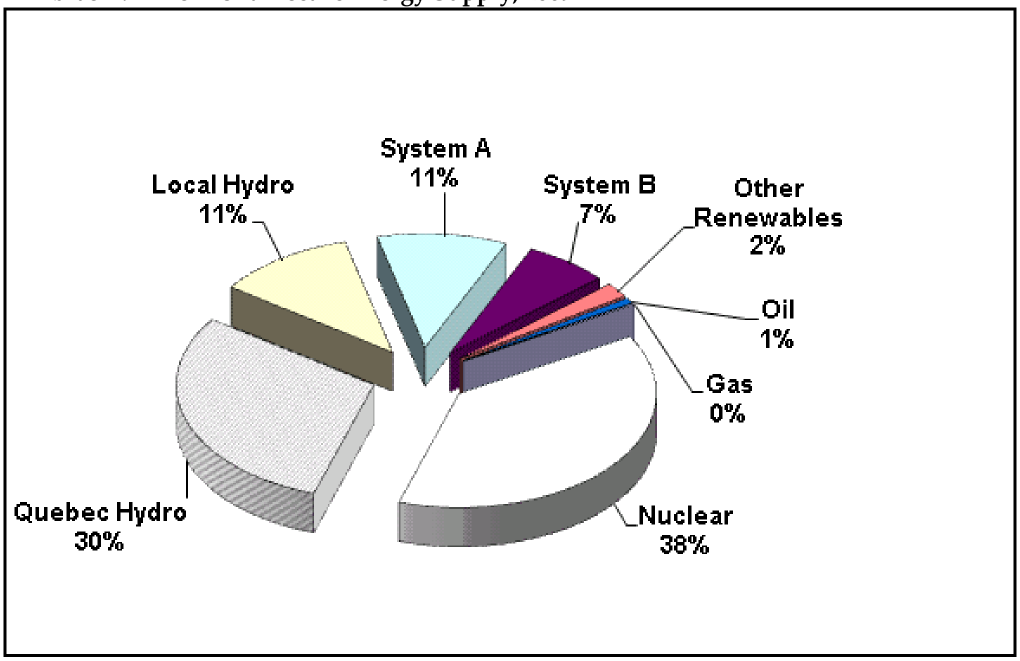
serve the entire electric load of the state of Vermont.[35] Recommendations are provided to facilitate acquisition of appropriate resources to set Vermont on a path to attain the goal of achieving 90% total renewable energy by 2050. We discuss specific policy tools that will help us achieve our goal.

5.1 Current Electric Supply

Historically, the Vermont electric grid has developed to function as an importer of electric energy, and its ties to New England, New York, and the Canadian provinces have served the state well. Nevertheless, Vermont-based resources have supplied a significant portion of the state's electric need.

Although the composition of portfolios for any one utility can vary, the aggregate supply of committed contracts or generation units (as opposed to open market purchases) has provided 85% to 90% of Vermont's energy needs over the last several years, of which 55% to 60% has been from Vermont-based resources. Exhibit 5-1 shows the mix of sources that supplied electric energy to end users in 2009.

Exhibit 5-1. Vermont Electric Energy Supply, 2009[36]



This supply mix is currently dominated by stable long-term commitments focused on two sources—Hydro-Quebec (HQ) and Vermont Yankee, which together have supplied approximately two-thirds of the electricity

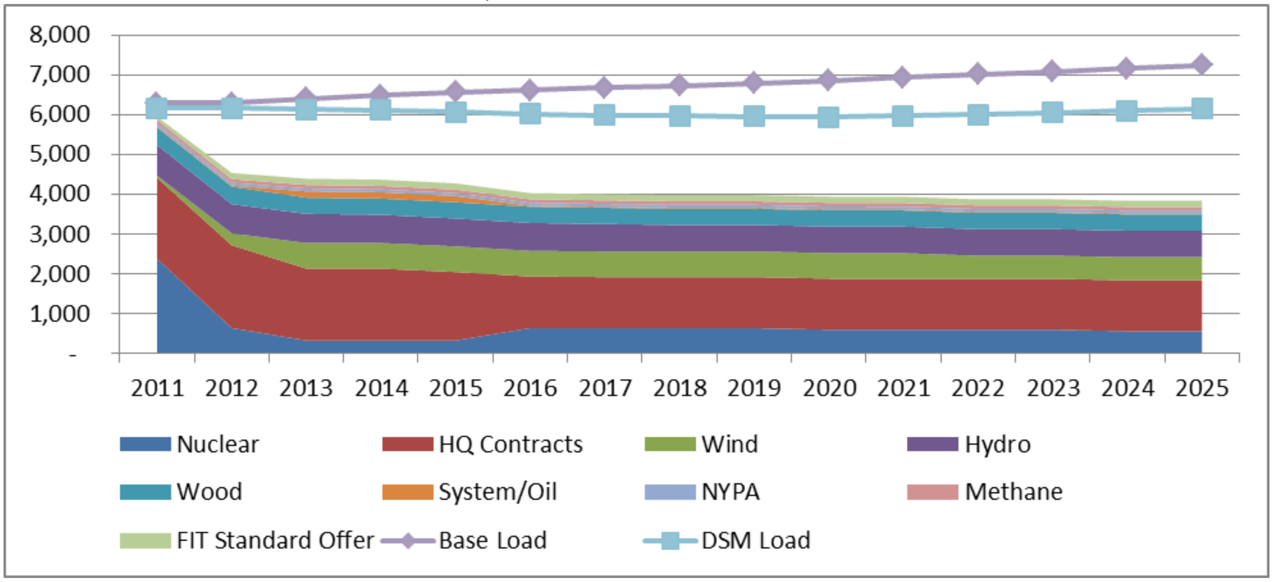
[35] *Forecasts of demand and policies to reduce demand can be found in Section 3. Moreover, although it is discussed in the context of reducing demand earlier in the CEP, efficiency can also be considered a supply resource just like wind, solar, or any other generator, and is the first choice of the state in meeting demand.*

[36] *System A is market purchases of energy by Vermont utilities. System B is energy produced by Vermont renewable facilities where the renewable energy certificates (RECs) have been sold to third parties who now own and claim those environmental attributes.*

used in the state for the last several years. Those two contracts are due to expire in 2016[37] and 2012, respectively. The replacement of these long-term contracts has begun. Recently, a new contract was signed with HQ by a coalition of Vermont utilities for 218 MW of capacity starting in 2016. In addition, as described in more detail in the section on nuclear power, some Vermont utilities have already contracted for power to, in part, replace the power previously provided by the Vermont Yankee contract.

As shown in Exhibit 5-2, even with the new Hydro-Quebec contract and other contracts to replace power previously supplied by Vermont Yankee, a gap between contracted supply and expected demand still exists. There is, however, an excess of supply in our regional market at this time. Vermont remains tied to the regional power pool, so Vermonters will have access to the vast resources inside New England and neighboring areas through the wholesale markets.

Exhibit 5-2. Committed Electric Resources, in GWh



A significant portion of electricity supplied to end users in Vermont is currently from renewable resources. In 2009, in-state hydroelectric power accounted for 11% of supply, and other in-state renewable generation accounted for approximately 2%.[38] Further, power generated from renewable resources in-state with renewable energy certificates sold out of state accounts for another 7% of Vermont's electric supply, for a total of nearly 20%.[39] When the renewable power from Hydro-Quebec, which has been approximately 30% of supply, is counted, nearly 50% of the power supplied for purposes of Vermont end-use consumption is presently from

[37] *The current HQ contract phases out in stages between 2012 and 2020; the majority of the power deliveries end by 2016.*

[38] *The percentage of energy from in-state renewable sources varies from year to year, mainly owing to fluctuations in river levels and the associated water availability for hydro generation. Wood biomass electrical generation also varies from year to year based on market prices for electricity.*

[39] *Vermont utilities own commercial-scale wind and landfill methane projects. Most of the attributes from the landfill methane project were sold into neighboring Vermont markets and therefore cannot be claimed in Vermont as renewable energy.*

renewable sources. While not downplaying the challenges and efforts necessary, we believe this fact shows that a goal of acquiring most of our electric supply from renewable sources is reasonable and attainable.

Vermont utilities should continue to diversify their portfolios with appropriate mixes of renewable energy, through contract procurement and ownership of generating supply via both in-state and out-of-state sources, with a goal of increasing the total renewable generation sources in the state's power mix to at least 75% over the next 20 years. The following sections delineate all the current resources in the electric portfolio, and describe policies and strategies to help achieve greater renewable electricity use in the next 20 years.

Generators can be divided into classes based on their size and how they connect to the grid. The CEP uses three classifications: large-scale centralized, small-scale centralized, and distributed. Large-scale and small-scale centralized generators are tied to the transmission or sub-transmission grids, whereas distributed generation is tied to utilities' distribution circuits. Large-scale is defined as a generator of 200 MW or larger. All three of these classes of generation exist in Vermont.

5.1.1 Large-Scale Production In-State

The infrastructure requirements of large facilities limit their application in Vermont. Currently, the only large-scale generator located in Vermont is the 620 MW Vermont Yankee Nuclear Power Station (Vermont Yankee) in Vernon. Some Vermont utilities contracted for a portion of its power output through March 2012, and the remainder of its power is supplied to neighboring states or the wholesale market.

5.1.2 Small-Scale Centralized Generation In-State

Small-scale centralized generation in Vermont includes hydroelectric, wood biomass, landfill methane, natural gas, and wind generators; these facilities are owned by utilities or by independent power producers (IPPs) that operate under the auspices of the Public Utility Regulatory Policies Act (PURPA).

Utility-owned generators include the McNeil Generating Station (50 MW, wood biomass), Burlington Electric's gas turbine (25 MW), Washington Electric Coop's Coventry Landfill methane plant (6 MW), Searsburg wind facility (6 MW), and a number of small hydroelectric facilities.

5.1.2.1 Independent Power Producers

In addition to utility-owned generators, Vermont has several generators owned by private merchant producers. Recently constructed examples include the Sheffield wind project (40 MW); others, such as the Deerfield wind project and the Georgia Mountain wind project, have received CPGs (certificates of public good) but have not yet been built.

Most of the presently operating, independently owned renewable resources in Vermont were developed in response to the Public Utility Regulatory Policies Act (PURPA). PURPA was passed by the U.S. Congress in 1978 in order to create a framework that allowed renewable projects and cogeneration projects access to the grid at prescribed market rates. Each state was left to implement PURPA on its own; Vermont's implementation of PURPA was through the Public Service Board's Rule 4.100.

Rule 4.100 allowed renewable generators to access stably priced long-term contracts. Twenty hydro projects and one large wood project entered into contracts under this rule. This rule also set up a central purchasing authority (Vermont Electric Power Producers Inc.) to purchase the output from Qualifying Facilities and allocate the costs and energy among the Vermont utilities. The rates for these contracts were established largely during the 1980s and early 1990s, on the basis of then forecasted future market prices. Those estimates have proven to be relatively high compared to the market prices that have transpired since the late 1990s. Although Rule 4.100 and PURPA were successful in bringing renewable energy and independent power to Vermont and much of the region, this approach to stimulating the market proved to be an expensive one when evaluated retrospectively. PURPA renewable energy projects and their annual output can be found in Exhibit 5-3. As can be seen, many of these projects have contracts ending soon.

Exhibit 5-3. Vermont Electric Power Producers (VEPP Inc.)

Project[40]	Annual Output[41] (kWh)	Capacity[42] (kW)	Contract Ending Date
Barnet	1,814,000	490	Oct. 31, 2016
Comtu	2,367,970	460	Dec. 31, 2018
Dewey's	6,903,800	2,790	Jan. 31, 2016
Dodge	27,000,000	5,000	Dec. 14, 2020
Emerson	700,000	230	Oct. 31, 2015
Killington	295,400	100	May 31, 2016
Martinsville	712,000	250	Jan. 31, 2009
Moretown 8	2,519,000	920	Jan. 31, 2019
Nantana Mill	760,000	220	Mar. 31, 2020
Newbury	1,096,268	270	Oct. 31, 2017
Ottauquechee	5,834,000	2,180	Aug. 31, 2017
Ryegate	173,412,000	20,500	Oct. 31, 2012
Sheldon Springs	70,808,000	26,380	Mar. 31, 2018
Slack Dam	1,950,000	410	Oct. 31, 2017
Winooski 1	29,000,000	7,300	Mar. 31, 2013
Winooski 8	3,500,000	910	Dec. 31, 2015
Woodside	729,000	120	Apr. 30, 2017
Worcester Hydro	400,000	170	Oct. 31, 2016

In addition to the policy tools for renewable generation discussed elsewhere in this section, the following are specific recommendations related to these Qualifying Facilities:

Recommendations

(1) The state should work to maintain existing Qualifying Facilities provided that the plants can be operated cost-effectively compared to new renewable energy generation.

[40] *All the VEPP Inc. projects are hydroelectric plants, except Ryegate, which is a wood-chip combustion plant.*

[41] *"Annual Output" is an estimate (provided by the producers) of average yearly production.*

[42] *"Capacity" listed is maximum capacity. In some months the capacities for some of the hydros decrease because of statistical water flows.*

(2) *Vermont utilities should explore opportunities to purchase former Qualifying Facilities as well as similar new generation projects currently under non-utility development, if such purchases would lower ratepayer costs in comparison to continued merchant ownership.*

5.1.3 Distributed Generation

Generators that connect directly with Vermont's utility distribution grids include net metered systems and those deployed through the SPEED Standard Offer Program. More than 13 MW of net metering systems have received certificates of public good CPGs), and 50 MW of projects have been approved to receive the Standard Offer. Net metered projects are limited to 500 kW or less, and the Standard Offer projects are 2.2 MW or less. Distributed generation reduces the load on transmission systems by meeting load on a distribution circuit with generation on that or a nearby circuit.

5.2 Considerations for New Generation in Vermont

Electric generation in Vermont can be a boon to the state's economy. However, not every generation technology and scale may be appropriate to meet Vermont's needs. Larger projects yield greater generation and may be able to take advantage of economies of scale, but can have greater negative impacts; smaller projects have less individual impact, both positive and negative. Although the scale of smaller projects may be more readily accepted by Vermonters, it is important to ensure that the projects (which are likely to produce relatively modest contributions to Vermont's energy supply) truly reduce rather than just distribute, environmental impacts.

Building and operating electricity generation facilities requires significant investment that generates substantial direct, indirect, and induced economic benefit. A ripple effect of direct benefits results from development, including jobs, potential land-lease payments and increased tax revenues, indirect benefits from businesses that support the facility, and induced benefits from additional spending on goods and services (e.g., restaurants, retail establishments, and child-care providers) in the surrounding area.

Such projects create engineering, legal services, manufacturing, construction, and operation and maintenance jobs. Jobs related to wind projects are concentrated during the construction phase (however, these jobs are short-term and may employ some out-of-state workers). Apart from specific project job creation, Vermont is home to a number of energy companies that employ Vermonters and export expertise and products.

Construction of new large-capacity generators such as combined-cycle natural gas plants, nuclear generators, and coal generators creates significant regulatory and other risks, due in part to large capital expenses necessary to begin construction, environmental impacts of large-scale construction, and the likely need for significant upgrades to transmission facilities to efficiently move the power. Large-capacity combined-cycle gas plants have been the favored technology for most of the new generation built recently in New England—in fact, approximately 40% of New England's power is generated via natural gas combustion. A large natural gas plant built in Vermont would compete with similar plants in New England, but would have no apparent competitive

5.8.2.1.1 Undeveloped In-State Capacity

Obtaining an accurate estimate of how much undeveloped hydro capacity exists in Vermont and how much of that capacity can be developed in an environmentally benign way is challenging. Opinions differ on the amount of available hydropower in Vermont. Depending on assumptions used, reports vary from 25 MW at 44 sites (estimated by the ANR in 2008) to 434 MW at 1,291 sites (estimated in a DOE study in 2006).[71] A 2007 study for the DPS identified more than 90 MW developable at 300 of the existing 1,200 dams.[72] The ANR is currently working on an updated assessment of the undeveloped in-state hydro capacity.

Under any assessment, it is clear that the best hydropower sites have already been developed. There are very few undeveloped sites that could support capacity greater than 1 MW, and a relatively low number in the 500 kW to 1 MW range. There are many potential smaller community and residential sites sized at less than 200 kW.

Incentives such as net metering, group net metering, and the Standard Offer Program are necessary to facilitate the development of the smaller sites. The ANR has recently approved sites with generation capability as low as 15 kW and 50 kW.

Because there are few undeveloped sites that are candidates for new hydroelectric plants, an effective way to increase capacity is to improve efficiency and output at existing hydroelectric facilities through three types of activities: installing more efficient turbines, installing small turbines at the dams that utilize bypass flows, and installing new turbines that can operate efficiently over a wider range of flows. These upgrades are often possible without changing the current operating requirements, i.e., power production can be increased without additional environmental impacts.

In addition, existing municipal water supply and wastewater treatment pipelines could capture the energy in these systems by installing hydro turbines to the pipelines without otherwise altering the regular operation of the system. Such in-pipe hydroelectric systems have minimal environmental impact. The town of Bennington has developed such a project, and another project is under development by the city of Barre. These projects generate electricity from the excess pressure in the municipalities' water supply systems.

5.8.2.1.2 Regulatory Process

Unlike other types of local renewable energy development, hydroelectric projects are regulated by the Federal Energy Regulatory Commission (FERC).[73] New projects may also require a permit from the U.S. Army Corps of Engineers. These federal permits trigger state review delegated under the federal Clean Water Act.

[71] *Hall et al., 2006, U.S. Department of Energy.*

[72] *See www.vtenergyatlas-info.com/hydro.*

[73] *Hydropower in municipal water or wastewater systems may request an exemption from FERC licensing.*

- No new dam or other barrier to aquatic organism movement and sediment transport.
- Run-of-river operation.
- Bypass flows necessary to protect aquatic habitat, provide for aquatic organism passage, and support aesthetics.
- Fish passage where appropriate.
- No change in the elevation of an existing impoundment or in water level management.
- No degradation of water quality, particularly with respect to dissolved oxygen, temperature, and turbidity.
- No change in the upstream or downstream flood profile or fluvial erosion hazard.

The ANR has stated that more work is needed to define projects that are truly low-impact, regardless of size, and has committed to this project.

5.8.2.1.4 Hydro-Quebec and Other Out-of-State Hydro Resources

In addition to the approximately 10% of its power coming from in-state hydro, Vermont currently receives a significant portion of its electricity from out-of-state hydro, principally from Hydro-Quebec (HQ). HQ power is stably priced, immune to escalating fossil fuel prices and retrofit costs, and does not contribute to the air quality problems of our region.[76] Further, since the power is supplied from many generators, its reliability is based on HQ's total system reliability, rather than the performance of a single dam or plant. The Vermont Legislature has recognized this resource as renewable.

Vermont has a long-standing contractual relationship with Hydro-Quebec. In 1990, a group of eight Vermont utilities (the Vermont Joint Owners, or VJO) entered into a 30-year agreement to purchase baseload power from HQ and to make it available at wholesale prices to other Vermont utilities. Under this HQ/VJO contract, power purchases increased from 51 MW in 1994 to approximately 310 MW today. This is a take-or-pay contract (i.e., regardless of whether the Vermont utilities need the contracted power, they still pay for it, although they may resell excess HQ power in wholesale markets. Currently, the average cost of HQ/VJO power is 7.0 cents per kWh, which was 16% above the cost of market alternatives in 2010). The HQ/VJO contract phases out beginning in 2012, with a large portion of its deliveries terminating between 2012 and 2015 and the last schedule expiring by 2020. The HQ/VJO contract currently supplies roughly one-third of Vermont's power requirements.

[76] *All power purchased from HQ is system power and not tied to any single unit. Of the HQ power in 2010, 97.8% is from hydro. Hydro-Quebec, Sustainability Report 2010,* *www.hydroquebec.com/publications/en/enviro_performance/pdf/rdd_2010_en.pdf*

In 2010, 20 Vermont utilities signed a 26-year power contract with HQUS (the power marketing arm of HQ) to purchase 218 MW to 225 MW of electricity from January 2012 through 2038. Under this new contract, the contracting utilities also purchased an equivalent quantity of environmental attributes corresponding to the energy from the HQ power system mix composed of at least 90% hydroelectricity. However, the environmental attributes reflecting the HQ power system mix are not currently traded within New England and do not currently qualify for any New England REC program, because only Vermont currently recognizes this resource as renewable.

The new HQUS power purchase agreement's (PPA's) starting price is $58.07 per MWh for the first year of the contract.[77] After that, the price is derived by a formula that remains the same over the contract term. The formula is based on regional electricity prices, and the movement in general of price levels observed across the U.S. economy subject to a damping feature that limits the change from the prior year's price. Contract price adjustments are made annually. The contract is thus stably priced in a way that mitigates market price fluctuations. The annual adjustments are expected to keep the contract price closely associated with market prices during periods of moderate volatility while significantly limiting Vermont's exposure to price spikes or sustained high price periods. In general, this type of protection can be obtained only from resources (like renewable energy) that are not directly exposed to high fossil-fuel input costs. The price of power under the HQ PPA is expected to be either competitive with, or favorable to, forecast market prices over its term and lower than the price of currently available power sources with similar characteristics, and the arrangement offers other favorable characteristics (low air emissions, relative price stability, renewable fuel, freedom from relying on a single generator, and potential for power system benefits).

Vermont will buy this new HQ energy via an internal bilateral transaction (IBT). An IBT significantly reduces performance risk to the utilities and their ratepayers compared to the HQ-VJO contract or to other non-firm power. The IBT mechanism also assures Vermont that the HQUS power deliveries will provide protection from lack of diversity associated with the HQ-VJO contract.

Under the HQUS contract, the initial amount of energy provided is equal to the current transfer capability at the Highgate interconnection, which is 218 MW. If Highgate's transfer capability is increased to 225 MW during the term of the HQUS contract, then delivered energy will likewise increase. Although the contract amount is tied to the size of the Highgate interconnection, Vermont can and does receive power through other interconnections, and the HQUS contract does not require delivery of power at Highgate.

HQ currently has approximately 41,000 MW to 42,000 MW of generating capacity. Approximately 97% to 98% of HQ's power system portfolio is produced by hydroelectric facilities. According to HQ's most recent strategic plan, HQ has a surplus of approximately 10 terawatt hours (approximately 5%) and is expected to add another 10 terawatt hours (an additional 5%) of hydroelectric supply by 2014. In other words, HQ has additional supply available for export.

[77] *The following language has been obtained from the docket for the current HQ contract. The docket order can be viewed at psb.vermont.gov/docketsandprojects/order/2010. Look for order #7670 dated 9-15-10.*