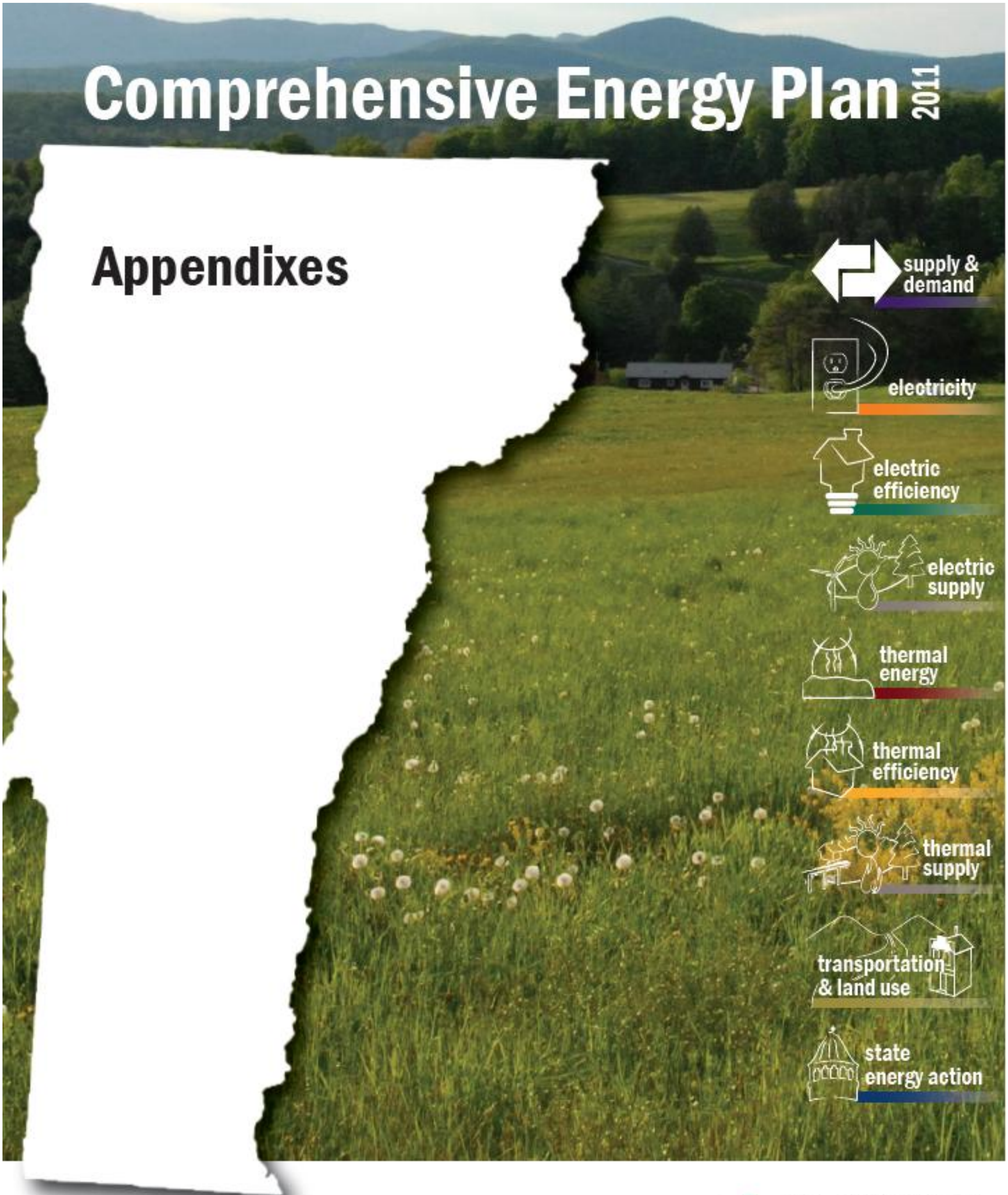
Comprehensive Energy Plan 2011

Appendixes



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Vermont's Energy Future: A Conceptual Map of Vermont's Energy Goals and Decision Makers

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Vermont's Energy Future: A Conceptual Map of Vermont's Energy Goals and Decision Makers

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Introduction

Energy planning is a complex matter; none of us can deny that. The technology is complex, the operational decisions are complex, the financing is complex, and the environmental effects are complex as well. Thus, energy *policy* and energy *decision making*, which try to pull together all of these elements, are inevitably complex as well.

Does this mean that we should throw up our hands and leave the decisions to technocrats and monopolists or, perhaps worse, abandon all efforts to plan and pursue a better energy future? Or can we work together, from all parts of Vermont, to seek reliable, affordable, and sustainable power?

This report presumes that Vermonters can do exactly this. However, we also believe that doing so requires a serious effort to understand our current structures and potentials: a kind of "conceptual map" that recognizes complexity, but also recognizes the order and the patterns in Vermont's current energy world. With this base, we can hope to build, together, decisions for Vermont today…and for our heirs.

Goals

The overarching goal of this Conceptual Map of Vermont's Energy Goals and Decision Makers (CM) is to provide an overview of Vermont's energy policy, legal, and regulatory landscape. The Conceptual Map was commissioned by the Department of Public Service to serve as an appendix the Department's Comprehensive Energy Plan (CEP). In this sense, the Conceptual Map supplements the plan by tying it to the current state law and identifying the legal and regulatory boundaries (set by federal, state, and local law) within which any energy policy must be implemented. However, the views expressed in this document are those of the Institute for Energy and the Environment of Vermont Law School and may or may not reflect the views of the DPS.

Scope of Review

Energy Policy Areas

This Conceptual Map deliberately follows the structure of the Comprehensive Energy Plan. Thus, it examines the following six energy policy areas: (1) electricity; (2) thermal (heating); (3) transportation; (4) end-use energy efficiency; (5) climate change; and (6) energy-related taxes and fees. Most of the energy policy areas are closely related. It is virtually impossible to imagine a conversation about climate change without mentioning the contribution that transportation, electricity and heat generation make to the increasing global temperatures. Similarly, efficiency is often mentioned as the top reliability tool in the electricity and heating solutions toolbox. Thus, we focus on the unique characteristics of each energy policy area in the dedicated section and mention the area's applicability in related sections.

Legal Sources

It is critical to note that our analysis is largely based on the text of the applicable statutes, rules, and regulations. We, generally, do not make conclusions about how well or how poorly the analyzed law *achieves* its goals. However, we close each section by noting several areas where tensions exist among multiple state policies. We examined the following types of legal sources:

State Level

- Vermont statutes;
- Findings of the Vermont Legislature;
- State legislative bills;
- Acts of the Vermont Governor including executive orders;
- Acts of the Public Service Board (PSB) (rules and orders);
- Rules and regulations promulgated by other Vermont state agencies, including the Department of Public Service (DPS);
- Vermont state court decisions.

Federal Level

- Federal statutes;
- Federal legislative bills;
- Rules and regulations promulgated by several federal administrative agencies such as the Federal Energy Regulatory Commission (FERC), the Environmental Protection Agency (EPA), the Internal Revenue Service (IRS) and others;
- U.S. Supreme Court decisions and decisions of federal district and circuit courts.

Municipal level

- Acts of municipal governments such as city council resolutions, municipal ordinances and codes;
- City and town charters codified by Vermont Statutes Annotated.

Several *secondary* sources address Vermont's energy situation and goals. For example, in 2009 Vermont Journal of Environmental Law published an article by John A. Sautter, James Landis, Michael H. Dworkin (one of the co-authors of this document) entitled: "Energy Trilemma in the Green Mountain State: An Analysis of Vermont's Energy Challenges and Policy Options." However, this Conceptual Map focuses on *primary* sources of actual legal authority.

Structure of the Conceptual Map

We focus on identifying goals and key substantive points in the legal and regulatory framework sections of the Conceptual Map. There, we also highlight limits and opportunities created by federal and local law that affect the state's ability to advance goals in the energy field. We provide a description of the main players and their roles in the structural overview sections of the Conceptual Map. In the section devoted to climate change, we provide a chart of five different organizations created to address climate change on the state level. We include decision-making maps for the electricity, thermal, and efficiency sections. Each map provides an "at a glance" view of each key player, the goals that the player is responsible for, and the duties assigned to the player by the applicable statute, order, rule, or regulation. Please use the following key to read the decision making maps.

We also include more comprehensive versions of the decision-making maps in the Appendix. There, we provide an expanded description of each player's role and add colored arrows represent the nature of the relationship among the players.

To illustrate how goals and drivers work or do not work together in practice, we include several "Spotlights," sections giving real examples of the energy field "in action." We conclude each section with a brief restatement and analysis of the goals and drivers of each energy policy area. In our analysis, we evaluate implicit and explicit statutory and regulatory goals according to the rubric known as of the Energy Trilemma or "Three Es of Energy:" (1) economy (economic impacts); (2) energy security (reliability); and, (3) environment (sustainability). We also identify available drivers that can help to reach each goal. We adopted the Department of Public Service's (DPS) classification of drivers from the Comprehensive Energy Plan.

Key for Decision Making Maps

Vermont Agency

Non-Government Actor

Federal Agency

Municipal Government

Boxes that combine more than two colors indicate either a governmental body that operates on more than one level or a private entity given the authority of a governmental agency.

Boxes highlighted in yellow represent key players within the map's central energy policy area.

= Energy security (reliability) is a goal for which this player is responsible.

= Environment (sustainability) is a goal for which this player is responsible.

= Economy (economic impacts) is a goal for which this player is responsible.

Electricity

A Regulated Commodity Under Deregulatory Pressure

The advent of electricity in the early 20th Century led every state, including Vermont, to embrace the so-called "regulatory compact" in which investor-owned utilities were subject to plenary regulation by the state, including the setting of rates and the obligation to serve all customers, in exchange for a monopoly on providing electric service in a designated territory. In Vermont, this pervasive regulation covers all utilities, including those that are owned by the public (municipal utilities) and those owned by the utilities' customers (rural electric cooperatives). The objective, as explicitly declared by the Vermont Legislature, is 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." 30 V.S.A. § 202a(1).

In the final decade of the 20th Century, Congress and about half the states, Vermont notably *not* among them, embraced the notion of restructuring the electric industry. Federal regulation of wholesale power means that producing electricity is no longer the exclusive province of utilities; power now trades at wholesale, and the bulk power transmission system is subject to open access to utility and non-utility producers alike.

Unlike the restructured states, Vermont has allowed its utilities to remain vertically integrated and thus retail customers must purchase their energy from the utility in whose service territory they are located. But nearly all of Vermont's power is acquired by the utilities from elsewhere, pursuant to wholesale contracts. Therefore, in some senses, Vermont's utilities are in a situation not unlike counterparts in neighboring states that have been compelled to divest their generation assets.

Regulation of the electric industry in Vermont has been vigilant and creative. Accordingly, Vermont is the national leader when it comes to promoting energy efficiency, and its commitment to renewable energy is both distinctive in its methodology and highly successful. In 2002, Vermont approved the sale of its only nuclear power plant from a consortium of utilities to a non-utility owner, with conditions designed to give the state the opportunity to opt out of nuclear power generation altogether in 2012.

Legal and Regulatory Framework

Applicable Principal Statutes, Rules, and Regulations

We have reviewed a number of sources that shape Vermont's electricity policy. The key sources include:

State Level

- Sections 2291-2291b of Title 10, concerning state agency energy plan;
- Chapter 1 of Title 30, establishing the Department of Public Service (DPS) and Public Service Board (PSB);
- Chapter 5 of Title 30, describing the DPS and the PSB powers and duties regarding electric utilities;
- Chapter 77 of Title 30, setting forth duties of electric utilities;
- Chapter 79 of Title 30, authorizing municipal utilities;

- Chapter 81 of Title 30, authorizing electric cooperatives;
- Chapter 83 of Title 30, authorizing the Vermont Public Power Supply Authority (VPPSA);
- Chapter 89 of Title 30, concerning the Sustainably Priced Energy Enterprise Development (SPEED) program, Regional Greenhouse Gas Initiative (RGGI), and renewable energy generally;
- PSB Rules 1.000, 2.000, 4.100, 4.200, 4.300, 5.100, 5.200, 5.300, 5.400, and 5.500;
- PSB orders in individual rate cases, permit applications and other dockets;
- Retail utilities' tariffs as approved by the PSB;
- DPS Rules governing appliance energy efficiency standards.

Federal Level

- Federal Power Act (FPA), including the Public Utility Regulatory Policies Act (PURPA);
- Atomic Energy Act (AEA);
- Rules of the Federal Energy Regulatory Commission (FERC);
- Tariffs of transmission utilities and ISO-New England (regional transmission organization) as approved by the FERC.

Municipal Level

- Municipal ordinances.

Policy Goals, Key Substantive Points, and Jurisdictional Boundaries

"Joint" Jurisdiction of Electricity Regulation

Electric service consists of three components: generation (i.e., the actual production of electricity), transmission (i.e., the movement of electricity at high voltage from where it is produced to the substations of the utilities where it will be used), and distribution (i.e., the movement of electricity from the substation, where it is stepped down from high to low voltage, and subsequently, delivered to the meters on the premises of retail customers). Broadly speaking, the Federal Energy Regulatory Commission has jurisdiction under the FPA over the rates and service provided by generators (but not the siting of or need for such facilities), as well as the transmission system. The remaining aspects of electric service, including the need for and siting of new generation facilities, rates for retail electricity, and the distribution system, are subject to state jurisdiction. Municipalities play a limited role, except insofar as they have opted to serve as a utility themselves.

State Level

Statutory Goals

Although this sub-section contains predominately an overview of policy goals, the discussion will not be fruitful without a proper introduction of two major players in the state's electricity policy area: the Public Service Board (PSB) and the Department of Public Service (DPS). The PSB is a quasi-judicial decision-making body that sets utility rates and decides other utility cases. The DPS, in turn, is tasked with representing the interests of consumers before PSB. In addition to representation before the Public Service Board, the Department of Public Services assumes a broader role of representing the interests of the state in energy-related matters. DPS is also the executive branch agency that develops and advances the state's public policy in the energy field.

All three energy policy goals can be easily derived from the Public Service Board's and Department of Public Service's statutory mandates. The economic goal of the state's electricity policy flows from the following provisions of Title 30. The Legislature has required the Department of Public Service and the Public Service Board to embrace the concept of least-cost integrated planning. 30 V.S.A. §202a(2). As adopted in numerous jurisdictions, least-cost integrated planning requires regulators to consider all available options (e.g., wholesale purchases, development of large and small generation facilities, improvements to transmission and/or distribution networks, conservation and efficiency initiatives) in a holistic rather than piecemeal fashion. Under Section 218c, each electric and gas utility (including Vermont Electric Power Company (VELCO), the transmission utility with no retail customers) must obtain Public Service Board approval of, and then implement, a least-cost plan. Such plans must assure service to customers "at the lowest present value life cycle cost, including environmental and economic costs." 30 V.S.A. §§ 218c(a)(1).

A distinctive aspect of Vermont's scheme of utility regulation, pursuant to Sections 211-212b, is the authority vested in the Department of Public Service to purchase power at wholesale and sell it at retail, so along as the transactions meet a cost-benefit test for retail customers, the state is not exposed to unreasonable financial liability, and the initiative promotes "effective competition." Section 212c requires PSB approval for such arrangements based on enumerated criteria that relate to economic benefits and consistency with the state's energy plan. The Public Service Board ruled that such filings would require a degree of documenting support equivalent to a utility power purchase. Consequently, the Department of Public Service has not exercised this authority in recent years.

The energy security (reliability) goal is derived from the statutory requirements imposed on the Department of Public Service by the Legislature. Section 214 gives the Public Service Board authority to order utilities to connect their transmission or distribution systems to one another, and sell (or purchase) energy from one another, as long as it does not impair the subject utility's ability to serve its own customers. The Public Service Board is authorized to determine the rates and charges for such service. Finally, the Public Service Board has explicit authority under Section 210 to order electric companies to build or rebuild electric transmission lines in order to provide adequate interconnection among the transmission systems of the state. The construction must be in the interests of consumers of electrical energy, not detrimental to the interests of the investors of the company ordered to build or rebuild, and consistent with the public good.

Title 30 addresses the environmental goal as well. Section 202 requires the Department of Public Service to take develop an energy plan for the state, which takes into account public health and safety, preservation of environmental quality, potential for reduction of rates paid by retail electricity customers, potential for reduction of demand through conservation and rate incentives, use of load management technologies, efficiency of electrical usage, use of waste heat from generation, and utility assistance to consumers for energy conservation. There is a specific requirement that, by 2028, at least 60 MW of power be generated within the state using renewable resources or via combined heat and power facilities.

Regulated State and the Concept of a Utility

Section 201 of Title 30 makes any individual or entity, including municipalities and electric cooperatives, that own or conduct "any public service business or property used in connection therewith," subject to plenary utility regulation by the Public Service Board and the Department of Public Service. Section 203 specifies that such companies include those that are "engaged in the manufacture, transmission, distribution or sale of gas or electricity" directly or indirectly to the public. Energy-related enterprises, such as suppliers of fuel oil and gasoline, are not on the list of regulated industries in Section 203.

Rates and Rate Design

As we mentioned above, in exchange for a monopoly on providing electric service in a designated territory, a utility gives up the right to set the rate it charges its customers to the state government. Under 30 V.S.A. § 218, the Public Service Board has broad authority to set utility rates that are "just and reasonable." The process of setting utility rates is called "ratemaking" and is based on each utility's cost of providing service.

A rate case is a quasi-judicial proceeding that begins with a detailed filing by the utility justifying the proposed rates. Sections 225, 226 and 227 lay out in detail the process by which the Department of Public Service considers proposed utility rate increases. The Department of Public Service then makes its own detailed response on behalf of the utility customers. Section 227(b) makes clear that the Public Service Board may initiate a rate case on its own motion, which means that if a utility's rates are too high (e.g., if the rates allow a utility's shareholders to receive an unreasonably high rate of return), the Public Service Board has the authority to reduce them via a rate case.

Others with specific interests not advocated by the Department of Public Service may seek permission to participate as a party. In a rate case, the utility, the Department of Public Service and any other parties exchange information via discovery, submit written testimony, and cross-examine witnesses at hearing. A hearing officer of the Public Service Board presides and makes an initial decision, subject to appeal to the three-member Public Service Board itself.

A rate case resolves two key questions: (1) the utility's revenue requirement, and (2) rate design. The revenue requirement includes the utility's operating costs as well as a reasonable return on the utility's investment in rate base (i.e., the assets used by the utility to provide service). Rate design involves allocating the revenue requirements among the different groups of customers served by the utility (e.g. residential, commercial, and industrial) and types of service provided by the utility. Rate design is a critical tool for discouraging certain types of energy use (e.g., demand at peak times) and encouraging others (e.g., demand at off-peak times or demand for renewable energy). The federal Public Utility Regulatory Policies Act (PURPA), in combination with 30 VSA § 209(a)(8), authorizes the PSB to approve rates, based on avoided cost, for non-utility generation facilities that use biomass, waste, renewable resources or cogeneration.

Section 218d specifies that alternative regulation plans must "offer incentives for innovations and improved performance that advance state energy policy such as increasing reliance on Vermont-based renewable energy and decreasing the extent to which the financial success of distribution utilities between rate cases is linked to increased sales to end use customers and may be threatened by decreases in those sales." The state's two major investor-owned electric utilities are now operating under "alternative regulation" plans that allow for automatic rate adjustments as specific costs vary.

The Public Service Board is required to implement rates that encourage energy efficiency, including the possibility of "residential inclining block rates." The Public Service Board is authorized to consider "dynamic pricing" (i.e., real-time changes in retail prices based on conditions in the wholesale market) made feasible by "smart grid" technologies. Utilities may also recover in rates the cost of seeking approvals for the construction of new renewable energy facilities, regardless of whether the approvals are granted.

Wholesale Power

Although under the Federal Power Act, the Federal Energy Regulatory Commission reserves to the right to determine whether wholesale rates are just and reasonable, 10 V.S.A. § 248(a)(1)(A) vests the Public

Service Board with the responsibility to determine whether a utility's purchase of electric capacity or energy from outside Vermont is consistent with the "general good of the state." This review is only triggered by purchases that exceed five years and represent more than one percent of the utility's historic peak demand.

Net Metering

In 30 V.S.A. § 219a, the Legislature authorized Vermont electric customers to engage in "net metering" with their utilities. In essence, this allows customers to generate their own electricity using renewable resources, deliver any excess to the utility, receive credit for the energy, and also use the utility's power when the customer wishes. The statute limits such systems to 500 kilowatts and requires participants to obtain approval from the Public Service Board.

A separate provision in section 219a creates "group net metering." Essentially, this allows several customers to pool their resources, to jointly create a small-scale renewable generation system, and each receive a share of the credit for any power fed back onto the grid from that system.

Facility Siting

Section 248 of Title 30 operates as an analog to Vermont's Act 250 permitting process, vesting PSB with authority to make siting decisions for new electric and gas facilities according to detailed criteria. The process also applies (1) to utility purchases of electric capacity or energy from outside Vermont for either periods exceeding five years or more than one percent of the utility's historic peak demand, and (2) to investments by utilities in generation or transmission facilities located outside Vermont.

To obtain a section 248 certificate of public good the proponent must demonstrate that the project or purchase:

- Will not unduly interfere with the orderly development of the region;
- Is required to meet the present and future demand for utility service and could not be met more cost effectively through conservation, energy efficiency, or load management;
- Will provide an economic benefit to Vermont and its residents;
- Will not adversely affect system stability and reliability;
- Will not have an undue adverse effect on aesthetics, historic sites, purity of air and water, the natural environment, and the public health and safety, with "due consideration" to the criteria in Act 250;
- Is consistent with the utility's least cost integrated resource plan;
- Does not "involve a facility affecting or located on any segment of the waters of the state that has been designated as outstanding resource waters by the Water Resources Board;
- Is, if a waste to energy facility, included in a duly adopted solid waste management plan;
- Can, if an electric facility, be served economically by existing or planned transmission facilities without undue adverse effect on Vermont utilities or customers.

Apart from these specific requirements, paragraph (a) of the statute requires the proponent to demonstrate that the project is consistent with the "general good of the state," a requirement that triggers a broad public policy inquiry that can include, for example, a requirement that a project attain additional efficiencies and economic benefits beyond the economic benefits demonstrated by the proponents. *See In re UPC Vermont Wind LLC*, 185 Vt. 296, 300 (2009).

Section 249 of Title 30 authorizes the Public Service Board to determine the service territory of utilities, altering them as necessary. The PSB must consider, among other things, whether any changes are consistent with the orderly development of the region.

Sustainably Priced Energy Enterprise Development (SPEED) Program

Several New England states have adopted a renewable portfolio standard (RPS) that requires electric utilities to acquire a specified percentage of their energy from renewable sources. Vermont took this step in 2005, but with a twist. Section 8005 of Title 30 postpones the effective date of the RPS and establishes the Sustainably Priced Energy Enterprise Development (SPEED) program to encourage the development of in-state renewable generation capacity. The objective is to meet all growth in electricity demand from January 1, 2005 and January 1, 2012 with new renewable resources developed under the SPEED program. If the SPEED program meets this goal and the SPEED resources equal five percent of the 2005 figure for retail electric sales, the RPS remains inactive. An alternative means of avoiding the renewable portfolio standard is for SPEED resources to comprise at least ten percent of the 2005 sales figure. The Public Service Board is charged with making the relevant determinations by January 1, 2013. Section 8005 contains an overall goal that 20 percent of the electricity sold at retail in Vermont will be generated by Sustainably Priced Energy Enterprise Development resources by mid-2017.

A key element of the SPEED program is Vermont's feed-in tariff, referred to in section 8005 as the "standard offer" program. Inaugurated in 2009, the standard offer program authorizes the state to procure up to 50 megawatts of capacity from developers of new renewable generation facilities sized 2.2 megawatts or less. The Public Service Board is tasked with setting rates that are available for at least ten years and that cover the project owners' costs, regardless of whether the renewable power is more expensive than conventional alternatives. Each Vermont utility is then obliged to purchase its pro rata share of the energy at the rate established by the PSB. (Docket 7533)

Section 8006 of Title 30 requires the establishment of a system of renewable energy credits (RECs), which allows generators of renewable energy to disaggregate the electricity they produce from the renewable attributes of the electricity, selling each separately. Since Vermont's renewable portfolio standard is not currently in effect, renewable producers in Vermont can sell their renewable energy credits to utilities in nearby states that are subject to renewable portfolio standards.

After May 1, 2012, any such renewable energy credit revenue associated with a "system of generation resources" with a capacity greater than 200 megawatts is subject to disposition or allocation by the Public Service Board in a manner that promotes the state's official energy policy and "supports the achievement of the greenhouse gas reduction and building efficiency goals" in sections 578 and 581 of Title 10.

A separate provision, 30 V.S.A. § 8003, authorizes utilities to implement renewable energy pricing programs. This allows utilities to offer renewable energy to customers at a premium in comparison to otherwise-applicable rates. The premium must be cost-based and "reasonably reflect the difference between acquiring the renewable energy and the utility's alternative cost of power." 30 V.S.A. § 8003(c).

Energy Planning by Vermont Utilities

Historically, the PSB reviewed and approved or denied rate recovery of utility investments on a piecemeal basis. Experience persuaded Vermont's regulatory agencies that this case-by-case, after-the-fact review of major utility investments was a high-risk process. Thus, 30 V.S.A. § 218c requires that each utility prepare and implement a least cost integrated plan "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." As a result, utilities develop long-term plans for meeting customer demand with both demand-side and supply-side resources and make investments consistent with their approved plans.

Energy Planning by State Agencies

Energy planning under Vermont law also occurs at a level beyond that of individual utilities. The Legislature has instructed the Department of Public Service to prepare and implement the state comprehensive energy plan to which this document is appended. 30 V.S.A. § 201 (mandating a 20-year planning horizon). In addition, 3 V.S.A § 2291 mandates the development a state agency energy plan. The Secretary of Administration is responsible for creating the plan, with the cooperation of DPS and Buildings and General Services (B&GS). The plan must address the following electricity-related matters:

- Devise strategies for conservation, environmentally and economically sound infrastructure development, purchasing, and investments in renewable energy and energy efficiency;
- Consider state policies and operations that affect energy use;
- Make provisions for monitoring resource and energy use and evaluating the impact of measures undertaken;
- Identify education, management, and other relevant policy changes that are a part of the implementation strategy;
- Include a strategy to reduce greenhouse gas emissions from state government activities;
- Provide for the installation of feasible renewable energy systems as part of the new construction or major renovation of any state building.

Although these energy plans address more than one energy policy area, electricity plays an integral part in each plan.

Federal Level

The state's ability to pursue an aggressive and innovative energy policy in the realm of electricity is significantly circumscribed. Vermont's transmission grid and wholesale power market are controlled not at the state level, but on a New England-wide basis by a so-called regional transmission organization, ISO New England, that is overseen at the federal level. Though Vermont retains authority over electricity facilities, and has undertaken regional efforts to control greenhouse gas emissions, much turns on national energy policy rather than state initiatives.

The Federal Energy Regulatory Commission regulates the bulk power transmission system, both in terms of planning and operating the system and setting rates for transmission service. These rates are paid by Vermont's retail utilities, which are then reflected in retail rates set by the Public Service Board (PSB is not in a position to disallow transmission costs incurred by utilities under federally-approved rates). Although states retain the authority to determine the need for generation facilities, the Federal Energy Regulatory Commission is responsible for determining that the wholesale rates charged by generation facilities to outside purchasers are just and reasonable. In recent years, the Federal Energy Regulatory Commission has been willing to assume arms' length power purchase agreements are just and reasonable if the generator demonstrates that is not able to wield market power. FERC rules grant state regulators automatic status as intervenors in relevant proceedings, a responsibility that is discharged in Vermont by DPS. This however is a limited role, involving only persuasion rather than authority.

The Atomic Energy Act (AEA) provides for federal regulation of radiological safety at nuclear power plants. Except insofar as Vermont can litigate and/or advise the relevant federal agencies, these Congressional enactments can also be viewed as constraints on state policymaking.

Municipal Level

Pursuant to 30 V.S.A. § 2901 et seq., municipalities may own and operate their own electricity distribution systems, which are regulated as utilities by the Public Service Board pursuant to Title 30. For this purpose, under 30 V.S.A. § 2910, a municipality may "municipalize," (i.e., take by eminent domain), the facilities of a utility that are within its borders, if approved by voters. A municipality may serve customers and operate utility facilities in areas outside their borders with the consent of the municipality or municipalities affected. 30 V.S.A. § 2922. Voter approval is required before a municipality undertakes activities, such as building a new generation facility or purchasing power, which require section 248 approval from the Public Service Board. 30 V.S.A. § 248(c). Municipalities exercise their traditional land-use authority over utility facilities, but 30 V.S.A. § 223 provides for an aggrieved party may appeal to the PSB.

Per 24 V.S.A. § 4382, each municipality (regardless of whether it owns its utility facilities) must have a comprehensive plan, which includes an energy plan analyzing "energy resources, needs, scarcities, costs and problems within the municipality, a statement of policy on the conservation of energy, including programs, such as thermal integrity standards for buildings, to implement that policy, a statement of policy on the development of renewable energy resources, [and] a statement of policy on patterns and densities of land use likely to result in conservation of energy." Another required element of the comprehensive plan is a "utility and facility plan," that includes, among other things, information about present and prospective energy infrastructure.

Section 1131 of Title 24 authorizes each municipality to appoint an energy coordinator to "coordinate existing energy resources in the town and cooperate with the municipal planning commission and with those federal, state and regional agencies of government which are responsible for energy matters." Such an official is authorized to "study and evaluate sources of energy which are alternatives to those presently available with a view toward the more efficient and economical utilization of existing and potential energy resources."

Section 4433 of Title 24 authorizes towns to appoint advisory committees for various purposes consistent with municipal authority. Many Vermont municipalities take advantage of this authority to appoint a town energy committee to develop strategies for meeting energy challenges at the local level. Additionally, Vermont law vests municipalities with various other authority and responsibilities that implicate energy policy. The regulation of zoning and subdivision approvals can either encourage or discourage deployment of wind turbines, solar panels, geothermal well systems, etc. Towns can also require new homes to meet energy efficiency standards that are more stringent than state requirements, or frame subdivision regulations so as to encourage building siting that takes advantage of solar energy potentials.

Structural Overview

Key Players and Their Roles

State Agencies

Per the above discussion, the Public Service Board and the Department of Public Service play the central role in implementation of the state's electricity policy. Vermont has adopted a distinctive organizational structure with respect to the state agencies that oversee utilities. In most states, there is an administrative agency (typically called a public utilities or public service commission) that both adjudicates rate cases and other formal proceedings related to utilities and also discharges informal administrative responsibilities related to plenary oversight of utilities. There is also usually a separate instrumentality, independent of the regulatory commission, which is charged with representing the interests of utility customers in adjudicative proceedings before the utility regulator. By contrast, in Vermont, the Public Service Board's authority is focused on rate cases and other adjudicative matters, while an executive branch agency, the Department of Public Service, is charged with representing the interests of utility customers before the Public Service Board and interests of the state as a whole in some other energy-related matters. In addition, the DPS plays a leading role in developing and implementing Vermont's energy policy. A practical effect of this division of authority is that, in contrast to other states, there are fewer personnel on the staff of the Public Service Board and more employees of the Department of Public Service. In addition, the ability of the Public Service Board employees to engage in informal contacts with non-employees is limited by the PSB's quasi-judicial role.

SPOTLIGHT

CLEAN ENERGY DEVELOPMENT FUND (CEDF)

The Clean Energy Development Fund (CEDF) has its roots in a 2003 PSB proceeding that ultimately led to the approval of Vermont Yankee's request to increase its capacity by 20%. Under an agreement between Vermont Yankee's owners and DPS, ultimately approved by the PSB, Vermont Yankee agreed to make certain contributions to several state funds. The Legislature opted in 2005 to direct this revenue stream to the newly established CEDF. The purpose of the CEDF is to "promote the development and deployment of cost effective and environmentally sustainable electric power and thermal energy or geothermal resources, and emerging energy-efficient technologies, for the long-term benefit of Vermont consumers, primarily with respect to renewable energy resources, and the use of combined heat and power technologies." 10 V.S.A. § 6523.

The 2011 energy bill adopted by the Legislature placed the CEDF under the aegis of DPS rather than a separately appointed Clean Energy Development Board (CEDB). The CEDB is still responsible for approving a five-year strategic plan, approving an annual budget, and approving any financial or incentive projects or program designs that the DPS creates under the CEDF.

DPS is authorized to use CEDF resources (which have also included money from the stimulus package approved by Congress in 2009) to support:

- Projects that will sell power in commercial quantities, with a funding priority for those projects that sell power to Vermont utilities on favorable terms;
- Projects that benefit publicly owned or leased buildings;

- Renewable energy projects on farms;
- Small-scale renewable energy in Vermont residences, institutions, and businesses;
- Projects that use thermal or geothermal energy;
- Emerging energy-efficient technologies;
- Natural gas vehicles and associated fueling infrastructure;
- Solar energy income tax credits—or grants in lieu thereof—authorized 32 VSA §§ 5820(d), 5930z(a), and 5930z(f).

Upon consulting with the CEDB, the DPS is also authorized to use the fund to guarantee bonds issued by the state treasurer that support the purposes of the fund.

The Agency of Natural Resources is responsible for assuring compliance with state environmental standards, including air quality, permitting for stationary sources of air emissions, and formal consultation during the section 248 siting process for utility facilities.

Private and Quasi-Governmental Authorities

The Vermont Public Power Supply Authority ("VPPSA") contracts to buy and sell wholesale power within Vermont and wholesale and retail power outside Vermont. The VPPSA also issues tax-free debt on behalf of municipal and cooperative electric utilities within Vermont. 30 V.S.A. § 5011 et seq.

Vermont Electric Power Producers, Inc. (VEPPI) is a nonprofit organization charged by the Public Service Board with acquiring power from independent producers of renewable energy pursuant to the Public Utility Regulatory Policy Act and its state analog (10 V.S.A. § 209). Consistent with the statutory mandate for power purchases from certain generators, Vermont Electric Power Producers, Inc. both acquires the power and then resells it to the state's electric utilities on a pro rata basis according to retail sales. The Public Service Board has also designated Vermont Electric Power Producers, Inc. as its Sustainably Priced Energy Development facilitator, which involves acquiring power from Sustainably Priced Energy Development resources, reselling it to utilities on a pro rata basis, and administering the feed-in tariff program.

The Vermont System Planning Committee (VSPC) completes the list of non-governmental entities that have been given certain agency-like authority. The Vermont System Planning Committee, established by a Public Service Board order, is a joint public/private board that is tasked with assisting Vermont Electric Power Company in the transmission planning process.

The North American Electric Reliability Corporation (NERC) oversees the reliability of the nation's electricity grid, subject to Federal Energy Regulatory Commission (FERC) oversight. A separate organization, the Northeast Power Coordinating Council (NPCC), is tasked with enforcing the North American Electric Reliability Corporation's reliability standards throughout New England, New York, and Canada from Ontario eastward.

Federal Agencies

Federal Energy Regulatory Commission (FERC) is tasked, pursuant to the Federal Power Act, with promulgating rules, adjudicating rate cases involving transmission (with the state retaining most authority over siting decisions), overseeing the transmission planning process, as well as, ensuring the safety and reliability of the transmission grid and exercising authority over power transmission.

The following group of federal agencies provides financial drivers for achieving the objectives of the state's electricity policy. The Department of Energy (DOE) provides financial assistance to "smart grid" projects and technology initiatives. The Treasury Department and Internal Revenue Service (IRS) oversee and administer tax incentive programs and other forms of financial assistance for renewable energy projects and other energy-related initiatives that are consistent with public policy objectives.

SPOTLIGHT

ISO NEW ENGLAND

To promote open access to transmission systems, assure reliability, and facilitate what are intended to be robust wholesale markets in the electric industry, the FERC has encouraged transmission owning utilities to form RTOs – regional transmission organizations. In part because New England had, since the 1960s, a so-called "tight power pool" to control the regional utility-owned transmission system, New England's utilities opted for the RTO model and formed ISO New England, based in Holyoke, Mass. ("ISO" stands for "independent system operator.")

A not-for-profit corporation, ISO New England serves all six New England states. It maintains operational control over the bulk power transmission system throughout the region, oversees and operates wholesale power markets, and conducts the transmission planning process for the region. ISO New England is subject to plenary regulation by the FERC, which must approve the tariffs that state the terms and conditions (including rates) under which the RTO operates the system. In the reliability realm, ISO New England is subject to oversight by the North American Electric Reliability Corporation (NERC) and its regional affiliates, designed by the FERC to perform this function. State authority over RTOs like ISO New England is limited, although the New England States Committee on Electricity (NESCOE) was formed in an effort to assure that the interests of the states are adequately represented in matters involving ISO New England's governance and decision making.

Regulated Community

Vermont has two traditional, investor-owned electric utilities (Central Vermont Public Service and Green Mountain Power), 15 municipal utilities, two customer-owned electric cooperatives and two transmission entities (Vermont Transco LLC, which owns the state's transmission system, and Vermont Electric Power Company (VELCO), which operates the system). Vermont Transco and Vermont Electric Power Company are jointly owned by the state's retail electric utilities. The jurisdiction of the Public Service Board extends to in-state merchant generators on matters relating to the siting of new electricity resources.

SPOTLIGHT

VELCO

Vermont's utilities formed the jointly owned Vermont Electric Power Company (VELCO) in the 1950s to develop, own and operate the state's bulk power transmission system. The initial impetus was the need for facilities to import power from the St. Lawrence River. With the formation of the New England Power Pool (which assumed control of the regional transmission grid in the wake of the northeast blackout of 1965, in order to improve reliability), VELCO served as Vermont's representative to that organization and, later, to its successor Regional Transmission Organization (ISO New England). In 2006, VELCO formed an affiliate, Vermont Transco LLC, to own the system assets, while VELCO continues to manage it.

VELCO is subject to pervasive regulation by federal and state authorities. As a transmission owner, VELCO must comply with the FERC's open access transmission requirements, which are designed to promote competition in wholesale power supply. Operational control of the VELCO system is now the responsibility of ISO New England, which is likewise subject to pervasive FERC regulation. The FERC is responsible for approving rates charged by both organizations according to the "just and reasonable" standard in the Federal Power Act. However, VELCO must seek PSB approval under section 248 for facility siting (including both new construction and capital upgrades) and is also subject to the same least-cost integrated resource planning requirements of all Vermont electric utilities.

In 2005, the PSB granted section 248 approval for a major upgrade to the VELCO system – the Northwest Reliability Project, the major component of which was a new transmission line between Rutland and Burlington. Although it approved the project, the PSB expressed concerns about being required, in essence, to consider the project in isolation. As a result, the Board opened an investigation into VELCO's planning process in 2005. The Legislature and governor shared this concern, enacting 30 V.S.A. § 218c(d) in 2005, explicitly making VELCO subject to a rigorous planning process. Ultimately, the docket resulted in a memorandum of understanding among VELCO, other utilities, and the DPS providing for the establishment of the Vermont System Planning Committee. The Vermont System Planning Committee consists of representatives of VELCO, Vermont's retail electric utilities, three public representatives appointed by the PSB, and non-voting representatives of DPS, Efficiency Vermont and the SPEED facilitator.

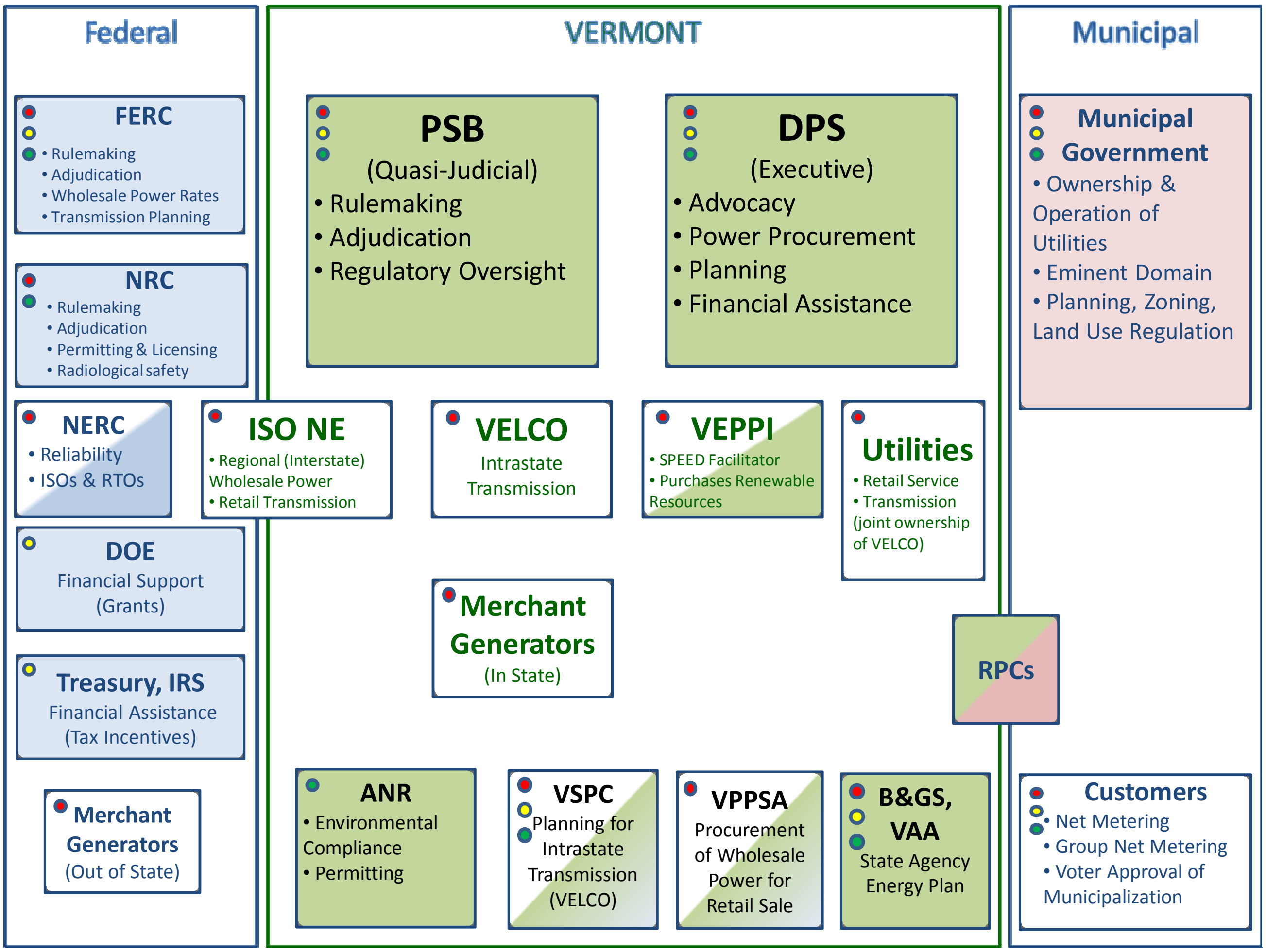
Municipal Governments and Local Communities

Section 2901 of Title 30 authorizes municipalities to provide service as electric utilities. Through enactment of comprehensive plans and land-use ordinances, municipalities affect the development of energy facilities subject to the preemptive authority of the 30 V.S.A. § 248 permitting process of the Public Service Board. Municipalities can issue bonds and enroll property owners in the PACE (Property Assisted Clean Energy) programs. Many municipalities create town energy committees to encourage development of renewable energy projects and the use of such energy by municipal government.

Decision-Making Map

ELECTRICITY

Key Players and Their Roles



Conclusions

Goals

- The policy objectives of Vermont's electricity-related statutes and regulations are well-articulated, but embody tensions between affordable electric service and the critical importance of minimizing environmental impacts;
- Where other states have adopted a renewable portfolio standard to mandate utility acquisition of renewable energy, Vermont opted for a different approach in its Sustainably Priced Energy Enterprise Development (SPEED) program. Some have argued that the lack of mandatory renewable generation capacity goal may slow down overall development of renewable energy in the state as Vermont utilities might be reluctant to acquire renewable power in addition to the capacity available through the SPEED program. Others contend that the SPEED program's overall

effect on energy markets will have positive outcomes similar to those of Renewable Portfolio Standards. We do not to attempt to resolve this debate here;

- Vermont's electricity-related laws and public policies seek a measure of energy independence. However, this aspiration may be limited by Vermont's dependence on other states and Canada for electricity, as well as by the federally set boundaries that affect Vermont's ability to oversee ISO New England. In practice, the ISO New England acts as the FERC's agent for the operation of the New England power grid and wholesale power markets;
- Achieving as much energy efficiency as possible has long been a paramount objective of Vermont's electricity regulation and, as a result, Vermont is the recognized national leader in this field.

Drivers

- In the absence of demonstrable market power, the Federal Energy Regulatory Commission assumes that wholesale power contracts negotiated at arms' length are just and reasonable within the meaning of the Federal Power Act. This makes restructuring a dominant theme even for a state like Vermont that has not itself restructured its electric utilities;
- Similarly, the relative lack of generation capacity owned by Vermont utilities, and the resulting need to purchase most power at wholesale, tends to limit the state's ability to control the state's electricity supply even though the Public Service Board must approve major contracts;
- The relative lack of integration between Vermont's utility regulation and its land-use regulation, means that land use decisions can effectively lead to energy decisions (e.g., the creation of more centralized infrastructure) than the state's energy law would otherwise suggest, require, or authorize;
- The limitations on the amount of capacity in the feed-in tariff, vis-a-vis the number of projects that bid into the program and the state's commitment to renewable energy;
- Tension exists between statutory standard of "general good of the state" and the regulatory imperative of just and reasonable rates.

Thermal (Heating)

Heating as a Seasonal Necessity

In Vermont, due to its cold climate, keeping buildings warm becomes a necessity during most fall, winter, and spring months. Correspondingly, cooling (air conditioning) is usually not an important issue except for the summer months. This is why we titled this section "Thermal" and focused it on the issues related to heating.

The increased need to heat houses, schools, and office buildings imposes an additional financial burden on households, school districts, and businesses. Additionally, the ensuing combustion of heating fuels leads to air pollution and carbon emissions. Unlike with electricity, the state does not have as much power to shape and channel this largely unregulated market. Plus, when regulation is appropriate, the state's jurisdiction is often limited by the powers of the federal government. Therefore, Vermont's "thermal" energy legal and regulatory landscape is dominated by the following three groups of issues: (1) regulating its only natural gas utility; (2) providing necessary assistance with heating to the people who really need it; and, (3) ensuring that buildings are kept warm in the most efficient manner, while minimizing the environmental effects of combustion.

Legal and Regulatory Framework

Applicable Principle Statutes, Rules, and Regulations

A variety of sources shape the legislative and regulatory thermal energy regime in Vermont. The key sources include:

State level

- Chapter 68 of Title 9 "Consumer Fraud;"
- Chapter 109 of Title 9 "Petroleum Inventories; Reporting Requirements;"
- Chapter 112 of Title 9 "Emergency Petroleum Set-Aside Act;"
- Chapter 14 of Title 29 "Natural Gas and Oil Conservation;"
- Chapter 5 of Title 30 "Powers and Duties of Department of Public Service;"
- Title 32 (Income, sales and use, and real property tax provisions);
- Chapter 26 of Title 33 "Home Heating Fuel Assistance;"
- Public Service Board Rules 1.000, 3.200, 3.300, 3.400, and 6.100;
- Public Service Board proceeding materials (e.g. PSB docket 7712).

Federal level

- The Natural Gas Act (NGA) of 1938;
- The Natural Gas Policy Act of 1978 (NGPA);
- Federal Energy Regulatory Commission (FERC) orders governing interstate transmission and sales of natural gas;
- Federal rules governing natural gas pipelines.

Municipal level

- Acts of municipal governments such as city council resolutions, municipal ordinances and codes.

Policy Goals, Key Substantive Points, and Jurisdictional Boundaries

State Level

Natural Gas

Although natural gas is one of the most important heating fuels for the U.S. economy, its use in Vermont is much lower than in the rest of the country. Presently, natural gas is available only in the Northwestern corner of the state. The Vermont Legislature set economic, environmental, and reliability goals in regulating natural gas. The statutory goals of natural gas regulation can be derived from the rate-making siting requirements, as well as, the goals of so-called "alternative regulation."

Section 218 of Title 30 requires the Public Service Board (PSB) to set rates and charges that are: (1) "cost-effective for the utilities and their customers;" and, (2) "encourage the efficient use of natural gas." Vermont Gas Systems, Inc. ("Vermont Gas"), the state's only natural gas utility is a prime example of alternative regulation provided by 30 V.S.A. § 218d. The main goal of alternative regulation under 30 V.S.A. § 218d is to create "clear incentives to provide least-cost energy service to their customers" while delivering safe and reliable service at "just and reasonable rates for service to all classes of customers." In Vermont Gas' case, alternative regulation translates into two rate adjustments that the company is allowed to make. First, Vermont Gas adjusts its rates quarterly to reflect the changes in the price the company pays for the gas it purchases. Second, Vermont Gas makes an annual adjustment based on the allowed rate of return on its equity in the prior year. Vermont Gas is currently seeking to modify its Alternative Regulation Plan to create a Vermont System Expansion and Reliability Fund for expansion of the company's service territory to Vergennes and Middlebury. Vermont Gas is asking the PSB to defer and escrow the savings from quarterly adjustments to finance the Fund. PSB docket 7712.

Pursuant to 30 V.S.A. §248, a certificate of public good is required for construction of every "natural gas facility" (transmission line, storage facility, etc.) unless the existing facility is being replaced with its equivalent in the usual course of business. The federal control over interstate sales and transmission of natural gas is often reflected in the state legislation. For example, 30 V.S.A. § 248 defines a "natural gas transmission line" as "any feeder main or any pipeline facility constructed to deliver natural gas in Vermont directly from a natural gas pipeline facility that has been certified pursuant to the Natural Gas Act, 15 U.S.C. § 717." Similarly, the provisions of 30 V.S.A. § 248 do not apply to a "natural gas company" as defined in section 717 of the NGA, unless such a company is about to construct a natural gas facility that is not solely subject to federal jurisdiction under the NGA. It is also important to note that a natural gas facility that is subject to 30 V.S.A. § 248 proceedings is exempt from the Act 250 requirements.

Vermont Gas is subject to the service requirements of the Service Quality and Reliability Plan approved by the PSB. The plan sets forth standards of performance, along with penalties if these standards are not met. In such a case, the utility is required to provide financial compensation in the form of credits and other financial benefits to the affected customers. Vermont Gas is also subject to PSB rules regarding customer deposits, disconnection and enforcement of gas safety and regulations.

Currently, no oil or natural gas production, processing, or coal mining activities take place in Vermont. Vermont is located just outside the Marcellus Shale area, and has not been targeted as an area where unconventional gas can be developed. Nonetheless, Vermont has the Natural Gas and Oil Resources Act (Title 29, Chapter 14). The act regulates all matters related to exploration and extraction activities ranging from drilling permits to gas and oil field conservation. It also establishes the Vermont Natural Gas and Oil Resources Board, an agency charged with implementation and enforcement of the state's oil and gas production policy.

Security (Reliability) of Service

As we mentioned above, due to Vermont's cold climate, heating service reliability becomes a major concern during winter, and most fall and spring months. Because almost all buildings in the state have their own heating units, the reliability of heating service rests on the reliability of fuel supply. Because fossil fuels dominate the heating fuel mix, the focus of reliability is centered on the oil, propane, natural gas, and kerosene supply. The Legislature enacted the Emergency Petroleum Set-Aside Act (Title 9, Chapter 112) in recognition of the threat posed by disruption in fuel supply. The state fuel set-aside program is intended to run if the federal government terminates, suspends or fails to implement all or part of the federal program. 9 V.S.A. § 4132. Despite the name, the statute covers propane, butane, kerosene, and heating oils. 9 V.S.A. § 4132. In a nutshell, the statute requires firms deemed "primary suppliers" to have reserves of liquid fuels (including heating fuels) in the amount determined by the DPS commissioner. In theory, these supplies should cumulatively cover shortages lasting no more than 90 days, as the statute presumes that the federal government program will resume within this period.

Primary suppliers are required to report to the commissioner information "concerning storage, inventory and product receipts." 9 V.S.A. § 4113. The DPS collects the data and issues a monthly "Vermont Fuel Price Report."

DPS may utilize the reserve or set-aside fuel from the total supply of a prime supplier to resolve hardships and emergencies due to energy shortages. 9 V.S.A. § 4132. The Emergency Petroleum Set-Aside Act requires a high degree of cooperation between primary suppliers and the DPS. Section 4133 requires primary suppliers to notify the DPS commissioner regarding their liquid fuel inventories on a monthly basis. Correspondingly, the DPS commissioner informs primary suppliers about the percentage of their total fuel inventory required to be set-aside. Pursuant to 9 V.S.A. § 4133, this amount cannot exceed three percent of a firm's total supply.

The anti-price gouging provisions of 9 V.S.A. § 2461d are intended to mitigate the effect of heating fuel shortages on the pocketbooks of Vermonters**.** This Section prohibits any petroleum or heating fuel-related business, during a market emergency, to sell any petroleum product or heating fuel product for an amount that represents an unconscionably high price. Chapter 26 of Title 33 also addresses the concern for security of thermal energy on a micro (household) level. It establishes a Home Heating Fuel Assistance Program. The program serves to secure the safety and health of low-income Vermont households by providing assistance for purchasing essential home heating fuel. Pursuant to 33 V.S.A § 2608, to receive benefits from the program, a recipient must consent to receive services from the Home Weatherization Assistance Program. The Home Heating Fuel Assistance Program is funded from the Home Heating Fuel Assistance Fund established under 33 V.S.A § 2603.

SPOTLIGHT

COMBINED HEAT AND POWER (CHP) FACILITIES: ENVIRONMENTALLY RELIABLE EFFICIENCY

Flexible and efficient CHP facilities provide a viable energy solution in a rural state like Vermont. CHP plants can be fueled by biomass or municipal waste making them ideal for farms and municipalities. The latter can utilize them for district heating. Conventional thermal power plants have a maximum efficiency of approximately 55 percent while some tri-cycle (gas turbine, steam turbine and steam condensate) can be up to 89% efficient.

The Legislature recognized the obvious benefits of CHP facilities by setting the following goal: by 2028, at least 60 MW of power in the state must be generated by CHP facilities. These facilities will be powered by renewable fuels or by nonqualifying SPEED resources. 30 V.S.A. § 202(i). Both the state and federal governments provide tax incentives that make it easier to reach this goal. Federal incentives include: accelerated depreciation, 10% and 30% corporate tax credits on investments in CHP facilities, Treasury grants equal to 10% of the basis of the energy producing property, USDA Rural Energy for America Program (REAP) grants in the amount of 25% of project costs, and USDA REAP loan guarantees.

Pursuant to 32 V.S.A. § 9741, micro-combined heat and power system of 20 kilowatts or less are exempt from the state sales tax. Additionally, municipalities, with voter approval, may choose to exempt alternate energy sources from real and personal property taxation. Upon voter approval, the tax exemption, which includes combined heat and power facilities, applies to the generation of electricity or production of energy used on the premises for private, domestic, or agricultural purposes, no part of which may be for sale or exchange to the public. 32 V.S.A. § 3845

Section 2461e of Title 9 is intended to protect consumers who enter into guaranteed price plans and prepaid contracts for the retail sale of heating fuel. The merchant is required to secure the supply of kerosene, liquefied propane, or heating oil with a futures contract, surety bond, or any other mechanism provided by the statute. An aggrieved customer can bring an action against a heating fuel distributor who fails to honor a prepaid contract or guaranteed price

Vermont law does a good job reconciling the energy security and environmental dimensions of energy policy. For example, the state conditions financial assistance with purchasing essential heating fuel on mandatory participation in the Home Weatherization Assistance Program.[1] As a result, not only can a participating household cut its heating fuel bills and reduce its dependence on the state fuel subsidies, it can also lower its carbon emissions and reduce air pollution. However, the lack of expressly stated environmental goals of the state's thermal energy policy diffuses the importance of balancing considerations of affordable and economic service with environmental concerns.

Tax Incentives Related to Thermal Energy

Our analysis of state tax incentives related to thermal energy shows that the purpose behind the incentives is two-fold. First, tax mechanisms are used to make heating fuels more affordable. Second, the Legislature encourages the use of cleaner, sustainable technology and fuels. In Vermont, sales of heating fuel that includes "electricity, oil, kerosene, natural gas, propane, wood, coal, and any similar product," are exempt from sales tax. Reg. § 1.9741(26). Under 32 V.S.A. § 5930w, a sustainable technology business, upon obtaining the approval of the Vermont Economic Progress Council (VEPC), may receive an income tax credit in the amount of 30% of qualified sustainable research and development expenditures. Such expenditures include funds used to produce heat for residential or commercial structures using biomass, geothermal, methane, solar, or wind energy resources. Section 5930x of Title 32 establishes the "economic advancement sustainable technology export tax credit." A sustainable technology business, upon obtaining approval of the Vermont Economic Progress Council, may receive an income tax credit. The amount of the credit depends on the nature of the entity applying. To be eligible, a business must be primarily engaged in the design, development, or manufacture of computer software, machinery, or equipment used by an industry to produce heat for residential or commercial structures using biomass, geothermal, methane, solar, or wind energy resources.

[1] We cover energy matters related to heating and cooling efficiency in a greater detail in the section on energy efficiency.

Federal Level

The most significant boundary that Vermont decision-makers need to keep in mind is FERC's jurisdiction over interstate transmission and sales of natural gas. Since the beginning of the deregulation process highlighted by the Special Marketing Program in the mid-1980s, FERC has been following the free market philosophy, and gradually loosening its regulatory grip on the natural gas industry. This recent trend represents a significant departure from the pro-consumer regulatory approach that the Federal Power Commission (FPC) and then FERC followed since the enactment of the NGA in 1938. Given the difference in approaches (rate of return regulation v. market-based pricing), a possibility for a tension between federal and state law is high when the line between interstate and intrastate natural gas transactions is blurred.

The federal government plays largely a different role in achieving the energy security goal. Instead of setting boundaries on what the state can do, it provides a basic level of energy security and creates additional opportunities for the state to advance its thermal energy policy agenda. For example, the U.S. Department of Health and Human Services' (U.S. DHHS) Low Income Home Energy Assistance Program (LIHEAP) provides financial assistance to low income households with meeting their pressing energy needs. The state adds an environmental and sustainability twist to its Home Heating Fuel Assistance Program by pairing it up with the Home Weatherization Assistance Program. The federal tax subsidies mentioned above provide Vermont with financial help to develop its thermal generation capacity, take into account local conditions and are based on the resources available in the region.

Municipal Level

In Vermont, municipalities are given discretion to shape their thermal energy profiles within the boundaries identified by the federal and state law. Cities and towns do so by instituting compliance and permitting programs, providing tax relief to certain heating projects, and participating in community heating initiatives.

The Heating Unit Certification Tag program in Burlington serves as an example of a permitting scheme employed by municipalities. Chapter 18-86 (c)(5) of the Code of Ordinances of the City of Burlington requires all fuel burning heating systems serving rental units to undergo a biennial inspection. Upon successful inspection, the Department of Public Works issues a tag that serves as a proof of inspection.

SPOTLIGHT

DISTRICT HEATING: LOCAL INITIATIVES DEPEND ON STATE AND FEDERAL SUPPORT

In 2009, the Legislature created the Vermont Village Green Renewable Pilot Program. Pursuant to 30 V.S.A. § 8101, two municipalities, the city of Montpelier and the town of Randolph were designated as sites for district heating (Vermont Village Green Renewable projects). The statute defines district heating as "a system for distributing heat generated in a centralized location within a host community to multiple residential, commercial, or industrial uses within that community or a combination of such uses." The source of heat may be a dedicated heat-only facility using renewable energy as a fuel or waste heat from electrical generation that uses renewable energy as a fuel to form a CHP system."

The program requires cooperation and contribution at and from each level of government. Section 8100 of Title 30 requires the municipality to develop and approve the proposal. Additionally, the municipality must invest in the project or at least demonstrate that it will make such an investment. Finally, the Vermont Downtown Development Board and the regional commission must clear the project. Only upon completion of these steps, the municipality may apply for certification of the project by DPS. If the project is certified, the CEDF is required to provide at least $100,000 in incentives to customers who will connect to the project.

As both Montpelier's and Randolph's experiences indicate, despite the incentives, the viability of a Vermont Village Green Renewable project depends on the financial support from the federal government. Unfortunately, the two municipalities had mixed success in applying for a grant from the Department of Energy (DOE). Randolph's $18 million application was denied, whereas Montpelier's $8 million request was accepted. As a result, only Montpelier's project is moving forward. In addition to the DOE grant, the Montpelier project will receive $7 million from the budget, $1 million from CEDF, $2.75 million from issuing a municipal bond, and $1.2 million from other sources.

Despite the fact that the statute designates Montpelier and Randolph as sites for Vermont Village Green Renewable Pilot Program, other municipalities are looking into district heating as well. For example, Burlington is considering utilizing the existing wood-fired McNeil Generating Station as a possible source for renewable thermal energy.

As mentioned above, according to 32 V.S.A. § 3845, municipalities have the right to grant property tax relief to certain CHP facilities upon voter approval. However, the following example shows a more direct way for Vermont towns and cities to get involved in solving their thermal energy needs.

Structural Overview

Key Players and Their Roles

State Agencies

State administrative agencies play a crucial role in the thermal energy policy area. The DPS takes a central stage in furthering policy goals. The agency serves in the following capacities: (1) consumer advocate, dealing with the state's lone natural gas utility; (2) agent of the state before FERC in matters related to natural gas; (3) administrator of the heating fuel reserve program; (4) administrator of financial assistance for CHP and district heating projects; (5) certification body for the district heating project; and, (6) fuel data collector and author of the Vermont Fuel Price Report.

Due to the fact that Vermont has only one natural gas utility, the PSB does not play as critical of a role in the thermal energy area as it does in the electricity field. The PSB has jurisdiction over rates and minimum standards of service for the natural gas that is piped into the state. In addition, the PSB may, at its discretion, initiate a proceeding in relation to an exempt natural gas company to form "an opinion in connection with federal certification or other federal approval proceedings." Finally, the PSB has the authority to promulgate rules on matters related to natural gas.

Several administrative agencies and an elected official aid the DPS and the PSB in implementation of the state's thermal energy policy. The Agency of Natural Resources (ANR) is responsible for ensuring compliance of heating units with established emission requirements. The Agency of Human Services (AHS) administers the Home Heating Fuel Assistance Program. The Office of the Attorney General has the authority to prosecute unfair and deceptive acts of heating fuel suppliers. In 2011, the Office of the Attorney General received even broader authority in regulating sales of propane. The law enforcers can also investigate irregularities and complaints suggesting unfair or deceptive acts in commerce by sellers of propane.

Federal Agencies

Implementation of the state thermal energy policy requires a high degree of collaboration with several federal agencies. The PSB and the DPS work closely with the FERC on regulatory matters related to interstate transportation of natural gas. The Agency of Human Services implements the federal LIHEAP program through the state's Home Heating Fuel Assistance Program.

Some federal agencies work directly with the regulated community and consumers. For example, the Internal Revenue Service (IRS) and the U.S. Department of Treasury provide tax incentives that make deployment of CHP facilities more economically feasible. Similarly, the U.S. Department of Agriculture (USDA) provide additional financial assistance for CHP projects through its REAP grant and loan guarantee programs. Finally, a grant from the DOE brought the Montpelier district heating project closer to becoming a reality.

Regulated Community

The regulated community consists of a wide range of players. Vermont Gas and certain CHP facilities that are subject to the Section 248 process operate under the PSB jurisdiction. The DPS acts as an advocate for the Vermonters that may be affected by the action the utility is seeking to approve before the PSB. The regulatory reach regarding heating fuel suppliers (other than natural gas and electric utilities) is not as extensive. There, the DPS acts as a regulator requiring primary suppliers to report their inventories and set aside certain amounts of heating fuel. Thus, a majority of thermal energy suppliers in the state are beyond the jurisdiction of the PSB.

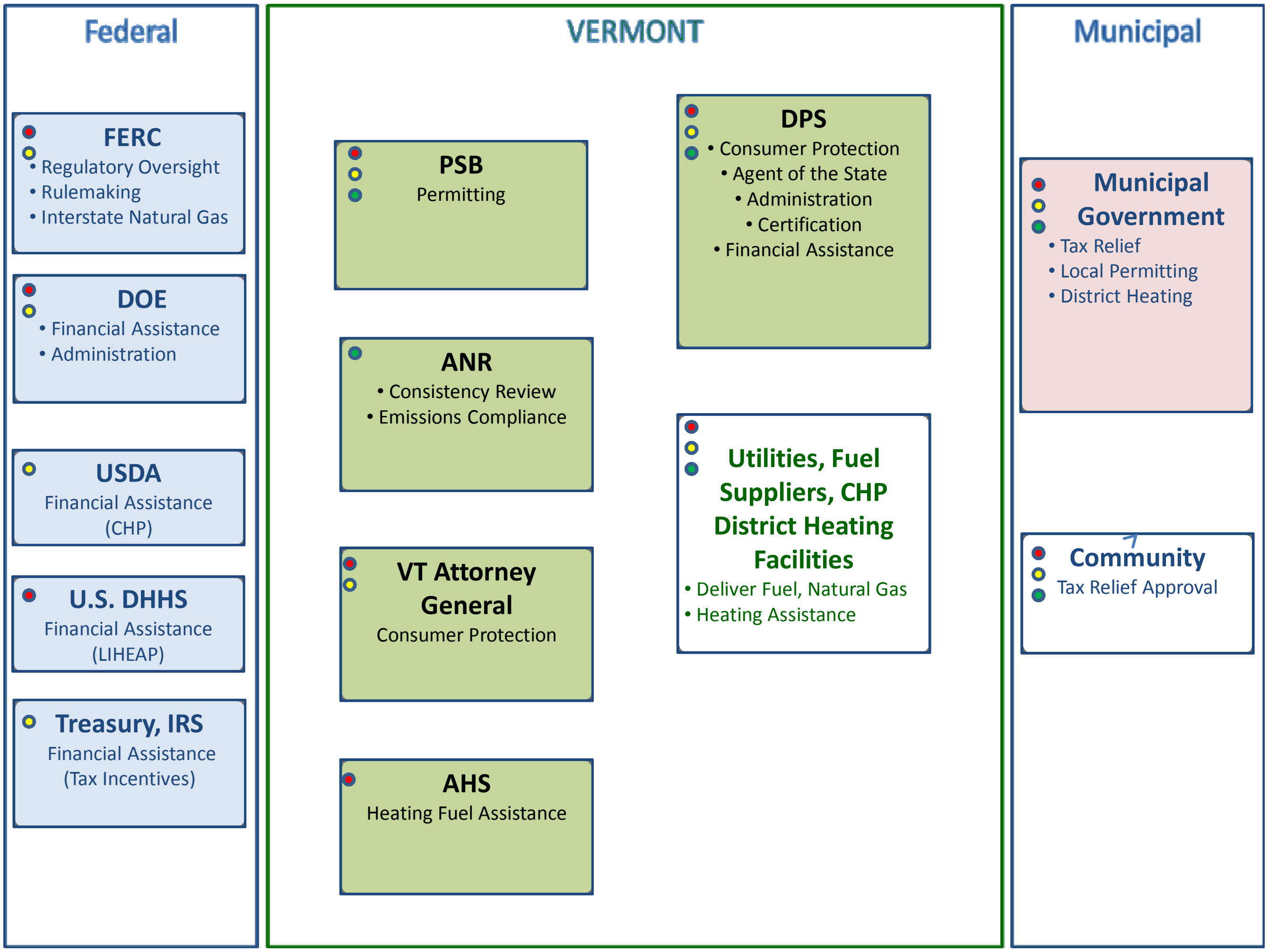
Municipal Governments and Local Communities

The role of municipal governments in implementing the state's thermal energy policy should not be underestimated. Some local governments set additional permitting and certification requirements for heating units. Additionally, municipalities may encourage local CHP initiatives by granting developers (with voter consent) property tax relief. Finally, the Montpelier city government initiated and serves as a primary driver of the city's "District Energy Project."

Decision-Making Map

THERMAL (HEATING)

Key Players and Their Roles



Conclusions

In our analysis of the legal and regulatory landscape of the thermal energy policy area, we concluded the following:

Goals

- Vermont laws and regulations do not expressly declare goals of the state's thermal (heating) energy policy;
- Energy security (reliability), environmental, and economic (affordability) goals of the state's thermal (heating) energy policy can be derived from key statutory provisions contained in Titles 9, 30, 32, and 33.

Drivers

- The thermal energy policy goals set by the Legislature are generally well-supported by the available drivers;
- Vermont statutes, rules and regulations generally provide ample support for the state's thermal energy policy goals;
- State's agencies appear to have well-identified roles with each agency capitalizing on its unique expertise;
- Vermont's legal and regulatory framework provides a structure for data collection that, in turn, may serve as an empirical basis for targeted education and outreach;
- Access to capital is available for several innovative technologies, however, some projects (e.g. the Randolph district heating initiative) become more economically feasible with the support from the federal government.

End-Use Energy Efficiency (Managing Demand for Energy)

Vermont as National Leader

Most states have now adopted some form of ratepayer-funded energy efficiency initiative, in which efforts are undertaken to encourage customers to adopt energy efficiency measures on their premises. Such initiatives save the directly affected customers money, reduce energy costs overall by allowing utilities to reduce fixed costs, and reduce externalities such as environmental impacts. Vermont has long been recognized as the national leader in this field by the American Council for an Energy Efficient Economy and others.

Improving the efficiency of the devices and systems that use energy in Vermont, as distinct from reducing the demand for such energy, is a pervasive aspect of the state's public policy. The Vermont approach has coalesced around replacing energy efficiency programs delivered by the electric utilities themselves and vesting that responsibility in a freestanding "efficiency utility" funded by charges assessed by the conventional electric utilities on their customers.

Legal and Regulatory Framework

Applicable Principle Statutes, Rules, and Regulations

The key sources governing the energy efficiency field in Vermont include:

State Level

- Chapter 74 of Title 9 "Energy Efficiency Standards for Appliances and EQU;"
- Section 581 of Title 10 (building efficiency goals);
- Chapter 15A of Title 10 "The Sustainable Jobs Fund Program;"
- Chapter 17 of Title 10 "Vermont Agricultural Credit Program;"
- Sections 266-268 of Title 21 (building efficiency standards);
- Section 209 (energy efficiency utility), Section 218 (rates), and Section 235 (efficiency services for heating fuel customers) of Title 30;
- Sections 2501a-2502 of Title 33 (weatherization for low-income households);
- Regulations of the Public Service Board;
- Regulations of the Department of Public Service.

Federal Level

- 42 U.S.C. § 6294a establishing the Energy Star program;
- 42 U.S.C. § 8621 et seq. establishing LIHEAP weatherization program;
- Rules promulgated by the Department of Energy (appliance efficiency standards).

Policy Goals, Key Substantive Points and Jurisdictional Boundaries

State Level

Section 581 of Title 10 sets forth a series of ambitious goals:

- To improve substantially the energy fitness of at least 20% of the state's housing stock by 2017 (more than 60,000 housing units), and 25% of the state's housing stock by 2020 (approximately 80,000 housing units);
- To reduce annual fuel needs and fuel bills by an average of 25% in the housing units served;
- To reduce total fossil fuel consumption across all buildings by an additional one-half percent each year, leading to a total reduction of six percent annually by 2017 and 10% annually by 2025;
- To save Vermont families and businesses a total of $1.5 billion on their fuel bills over the lifetimes of the improvements installed and measures taken between 2008 and 2017;
- To increase weatherization services to low income Vermonters by expanding the number of units weatherized, or the scope of services provided, or both, as revenue becomes available in the home weatherization assistance trust fund.

The Legislature has mandated efficiency standards for both new residential buildings and new commercial premises. The Department of Public Service is tasked with developing a plan to assure compliance with the standards no later than February 1, 2017 in at least 90% of new and renovated residential and commercial building space.

Section 209(d) authorizes the Public Service Board to require utilities to impose an energy efficiency charge on ratepayers to support energy efficiency programs. Also reserved to the fund are revenues from the sale of carbon credits associated with the Regional Greenhouse Gas Initiative (RGGI). 30 V.S.A. § 203a. Pursuant to 30 V.S.A. § 209(d)(2), the PSB created an "energy efficiency utility" to deliver efficiency services, which had previously been provided by the electric utility, to customers. These efficiency services are funded through the ratepayer charge and RGGI revenues described above.

Section 218(b) of Title 30 requires the DPS and the PSB, respectively, to propose and adopt rates of return, rates, and other schedules that encourage energy efficiency. Such energy efficiency measures must be cost effective for the utility and its customers on a life cycle cost basis.

The DPS oversees and promulgates standards for the energy efficiency of appliances and light fixtures pursuant to 9 V.S.A. §§ 2791-2798. In addition, the DPS promulgates residential building efficiency standards pursuant to 21 V.S.A. § 266 and commercial building energy standards pursuant to 21 V.S.A. § 268. The agency also accredits home energy rating organizations pursuant to 21 V.S.A. § 267. These organizations provide technical expertise to both the LIHEAP program and Efficiency Vermont.

The Legislature has also recognized the importance of providing financial assistance to Vermont's farmers by establishing the Vermont agricultural credit program (10 V.S.A. § 374a). This program provides loans for projects that increase the energy efficiency of agricultural facilities.

Recognizing the vital link between Vermont's economic prosperity and protecting the state's natural resources, the Legislature creating the Vermont Sustainable Jobs Fund (10 V.S.A. § 326). Although increasing energy efficiency is among the many stated goals of the Fund, its current focus is on the link between renewable biomass energy and sustainable farming and foresting practices.

The Department of Buildings and General Services contracts with energy service companies and third-party leasing companies for energy efficiency and fuel switching improvements to state facilities (29 V.S.A. § 152).

As mentioned above the Office of Home Energy Assistance (of the Agency of Human Services) administers the state's federally-funded LIHEAP program that provides weatherization services for the homes of low-income Vermonters. 33 V.S.A. § 2501a. Using LIHEAP funds as well as the proceeds from a one-half percent gross receipts tax on all non-transportation fuels sold in the state, the weatherization program offers services to households whose incomes are at or below 60 percent of Vermont's median income, based on household income and size. If a household includes a member who receives Supplemental Security Income (SSI), Reach Up, Food Stamps, or Home Energy Assistance, the household is automatically considered eligible for weatherization services.

Section 235 of Title 30 establishes the Heating and Process Fuel Efficiency Program. The program requires the Department of Public Service to propose and monitor effort to provide efficiency on a state-wide basis for both heating and process fuels. These programs may be implemented through competitively selected providers but should be offered to all retail consumers "regardless of retail electricity, gas, or heating or process fuel" provision. The Heating and Process Fuel Efficiency Program puts a special focus on end-use energy efficiency in achieving its goals.

Pursuant to 10 V.S.A. § 584, the Air Pollution Control Division of the Agency of Natural Resources administers the outdoor wood boiler (OWB) Change-Out Program. The program provides financial incentives to encourage people to replace their old OWBs with cleaner, more efficient heating systems. OWBs that do not comply with state emissions standards must be retired by December 31, 2012.

Federal Level

The Environmental Protection Agency and the Department of Energy administer the Energy Star program established by 42 U.S.C. 6294a. Energy Star is a voluntary program that involves the certification and promotion of energy efficient products that carry the "Energy Star" marketing label. Qualifying appliances must meet specified efficiency requirements, while still providing the same features and functions of standard appliances.

The Department of Health and Human Services makes block grants to states through the Low Income Home Energy Assistance Program (LIHEAP), pursuant to 42 U.S.C. § 8621 et seq. These funds are administered by Vermont's Agency of Human services as described above. The amount of funding Vermont receives each year depends how much money Congress appropriates for the LIHEAP program and by the number of qualifying Vermont households.

Under the Energy Policy Act of 2005 and earlier legislation, the Department of Energy sets efficiency standards for a variety of consumer products (e.g., air conditioners, appliances, lamps, furnaces, television sets) and commercial equipment (e.g., electric motors, pumps, small electric motors). These standards establish a minimum efficiency level for a wide array of devices sold in the U.S. The Energy Star standards discussed previously, require stricter efficiency levels than the baseline standards established by DOE.

Municipal Level

Municipalities may form clean energy assessment districts pursuant to 24 V.S.A. § 3261 et. seq. for the purpose of acquiring tax-exempt financing for property owners' energy efficiency projects. This alternative form of financing allows a municipality to finance energy efficiency projects undertaken by property owners living within the municipality's boundaries.

Structural Overview

Key Players and Their Roles

State Agencies

The Public Service Board has primary responsibility for the oversight of the energy efficiency utility. The agency selects the contractor, subject to legislative approval. Previously, the contractor was selected on a three-year basis. However, the PSB now selects the contractor on a 12-year cycle and oversees its performance. The PSB also establishes energy efficiency goals and approves the budget of the efficiency utility.

Although, in other contexts, e.g., in PSB proceedings, the DPS is a public policy advocate, in the realm of energy efficiency the DPS is also a regulator. The DPS enforces the residential and commercial building efficiency standards codified in 21 V.S.A. § 266, 268 which requires rules that are in compliance with the 2009 edition of the International Energy Conservation Code of the International Code Council. These standards establish minimum efficiency standards, such as insulation levels, window efficiency levels, and standards for the efficiency of heating systems, in new and renovated residential and commercial buildings.

DPS administers the Clean Energy Development Fund, which counts efficiency projects among its funded initiatives. The Department of Buildings and General Services is charged with developing a state strategy to reduce overall energy consumption in existing and proposed state buildings.

The Office of Economic Opportunity in the Department for Families and Children (within the Agency of Human Services) administers Vermont's weatherization program. The Office of Economic Opportunity administers a state-funded weatherization program to supplement LIHEAP.

The Air Pollution Control Division of the Agency of Natural Resources administers the OWB Change-Out Program.

Federal Agencies

The Department of Energy, the Environmental Protection Agency and the Department of Health and Human Services play a key role on the federal level. The first two agencies administer the "Energy Star" program, whereas the latter provides financial assistance through LIHEAP.

Utilities: Electric, Gas, and End-Use Efficiency

Efficiency Vermont takes center stage among utilities because energy efficiency is the sole reason for the utility's existence. The Vermont Yankee nuclear power plant has provided funding for the Clean Energy Development Fund (CEDF), a portion of which has been used to finance efficiency initiatives. Vermont Gas, the state's lone natural gas utility has been a willing and active partner in several energy efficiency initiatives. Its efficiency programs provide financing and incentives to both residential and commercial customers for installing energy efficient equipment or taking measures to increase the overall efficiency of their buildings.

Since 1999, Vermont's electric utilities have been removed from the process of delivering energy efficiency programs to their customers. Instead, Efficiency Vermont provides these services across the entire state. An exception is the Burlington Electric Department (BED), a municipal utility. Although the BED has joined the state in contracting with Vermont Energy Investment Corporation (the current contractor providing

Efficiency Vermont services) to provide efficiency services to its customers under the Efficiency Vermont rubric.

SPOTLIGHT

EFFICIENCY VERMONT

In 1999, Vermont moved from utilities delivering ratepayer-funded energy efficiency programs to having a statewide energy efficiency utility, operating under the trade name "Efficiency Vermont," undertake these efforts. The PSB has contracted with the nonprofit Vermont Energy Investment Corporation to serve as the energy efficiency utility.

According to its most recent annual report, Efficiency Vermont delivered efficiency measures in 2009 that yielded more than $65 million in net economic benefits (based on an estimated $112 million in lifetime economic benefits and $47 million in costs). The economic benefits include avoided costs for electricity, net fossil fuel savings, and water savings.

Efficiency Vermont delivered programs in the areas of residential new construction, existing home retrofits, energy efficient retail products, business new construction, and retrofits to existing business premises. Efficiency savings from measures installed in 2009 provided 1.6 percent of Vermont's statewide electricity requirements for that year.

Nonprofits

The International Code Council promulgates the International Energy Conservation Code (and other standards for the construction industry) that has been incorporated by the legislature into Vermont's residential building efficiency standards.

Low income Vermonters seeking weatherization services obtain them through offices administered by nonprofit organizations: BROC - Community Action in Southwestern Vermont, Central Vermont Community Action Council (CVCAC), Champlain Valley Office of Economic Opportunity (CVOEO), Northeast Employment and Training Organization (NETO), and Southeastern Vermont Community Action (SEVCA).

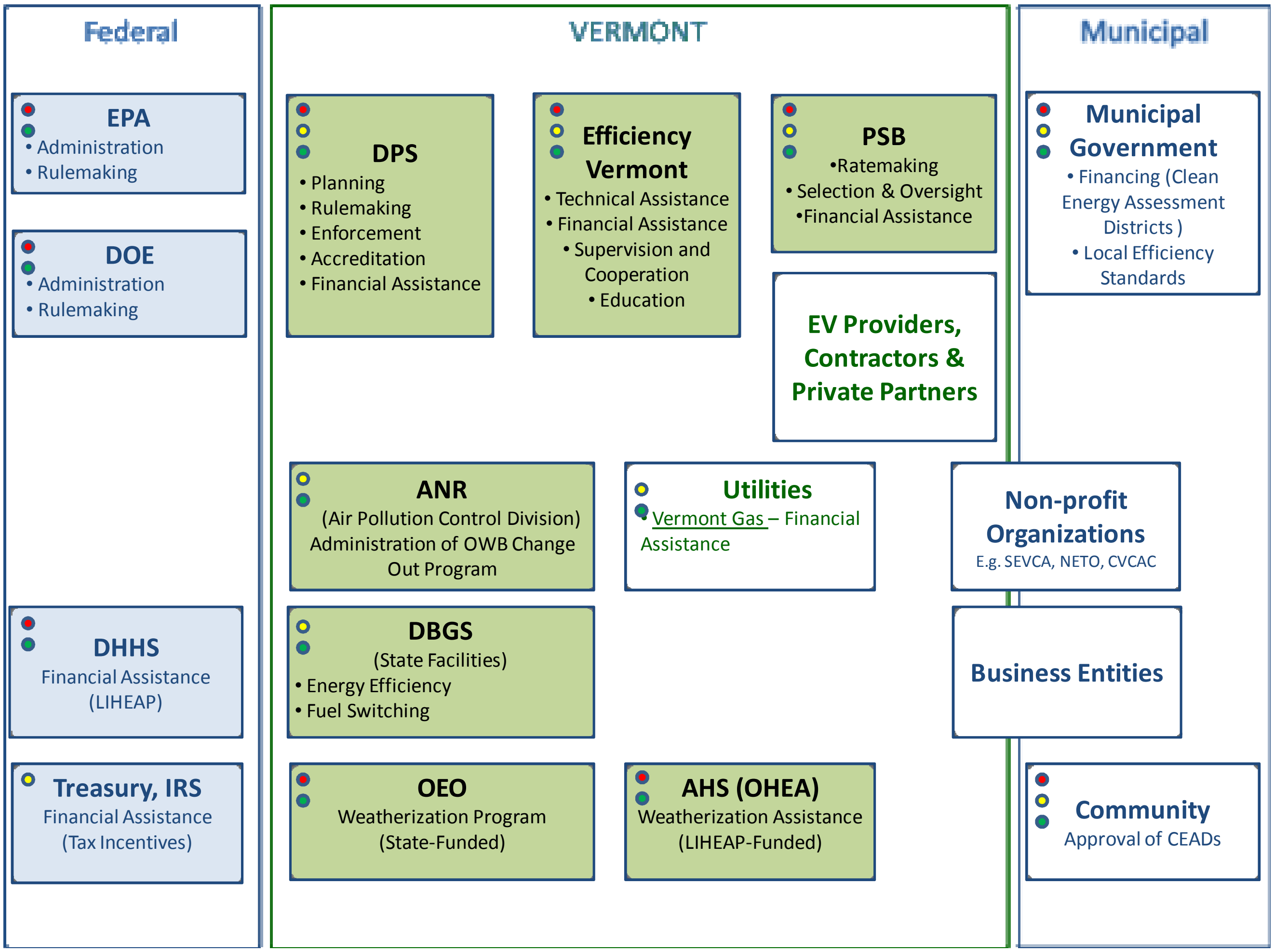
Business Entities and Individual Customers

Section 209(h) of Title 30 authorizes the PSB to adopt a program of "self-managed" energy efficiency programs for industrial electricity customers (thus allowing them to opt out of paying for, and using, Efficiency Vermont) if their electricity bills were at least $1.5 million in 2008. To date, the only customer approved by the PSB for participation in this program is IBM, which was required by PSB order to spend $3 million on energy efficiency initiatives from 2010-2012. Architects and builders certify compliance with residential and commercial building efficiency standards.

Decision-Making Map

End-Use Energy Efficiency

Key Players and Their Roles



Conclusions

Vermont can be proud of its role as the national leader when it comes to energy efficiency programs for electric customers. According to the most recent annual 'scorecard' issued by the American Council for an Energy-Efficient Economy, the incremental energy savings achieved via energy efficiency programs has reached beyond 2.5 percent of electricity sales in the state – far outpacing all other states. However, Vermont confronts additional challenges with respect to maximizing the efficiency of energy use overall. Specific challenges include:

- The mandate for an extensive efficiency-related retrofit of a significant percentage of the state's housing stock without an effective strategy to achieve the objective;

- The historic lack of enforcement of the state's building energy codes for new residential and commercial construction, which has led to many existing buildings failing to minimum efficiency standards;
- The tension between deploying energy efficiency assistance based entirely on energy savings potential vs. deploying such resources with notions of social equity in mind;
- Alternative regulation plans that allow utilities to earn reasonable returns on shareholder investment without needing to promote increased sales, but do not in themselves encourage energy efficiency;
- The lack of transportation efficiency standards or incentives, a particular challenge in a rural state without pervasive mass transportation.

Transportation

Unique Vermont Challenges

Sparsely populated Vermont is among the nation's most auto-dependent states. Its vehicle miles traveled per capita is among the highest in the nation and is the highest in New England. Vermont's transportation sector accounts for 33% of the State's overall energy use, which is five percent above the national average. Transportation is also the largest user of energy by sector. Furthermore, the transportation sector represents nearly 60% of Vermont's greenhouse gas emissions.

Legal and Regulatory Framework

Applicable Principle Statutes, Rules, and Regulations

State level

- Title 5 ("Aeronautics and Surface Transportation Generally"), contains several chapters potentially relevant to both the fuel use and tailpipe emissions aspects of climate change, as does Title 19 ("Highways");
- Chapters 27 and 28 of Title 23 ("Motor Vehicles") address the diesel fuel and gasoline taxes respectively.

Federal level

- Clean Air Act (CAA), 42 U.S.C. § 7543: emissions standards for vehicle engines;
- CAFE standards under the Energy Policy Conservation Act;
- Policy and appropriations decisions regarding federal funding for highways and infrastructure for public transportation systems.

Municipal level

- Title 24 giving municipalities the power to manage issues that can impact transportation, such as city planning and zoning;
- Specifically, Chapter 126 and 127 of Title 24 relating to public transportation and mass transit authorities respectively;
- Title 24A containing individual city charters, which may enumerate other powers that particular municipalities have reserved in regard to transportation.

Policy Goals, Key Substantive Points, and Jurisdictional Boundaries

State Level

Policy Goals

Generally speaking, Vermont's legal and regulatory frameworks focus on increasing the mobility of its sparsely settled citizens. Transportation policies' effects on energy consumption levels are therefore often secondary, and may either increase or decrease overall energy usage and cost. However, some Vermont transportation policies are aimed at providing alternative transportation solutions that improve mobility, while also preserving air quality standards and reducing greenhouse gas emissions.

In Chapter One of Title 19, the Legislature articulates transportation the policy goals of coordinating all modes of transportation, supporting projects that improve the state's economic infrastructure, and using resources "in efficient, coordinated, integrated, cost-effective, and environmentally sound ways." The Legislature makes the Vermont Agency of Transportation (VTrans) responsible for these goals. The specific programs that VTrans operates are listed below, but the agency must work with the state's Climate Change Oversight Committee, as well as with local and regional planning entities:

- To assure that the transportation system as a whole is integrated, that access to the transportation system as a whole is integrated, and that statewide, local, and regional conservation and efficiency opportunities and practices are integrated; and
- To support employer, local, or regional government-led conservation, efficiency, rideshare, and bicycle programs and other innovative transportation advances, especially employer-based programs.

The same section outlines the state's official policy on public transportation, which is largely dependent upon whether federal funding is available for improvements. However, the Legislature has tasked VTrans with developing a plan to invest in public transportation services and infrastructure. The plan must involve coordination of "rideshare, public transit, park and ride, interstate, and bicycle and pedestrian planning" as well as "investment at the state, regional, and local levels" to maximize interregional ridesharing and access to public transit. To this end, the Legislature has instructed the agency to develop an online integrated service that helps the public plan coordinated trips that rely upon alternative modes of transportation that are cost effective and timely.

With respect to the state's policies for railways, the legislature articulated several goals relevant to energy issues in Chapter One of Title 19. The state desires "to maintain and improve intercity bus and rail and freight and commuter rail services, and the necessary intermodal connections, and to increase the efficiency of equipment and the extent to which equipment selection and operation can limit or avoid the emission of greenhouse gases" and "to plan for increased ridership with city-to-city and commuter rail service, and for increased coordination of rail service with bus service, car-pooling, and ride-sharing opportunities." 19 V.S.A. § 10.

Although the Legislature has not explicitly articulated goals regarding the adoption of electric vehicles, the Comprehensive Energy Plan envisions a future in which Vermonters increasingly rely on electric vehicles instead of traditional gasoline cars. Shifting to electric vehicles has the potential to reduce greenhouse gas emissions from Vermont's transportation sector and can provide storage capacity to help balance increased renewable energy on the electric grid. Significant policy issues must be addressed if the state is to realize this future. These include, (1) creating financial incentives to reduce the initial purchase price of electric vehicles; (2) incorporating electric vehicles into the utility integrated resource planning process; (3) designing electricity rates to encourage vehicle charging habits that minimize strain on the electric system; and, (4) developing a legal framework for the development of electric vehicle infrastructure. More information about these issues is available in a spring 2011 Energy Law Journal article "The Legal Regime of Widespread Plug-In Hybrid Electric Vehicle Adoption: A Vermont Case Study," by Danielle Changala and Paul Foley, of the Institute for Energy and the Environment of Vermont Law School.

Air Quality

The Agency of Natural Resources is tasked with overseeing particular air quality issues related to transportation, such as vehicle emissions testing. Other entities within the state government, however, also administer programs or establish policies aimed at reducing air pollution; the Department of Buildings and General Services and the State Board of Education are just two examples. Taxes on gasoline and diesel, designed primarily for the purpose of generating revenue, also have the secondary effect of impacting consumers' energy consumption decisions.

The Gasoline Tax

Sections 3101-3121 of Title 23 establish Vermont's gasoline tax. It presently stands at 24.9 cents per gallon. Most of the revenue is credited to the state Transportation Fund, with a small percentage reserved to the Fish and Wildlife Fund and Department of Forests, Parks and Recreation for natural resource management.

Federal Level

Laws, regulations, and policies at the federal level that greatly impact the energy use of Vermont's transportation sector include emissions standards as well as funding decisions for roads and for public transportation infrastructure. Decisions made in Washington on these fronts affect how much gasoline Vermonters purchase, how much they pay for it, and whether they have the opportunity to leave the car at home in favor of an alternative mode of transportation that is cheap and convenient enough to meet their needs.

Emissions

Under the relevant provisions of the Clean Air Act (CAA), 42 U.S.C. § 7543, the EPA sets emissions standards for vehicle engines, including standards for greenhouse gas emissions. The statute granted California the right to establish its own emissions standards, which may then be adopted by other states; California is the only state that has been vested with such authority. All other states can implement either the California standards or the less stringent EPA standards. Vermont currently follows the California standards.

Fuel Economy

In 1975 Congress passed the Energy Policy Conservation Act (EPCA), which requires car manufacturers to meet average fuel economy standards, dubbed Corporate Average Fuel Economy (CAFE) standards, across their entire fleet of vehicles sold in the United States each year. The National Highway Traffic Safety Administration (NHTSA), an agency within the US Department of Transportation, administers the CAFE program; the EPA is charged with calculating the average fuel economy of each manufacturer. The EPCA does not dictate how manufacturers must satisfy the CAFE standard requirements. Instead, manufacturers were intentionally given wide discretion over how to meet the goals set under the CAFE program.

Highways or Public Transit?

The U.S. Department of Transportation's mission is to "serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future." While in past decades, the idea that building more highways for automobiles was the primary way of meeting these goals, some voices in today's political landscape are calling for a shift in focus toward public transportation systems. Politicians have begun to wage political battles over the wisdom of installing such systems, and the debate will likely continue to rage into the foreseeable future.

Municipal Level

Title 24 of the Vermont Statutes Annotated gives municipalities the authority to manage processes that impact transportation infrastructure, including town planning, zoning, economic development, historic downtown development, and urban renewal. These types of decisions can be significant, particularly for cities and large towns. However, the effects of state and federal decisions on transportation may have greater impacts on transportation-related energy use in Vermont.

Structural Overview

Key Players and Their Roles

State Agencies

The Vermont Agency of Transportation (VTrans) has jurisdiction over the state's airports, railways, highways, public transit, bicycle, and pedestrian facilities and oversees the Department of Motor Vehicles (DMV). VTrans has adopted two major plans that guide how it allocates its resources in the long and short term.

The increased maintenance cost of Vermont's infrastructure in conjunction with the State's limited financial resources means that VTrans must prioritize its funds in favor of the preservation and maintenance of existing infrastructure over new roadway construction. This shift has resulted in an increased focus on reducing impact on roadways by decreasing the number of vehicles on the road. This is achieved largely through rideshares, park and ride facilities, public transportation, and the incorporation of intelligent transportation systems, which employ the use of information technology to improve the safety and efficiency of the transportation system. Due to Vermont's low population density, successful rideshare and public transit programs require a network of Park and Ride facilities throughout the State. Vermont currently has 27 facilities totaling more than 1,000 parking spaces throughout the state. Park and Ride facilities are supported through the VTrans Municipal Park-and-Ride Grant Program, which issues grants to municipalities to build their own facilities.

As required by the transportation bill adopted by Congress in 2005, VTrans has adopted a comprehensive 25-year plan for the state's multimodal network, entitled the Vermont Long Range Transportation Business Plan (LRTBP). Although the LRTBP does not identify specific projects for development, it provides a framework for prioritizing future transportation improvements and developing funding alternatives. It also takes into account various alternative future scenarios that will guide the choice of strategy implementation.

VTrans uses Intelligent Transportation Systems (ITS) to improve the safety and efficiency of the transportation system. ITS utilizes information technology to disseminate real-time information to travelers about weather, accidents, traffic, construction and other road conditions.

VTrans also administers "Go Vermont," a free online resource that provides transportation information in order to reduce the cost and environmental impact of driving. The program features free rideshare matching services for carpools, vanpools, and single trips or events. The site offers a commute calculator to educate drivers about the annual cost of their commutes and the potential savings to be gained from ridesharing. Additionally, the site provides practical information on other modes of travel including biking, walking, bus, train, and ferry.

The Vermont Climate Cabinet, an interagency coordination group, is tasked with, among other things, identifying strategies to reduce Vermonters' dependence on fossil fuel for transportation and reduce greenhouse gas emissions by encouraging alternatively fueled vehicles and more efficient vehicle and mobility choices.

The Agency of Natural Resources oversees at least two programs that impact energy use in the transportation sector. First, the Low Emission Vehicle (LEV) program was established by rule and is administered by the Air Pollution Control Division of the Department of Environmental Conservation within the Agency of Natural Resources. Essentially, the LEV program adopts California's emissions standards pursuant to the Clean Air Act, which requires that new motor vehicles sold in Vermont meet the same stringent air quality standards as those sold in California. Thirteen states, including all of New England except New Hampshire, have adopted California's standards.

The Agency of Natural Resources also oversees the Vermont Motor Vehicle Inspection Program: On-Board Diagnostic Check requirements. The Agency of Natural Resources has mandated by rule that "No motor vehicle shall be issued an inspection sticker unless the emission control devices have been inspected . . . . for the proper functioning of the on-board diagnostic system." 16-3 Vt. Code R. § 100. A functioning on-board diagnostic system can detect a malfunction or deterioration of engine components well before a driver would become aware of it. Addressing engine issues immediately helps lower emissions and increases fuel efficiency.

The Department of Buildings and General Services, runs the Fleet Management Services (FMS). FMS is the centralized fleet services program responsible, pursuant to 23 V.S.A. § 903, for the management and oversight of Vermont's passenger vehicles and light duty trucks. FMS aims to reduce the overall cost of employee travel and to reduce emissions by managing the state's vehicle fleet, including purchases and sales, and by providing state employees with fuel efficient vehicles appropriate for their expected use. Section 271 of Title 3 requires that at least 50 % of the vehicles purchased annually by the state be low emission passenger vehicles, creating an increased market demand for hybrid and low-emission vehicles. Additionally, 23 V.S.A. § 903(g) mandates that alternative fuel vehicles be considered when purchasing vehicles for state use. In March 2011, FMS implemented an idling policy, which prohibits FMS vehicles from being left idling for more than five consecutive minutes in a 60-minute period.

Section 1282 of Title 23 requires that school bus drivers not idle their engines while waiting for children to board or to exit at a school and shall not start their engines until ready to leave the school premises. The State Board of Education is responsible for implementing this statute by rule.

Federal Agencies

Vermont officials and agency staff must work closely with the DOT when federal funds are involved in transportation projects. Federal entities may also work directly with consumers, as with the "Cash for Clunkers" program, which rewarded consumers for turning in less efficient vehicles for more efficient ones.

Municipal Governments

As explained above, municipal governments can drive increases or decreases in energy consumption through the choices they make. For example, zoning that encourages mixed use and compact development diminishes the need for long commutes in cars. Similarly, cities may have the authority to reward pedestrians and cyclists by making the streets more inviting for them through well-marked bike lanes and wider sidewalks or "pedestrian only" zones.

Conclusions

In our analysis of the legal and regulatory landscape of the state's energy policy related to transportation we concluded the following:

Goals

- Vermont laws and regulations generally encourage increased mobility, and effects on energy use are often secondary;

- Some policies explicitly encourage increased alternative means of transportation, but the extent to which the state can realize these goals may depend heavily on the availability of federal funding;
- State and federal goals pertaining to air pollution are more obvious, and agencies are already running various programs to meet these goals;
- Municipalities may have transportation-related goals that they can accomplish through town planning, zoning, and town ordinances.

Drivers

- VTrans is the primary state agent that carries out the legislature's transportation goals as expressed in statutes;
- Vermont's sparsely populated regions complicate efforts to reduce both transportation-related energy use and emissions;
- Public transportation solutions will require ample funding, while other smaller scale programs may make progress without significant infusions of cash.

Climate Change

What can Vermont do?

Climate change is a global problem. Most scientists believe that it is largely irrelevant if a tonne of CO_2 is emitted in Shanghai, China or Randolph, Vermont – the tonne will increase CO_2 concentration in the global atmosphere. Thus, since the 1980s when the problem was first getting attention with policymakers, the dominating solution to climate change was thought to be global cooperation. Meanwhile, global GHG emissions have been on a steady rise - during the period from 1990 to 2005 global greenhouse gas emissions increased by 26%. Carbon dioxide emissions grew by 31% during this period. The increase in carbon dioxide emissions is particularly noteworthy because they account for 77% of all GHG emissions.

Since the dawn of the climate change debate, scientists established that combustion of fossil fuels is the primary cause of the shifting climate. According to the recent report by the International Energy Agency (IEA), energy-related carbon dioxide emissions reached 30.6 Gigatonnes (Gt) in 2010. This number represents a new all-time high exceeding the previous record set in 2008 by five percent. In comparison, the world's energy-related carbon dioxide emissions were 21.537 Gt in 1990.

In her recent paper entitled, "A Polycentric Approach for Coping with Climate Change," Elinor Ostrom, the 2009 Nobel Prize winner in economics, questions the quarter of a century old assumption that global cooperation is necessary to address climate change. She employs many years of research on the polycentric theory of governance and argues that policy makers should not rely solely on a global solution. Instead, governments, business, and civic organizations of different levels, shapes, and sizes should combat the complex problem of climate change from the angle at which they are most effective. Therefore, a strong theoretical basis exists for Vermont's role in addressing the most serious environmental problem the world has ever faced.

Energy-related emissions provide 65%—the greatest contribution—of all global anthropogenic GHG emissions. This ratio makes energy both the largest contributor and the largest solutions to addressing climate change. That is why we noted climate-related energy solutions in every preceding section of this Conceptual Map. The primary purpose of this section is to: (1) identify key legal mechanisms and players responsible connecting the climate change problem with these solutions; and (2) summarize such energy-related solutions within the context of climate change. Because the Conceptual Map is an energy driven report, we limited our inquiry to the means of reducing carbon emissions in the atmosphere *i.e*. climate change mitigation mechanisms.

Legal and Regulatory Framework

Applicable Principle Statutes, Rules, and Regulations

As the previous four sections indicate, climate-related legal provisions can be found in many energy-related statutes, rules, and regulations. Therefore, we list only sources that include climate change as the main topic. These key sources include:

State Level

- Section 578 of Title 10 Greenhouse gas reduction goals;
- Section 552 of Title 10 defining GHGs;

- Section 255 of Title 30 confirming Vermont's participation in the Regional Greenhouse Gas Initiative (RGGI);
- Executive Order Nos. 05-11, 14-03, and 07-05 establishing, respectively, the Climate Cabinet, Climate Neutral Working Group, and Governor's Commission on Climate Change.

Federal Level

- The Clean Air Act (CAA);
- EPA fuel efficiency rules, as well as the "tailoring" rule under the CAA;
- U.S. Supreme Court decisions in *EPA v. Massachusetts* and *AEP v. Connecticut*;
- The Waxman-Markey bill (H.R. 2454: "American Clean Energy and Security Act of 2009").

Policy Goals, Key Substantive Points, and Jurisdictional Boundaries

State Level

Statutory Goals

Section 578 of Title 10 sets ambitious GHG reductions goals for the state of Vermont. According to the statute, the state must cut carbon emissions from the 1990 baseline by the following amounts: (1) 25% by January 1, 2012; (2) 50% by January 1, 2028; and, (3) 75% by January 1, 2050 ("if practicable using reasonable efforts"). The Legislature specified that these goals can be met by: (1) reducing GHG emissions "within the geographical boundaries of the state;" and (2) reducing GHG emissions outside the boundaries of the state that were caused by the use of energy in Vermont if such reductions contribute to decrease of GHGs on the regional level.

The statute also requires that: "all state agencies [to] consider, whenever practicable, any increase or decrease in greenhouse gas emissions in their decision-making procedures . . . ." In addition, the Public Service Board, the Secretary of Natural Resources, and the Commissioner of Public Service are required to argue before national and regional policymakers for a cap-and-trade system covering a greater region and even the entire country.

Legislative Findings

The Vermont Legislature is to be commended for using the adverse consequences of climate change as the reason for several initiatives which promote sustainable development and conservation of resources. In particular, the Legislature made the following finding:" Global climate change, which is threatening our environment and perhaps ultimately our existence, has been caused in part by an energy policy that is largely dependent on the burning of fossil fuels." 6 V.S.A. § 4710. In the same finding, the Legislature set the goal to "reduce greenhouse gas emissions and environmental degradation . . . ." Finally, the Legislature determined the appropriate means of reaching this goal: "reduce or eliminate our dependency on fossil fuels by significantly improving energy efficiency and shifting to non-polluting benign forms of energy such as wind, sun, and water power."

Vermont lawmakers used this finding as a basis for a variety of initiatives. The Vermont Farm Viability Enhancement Program (6.V.S.A. § 4710), the "25 by 25 state goal" requiring that 25% of all energy consumed in the state will be from renewable sources by 2025 (10 V.S.A. § 580), and the Heating and Process Fuel Efficiency Program (30 V.S.A. § 235) are among these initiatives. In statutory language codified at 30 V.S.A. § 255, the Legislature determined that there is a growing scientific consensus that "increased anthropogenic emissions of greenhouse gases are enhancing the natural greenhouse effect," causing changes in the Earth's climate that pose "serious potential risks to human health and terrestrial and aquatic ecosystems globally, regionally, and in Vermont." The lawmakers used this finding to effectuate Vermont's participation in RGGI.

Regional Greenhouse Gas Initiative

In 2005, Governor Douglas signed the memorandum of understanding that formally established the Regional Greenhouse Gas Initiative, the first GHG emissions cap-and-trade program in the United States. The Legislature tasked the Agency of Natural Resources and the Public Service Board with promulgating rules to effectuate Vermont's participation in RGGI, instructing that the initiative should "maximize the state's contribution to lowering carbon emissions while . . . minimizing impacts on electric system reliability and unnecessary costs to Vermont energy consumers [and] minimizing the costs and the emissions resulting from the use of petroleum-based fuels for space heating and process heating for residential, commercial, and industrial purposes."

Under the RGGI memorandum of understanding, each participating state receives a specified number of carbon credits that it then sells via periodic auctions. The Public Service Board is responsible for allocating the carbon credits that Vermont receives under RGGI and for appointing a trustee to "receive, hold, bank, and sell carbon credits." Net of administrative costs, proceeds from the auction of Vermont's carbon credits go to the electric efficiency fund created by 30 V.S.A. § 209(d)(3) for use by the state's energy efficiency utility.

The Regional Greenhouse Gas Initiative requires carbon-emitting facilities of 25 megawatts or greater to purchase carbon allowances in the regional market set up for this purpose. The relative lack of in-state generation capacity, particularly capacity employing fossil fuels, means that Vermont's electric utilities are subject to few, if any, emissions credit purchase obligations as a result of RGGI. However, the carbon costs incurred by the out-of-state generators (from RGGI states), whom Vermont utilities purchase power from, may be passed on to the Vermont utilities.

An important component of the Regional Greenhouse Gas Initiative program is "offsets." An offset represents a project-based greenhouse gas emission reduction outside of the capped electric power generation sector. The RGGI participating states limit the offset allowances to projects involving landfill methane capture and destruction, reduction in emissions of sulfur hexafluoride (SF6) in the electric power sector, sequestration of carbon due to afforestation, reduction or avoidance of CO_2 emissions from natural gas, oil, or propane end-use combustion due to end-use energy efficiency in the building sector, and avoided methane emissions from agricultural manure management operations.

The following ten states participate in RGGI: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. However, the governor of New Jersey has announced that his state will discontinue its participation in RGGI at the end of 2011.

Climate-Related Energy Provisions

Many of the policies discussed in the previous sections, although not always aimed specifically at reducing greenhouse gas emissions, will help the state address its climate change goals. In the electricity sector, the following policies will reduce reliance on fossil fuels and thus reduce carbon emissions associated with generation, transmission, and consumption of electric power:

- Energy Efficiency:
    - Rate Design and Incentives;
    - Load Management Technologies.

- Renewable Energy:
    - SPEED Program;
    - Net Metering (including group net metering);
    - Rate Design – PURPA authorization for avoided cost rates for biomass, waste, renewable resources or cogeneration.
- Energy Planning:
    - Comprehensive Energy Plan;
    - 5-Year State Agency Energy Plan.

Additionally, policies addressing thermal energy use do and will continue to have an impact on carbon emissions. Such policies include:

- Vermont's goal of at least 60MW of power from renewable energy or cogeneration by 2028;
- District Heating;
- Tax Incentives for high efficiency thermal equipment;
- Participation in the Home Heating Fuel Assistance Program is contingent on participation in the Weatherization Assistance Program.

As mentioned above, efficiency can also reduce greenhouse gas emissions. The following are existing Vermont goals aimed at increasing efficiency throughout the state:

- Improve the energy fitness of 25% of the state's housing stock by 2020 (approximately 80,000 housing units);
- Reduce fossil fuel consumption in all buildings by an additional one-half percent annually, leading to a total reduction of 10 percent annually by 2025;
- Increase weatherization services to low income Vermonters by expanding the number of units weatherized, or the scope of services provided, or both, as revenue becomes available in the home weatherization assistance trust fund.

Transportation policies will also affect Vermont's ability to realize climate-related goals. Opportunities to address climate through transportation issues include:

- The Low Emission Vehicle Program;
- Vermont Motor Vehicle Inspection Program: On-Board Diagnostic Check;
- Go Vermont – Commuter Resource;
- Fleet Management Services (FMS).

Federal Level

H.R. 2454: The "American Clean Energy and Security Act of 2009," better known as the "Waxman-Markey bill," after barely passing the House in 2009, never came to a vote in the Senate. After the shift in the political landscape in the fall 2010, the climate pendulum swung in the other direction. With the economy dominating the political agenda until the Presidential elections in 2012, we do not foresee any federal legislative action on the climate front at least until 2013.

In 2007, the U.S. Supreme Court held that greenhouse gases were air pollutants under the Clean Air Act in *Massachusetts v. EPA*. The court stated that the Environmental Protection Agency could only avoid regulating GHG emissions if the agency provided a reasonable explanation for doing so. Since the Court's decision, the EPA made a formal finding that GHG emissions endanger public welfare. The Supreme Court decision and agency finding have allowed the EPA to adopt several regulations related to GHGs emissions including:

- EPA and National Highway Traffic Safety Administration Standards aimed at reducing GHG emissions and fuel use for new cars, light trucks and medium and heavy duty vehicles; and
- GHG tailoring rule that determines which existing industrial facilities must obtain certain permits under the Clean Air Act.

Given the emergence of the EPA's authority to regulate GHGs under the Clean Air Act forced by the *Massachusetts v. EPA* litigation, climate-progressive states are not completely precluded from regulating GHG emissions. The Supreme Court in the *AEP v. Connecticut* case left the viability of a climate change claim under state common law open. Thus, Vermont is not limited to in-state mitigation initiatives and the door is still open for the state to influence the behavior of large out-of-state emitters.

Structural Overview

Key Players and Their Roles

To identify key players responsible for the development and implementation of climate change policy in Vermont, we need to include the majority of players listed in the previous four sections. Such a restatement would have been lengthy and redundant while adding little substance to this Conceptual Map. Instead, we concentrate on five entities created during the last eight years to address the climate change problem. Please see the next page for the spotlight on Vermont's climate change "commissions."

Conclusions

In our analysis of the state's climate change policy area, we concluded the following:

Goals

- Vermont is very clear about its concerns regarding climate change and about the willingness of Vermonters to take actions to mitigate the problem;
- The state's climate change policy goals are clearly stated;
- Legislative findings regarding the origins and dangers of climate change establish a connection between an energy-related solution and the core problem.

Drivers

- Participation in RGGI makes Vermont one of the most progressive states in terms of climate policy;
- Although the viability and effectiveness of the RGGI are yet to be determined, participation in the first GHG emission cap-and-trade program in the country establishes Vermont as a leader, particularly if similar mechanisms are implemented in a greater region or nationwide;
- The high level of development of climate change and climate change-driven legislation in Vermont positions the state as a national leader;
- Based on the evolution of climate change "commissions," Vermont appears to be en route to having effective coordination and expert consultative bodies to help shape and direct the state's climate change policy;
- Despite many significant achievements, several opportunities exist for Vermont to further its climate change policy agenda.

Spotlight

Vermont Climate Change Commissions

Entity	Climate Cabinet	Climate Change Team	Climate Neutral Working Group	Vermont Climate Collaborative	Governor's Commission on Climate Change
Status	Currently active May '11 - Present	Currently active Jan. '08 - Present	Currently active Sept. '03 - Present	Currently inactive Active: Oct. '08 - July '11	Currently inactive Active: Dec. '05 - Oct. '07
History	Established by Executive Order #05-11	Established by the Secretary of ANR	Established by Executive Order #14-03	Established by the VCC Charter	Established by Executive Order #07-05
Organization	Comprised of various state agency and department heads	Comprised of members from various ANR divisions and departments	Comprised of members from various state agencies and departments	Partnership between state government, academia, and the private sector	Consisted of no more than six members appointed by the Governor.
Goals	Provide comprehensive leadership by coordinating climate change efforts across all agencies and departments	Facilitate enhancements to existing programs to promote sustainability, reduce GHG emissions, improve waste reduction, implement adaptation and mitigation methods, and advance related economic opportunities	Create biennial report to coordinate, document, and encourage efforts to meet Vermont's GHG emission reduction goals	Develop strategic partnerships to reduce GHG emissions and to build the green economy	Develop recommendations to reduce GHG emissions that are consistent with Vermont's need for continued economic growth and energy security
Special Contribution **Assigned Duties**	**Comprehensive Leadership** • Provide outreach and education on the effects of climate change • Identify strategies to reduce Vermonters' dependence on fossil fuel and GHG emissions	**Administration and Implementation** • Program planning and development • Liaison with other agencies • Performance metrics, benchmarks, and reporting • Communication and coordination • Promotion of renewable energy and efficiency • Marketing and branding • Outreach and education • Adaptation and mitigation planning	**Report State of Science** • Document efforts to meet the GHG emission reduction goals • Identify potential actions and their anticipated impacts • Highlight any challenges for meeting GHG emission reduction goals • Highlight opportunities for expediting GHG emission reductions	**Strategic Partnerships** • Form working groups to draw expertise from stakeholders and experts to assess specific issues • Hold conferences to create opportunities to share ideas, information, and viewpoints • Conduct public engagement and outreach	**Investigate and Recommend** • Examine effects of climate change on Vermont • Produce inventory of existing and planned actions that contribute to GHG emissions • Educate public about climate change and how they can play a role in reducing GHG emissions • Gather input from all sectors regarding opportunities to reduce emissions • Develop recommendations for the Governor

Energy-Related Taxes and Fees

In addition to the substantive policies and initiatives described above, Vermont imposes a variety of taxes and fees that are related to energy use and transportation. In many instances, these taxes and fees provide a dedicated revenue stream for specific state programs.

Fuel Gross Receipts Tax

The retail sale of heating oil, kerosene, propane, natural gas, electricity and coal are taxed at the rate of 0.5 percent when the seller receives more than $10,000 per year for the sale of such fuel. The tax is currently scheduled to sunset after June 2016. Revenues are dedicated to the Weatherization Assistance Program.

Heating Oil Tax

In addition to the Fuel Gross Receipts Tax, heating oil and kerosene are taxed at 1 cent per gallon, paid by retail sellers receiving more than $10,000 in sales taxes for these fuels. This tax is currently scheduled to sunset after April 2016. Revenue is dedicated to the Petroleum Cleanup Fund.

Electric Energy Tax

This tax applies to electric generation facilities built after 1965 if they have a capacity of at least 200 megawatts. The rate is $2 million for plants that generate less than 2,300,000 megawatt-hours per year with a higher graduated tax for plants that exceed this production level. These plants also pay an education property tax of $1.465 million for plants producing less than 2,300,000 megawatt-hours with a higher graduated tax for plants that exceed this figure.

Utility Gross Receipts Tax

To fund the operations of the Public Service Board and the ratepayer advocacy of the Public Service Department, electric utilities pay a tax equal to 0.5 percent of their gross operating revenue. Gas utilities pay a tax of 0.3 percent of gross operating revenue.

Utility Energy Efficiency Charge

To fund Efficiency Vermont, the state's energy efficiency utility, the Public Service Board annually approves an energy efficiency charge that is paid by most retail electric customers via their monthly utility bills. For 2012, the applicable rate for residential customers is 0.931 cents per kilowatt-hour, with a separate rate of 0.644 cents per kilowatt-hour applying to customers of the Burlington Electric Department.

Sales Tax on Commercial Energy Use

Electricity, natural gas, fuel oil, propane and wood that is sold to commercial establishments (but not residences, farms or industrial facilities) is subject to a 6 percent sales tax, which is paid into the state's general fund.

Motor Fuel Taxes and Fees

Gasoline is subject to a tax of 20 cents per gallon, with diesel fuel taxed at 26 cents per gallon. Both taxes include one cent per gallon as a petroleum cleanup fee. Most of the revenue goes to the state's transportation fund. In addition, as of 2009, motor fuel is subject to a Motor Fuel Transportation

Infrastructure Investment fee of 2 percent of the average retail price of such fuel. The assessment is revised on a quarterly basis and the revenue is applied to the Transportation Infrastructure Bond Fund.

Motor Vehicle Purchase and Use Tax

In lieu of sales tax on motor vehicles, Vermont residents who purchase a motor vehicle are subject to a tax of 6 percent. For trucks weighing 10,100 pounds or more, the maximum fax is $1,850. For vehicles purchased outside of Vermont, the tax is assessed at the time of registration in Vermont.

Motor Vehicle Registration Fees

There is an annual registration fee of $65 for automobiles ($27 for diesel-fueled vehicles) and a corresponding registration fee for trucks that varies with loaded weight and type of fuel used. For example, a gasoline-fueled truck weighing 17,000 pounds when loaded would be assessed $342.

According to preliminary figures from the Legislature's Joint Fiscal Office, the various taxes and fees that are dedicated to the state's Transportation Fund produced $217.6 million in funds available for transportation expenditures in fiscal 2001, with an additional $18.5 million applied to the Transportation Infrastructure Bond Fund.

Conclusion

We began this paper with the observation that energy policy is both too important to leave solely to insiders and too complex to successfully address without hard work and some essential knowledge. We continued with the faith that putting useful knowledge in the hands of Vermont's citizens could give us all some key tools for helping to understand—and shape—a better energy future for our state.

As one step toward helping that process, we have, in the pages above, summarized Vermont's most important energy statutes, regulations, executive orders and decision-makers. Our focus has been on summarizing our state's legally defined goals and on identifying those with formal authority to make decisions. Vermonters are, of course, committed to an ideal in which all affected people should influence policy decisions, and defining our formal decision-makers is but one step toward helping all Vermonters see and contribute to important policy decisions.

Our review of a century-old system has, inevitably, revealed that some policy goals are in tension with others, and that some decision-making may be redundant. Thus, our work suggests—but does not specify—improvements in several areas.

More importantly, though, our review has highlighted several areas of broad agreement. Vermont's statutes, regulations and orders consistently do value certain things in the energy field. These include:

- Reliability and Lowest life-cycle costs;
- Recognition of both fiscal and environmental costs;
- Strong commitment to energy efficiency across our entire state; and
- A high degree of openness and public involvement in energy policy debates.

We hope—and expect—that Vermonters will use the tools we describe above to seek those common goals and build a better energy future for each of us, and for all those who will live for decades with the decisions we make now.

Appendix

Detailed Decision Making Process Maps

Key for detailed decision making maps

Vermont agency

Non-government actor

Federal agency

Municipal government

Boxes that combine more than two colors indicate either a governmental body that operates on more than one level or a private entity given the authority of a governmental agency.

Boxes highlighted in yellow represent key players within the map's central energy policy area.

= Energy security (reliability) is a goal for which this player is responsible.

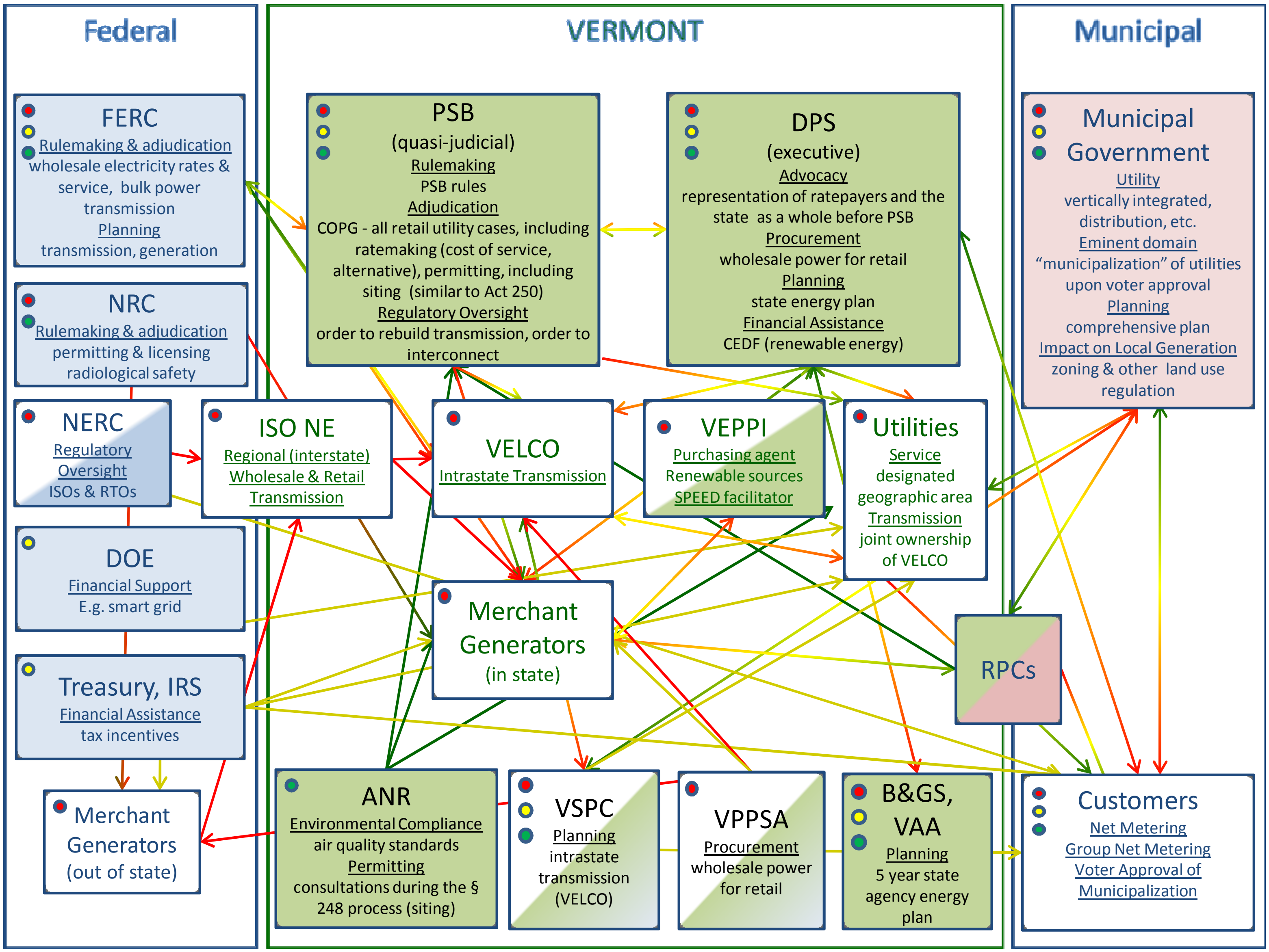
= Environment (sustainability) is a goal for which this player is responsible.

= Economy (economic impacts) is a goal for which this player is responsible.

The red, green, and yellow color scheme also applies to the arrows, representing the nature of the relationship between the players. Where players interact to reach more than one goal, arrows are accordingly multicolored.

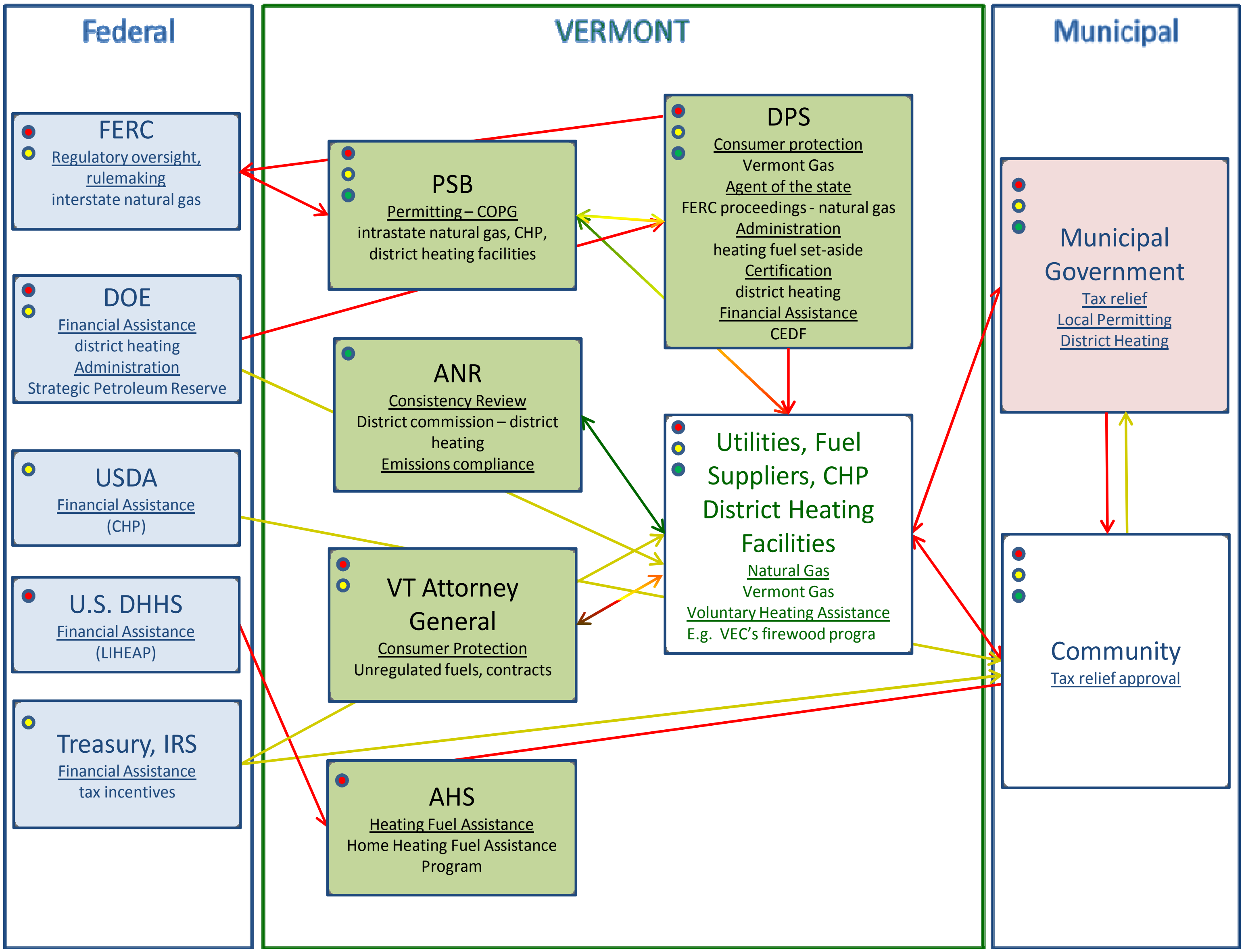
Electricity

Decision-Making Process Map



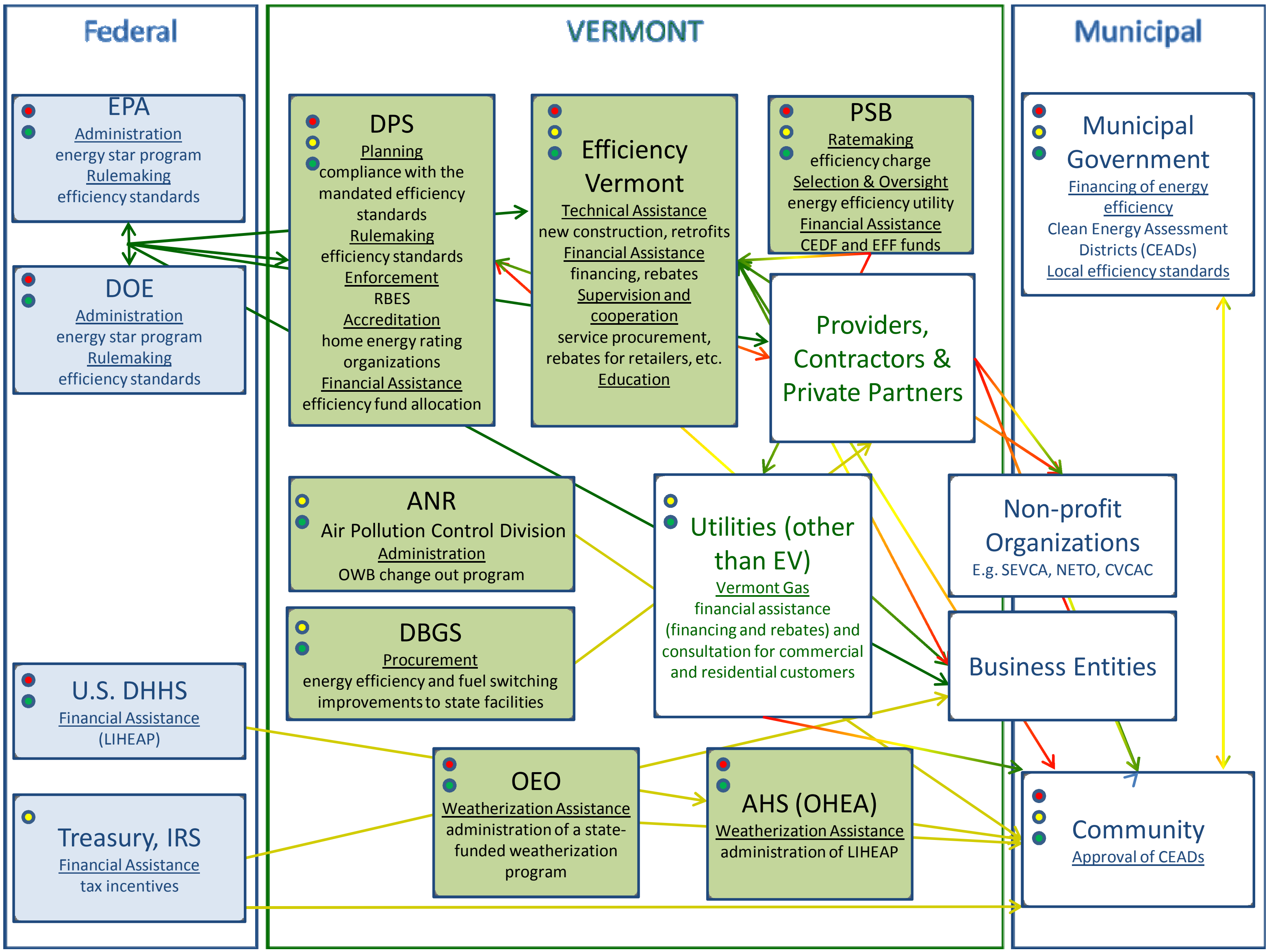
THERMAL (HEATING)

Decision-Making Process Map



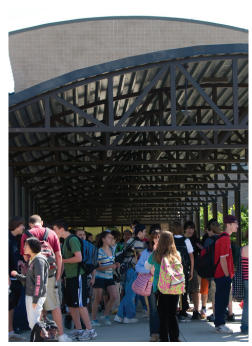
End-Use Energy Efficiency

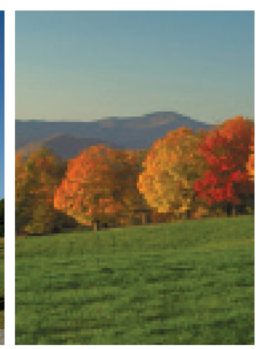
Decision-Making Process Map



Appendix 2—Public Health Assessments

Public Health Assessments & Energy Planning





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Public Health Assessments & Energy Planning

Good health is not simply due to good medical care, but a result of what we as a society do to create the conditions in which people can be healthy. Public policy – including legislation, regulation, policy and practice beyond the realm of health care or public health – is one of the most effective ways to protect and improve the health of the population.

In a major report released in June 2011, *For the Public's Health – Revitalizing Law and Policy to Meet New Challenges*, the Institute of Medicine recommended that local, state and federal agencies consider the potential health impacts and the health costs of major legislation, regulations and policies relating to education, transportation, land use planning, agriculture, etc. This concept of making "healthy" policy can be applied just as well in energy planning.

In keeping with similar guidance from the federal Centers for Disease Control & Prevention, the Vermont Department of Health recommends that public health assessments be incorporated into the state's energy planning processes and policies, and when reviewing new and existing energy projects.

What is a Public Health Assessment?

The public health assessment is a tool that can be used to help decision makers in selecting among energy alternatives by evaluating the potential public health and safety impacts, and identifying opportunities to maximize benefits and mininize risks. The assessment is tailored to the particular project and may be used to inform both broad planning processes and specific permitting proceedings. Once completed, portions of a public health assessment may be used for multiple similar analyses, and can also be useful for home or business owners as they modify or replace energy sources.

The essential elements of a public health assessment are evaluations of the policy or project to determine its scope and complexity, a description of potential health benefits and adverse effects, characterization of the people likely to be affected, and identification of engineering or human controls that could be used to mitigate negative health impacts.

A public health assessment consists of four elements:

1. SCOPE: Describe location, size and scope of the energy policy or project
2. IMPACT: Describe possible health benefits and adverse effects
3. POPULATION: Characterize the groups of people who may be affected
4. CONTROLS: Identify engineering or human controls that would maintain or improve performance, and mitigate adverse health effects

Who Conducts a Public Health Assessment?

A public health assessment is conducted by the proponent of the policy or project to assure that potential health impacts have been considered in the design or development stages. For example, a utility in a Section 248 proceeding could submit the assessment as part of its initial filing to demonstrate that the project will not have a negative effect on public health and safety.

In appropriate instances, the Health Department may evaluate a petitioner's public health assessment. The Health Department may also prepare a public health assessment to help state and local autorities understand the potential for health impacts as they consider energy policies or projects.

Public health assessments are performed by specialists knowledgeable both in the specific energy policy or project and in public health. In some instances, a literature review may be sufficient, and in other more complex situations an analysis of the specific technical aspects will be required. When potential health effects are identified, additional analysis will be needed to describe control systems such as site-specific modifications and post-installation operator training, component maintenance, and system monitoring that could be used to mitigate the adverse effects.

How is a Public Health Assessment Used?

The public health assessment is used to improve an energy project by identifying opportunities to maximize health benefits and mitigation measures to minimize adverse health effects. For example, the assessment might describe potential benefits such as greater opportunities for physical fitness and reduced carbon emissions when a project is designed to encourage walking, bicycling and carpooling. The assessment might also identify potential risks such as illness, injury and death from exposure to hazardous materials, and identify measures to eliminate or lessen those risks.

A public health assessment also may provide confidence that a new technology will not have negative health effects, or identify ways such effects can be avoided or minimized. A literature search conducted for the public health assessment may also identify methods to manufacture or use energy components with less waste, or new ways to reuse or recycle materials.

Incorporating thoughtful consideration of health consequences into planning and permitting projects will allow for improved policy development and project design, and minimize societal costs from adverse health effects that could otherwise be avoided.

Benefits of a Public Health Assessment

Take electricity as an example. Regardless of how it is generated – with fossil fuel, nuclear energy, water, wind or solar energy – there are risks inherent in transmitting electricity as well as from associated waste management, transportation and emissions. The following are examples of how a public health assessment might be used to minimize or mitigate the risks:

- Herbicides used to maintain access to transmission lines can leach into groundwater and public or private water supplies, and can affect food supplies. Identifying groundwater sources and public or private water supplies in advance of locating a transmission corridor can help planners avoid those areas and prevent such contamination from occurring.

- Transmission system substations have high-voltage components, exposing workers to risk for shock, burns and electrocution. High-energy electromagnetic fields may increase cancer risk, and cooling fluids in transformers could leak and contaminate the soil or drinking water. Identifying those risks, planning for alternatives where feasible, and employing engineering and human controls can minimize such risks.

- Spent nuclear fuel presents the greatest and longest lasting toxicological hazard, and requires the most stringent waste management practices. Location and containment decisions informed by a public health assessment will assure that not only the potential direct environmental effects are considered, but also the effects on workers and the public are addressed in decisions about how to manage spent nuclear waste.

- Ash from coal and biomass fuel concentrates the toxic chemicals present in the original form. Options for recycling ash waste (e.g. as fertilizer) should be thoroughly evaluated to ensure health risks are quantified and acceptable.

- Some of the physical components of solar, wind, hydroelectric and geothermal power generation are considered hazardous waste when they reach the end of their useful life. Planning for the safe disposal of these components right from the start assures that decisions made today do not create public health hazards in future years.

- No energy alternative is free of transportation-related health costs. Fossil fuels, biomass and uranium are transported by highway, rail and water from the drilling, mining or harvesting site, to processors, to generating stations, and finally to recycling or disposal sites. Components of solar energy collection, hydroelectric dams, wind turbine systems, geothermal energy utilization, and the electrical transmission and distribution system involve transporting raw materials to places of manufacture and on to destinations of ultimate use. The public health assessment may identify transportation risks and may also identify transportation corridors that could be avoided to minimize risks.

Emissions, Pollutants and Climate Change

Each energy alternative will have some degree of impact on climate change. The potential human health consequences of climate change are just beginning to be thoroughly investigated. These include the direct and indirect adverse health effects of extreme heat and weather events on people and agricultural crops, increases in infectious disease due to water and food contamination, and increases in allergies and other respiratory illnesses.

Pollutants such as nitrogen oxides, sulfur oxides, carbon monoxide and fine particulates can pose a health hazard to the general public, as well as to the workers who manufacture and transport fuels. The potential impacts include increased heart disease and respiratory illnesses such as asthma and lung cancer. A public health assessment would assure that the effects on people from such pollutants are specifically considered, and may identify means to control them. For example, the concentrations of these and other toxic chemicals can be reduced using technologies such as electrostatic precipitators and other emission-reducing and efficiency-building devices. These are being used in many areas of the world and in Vermont with some success.

A public health assessment of an energy alternative or a particular project will identify the pollutants that may increase the burden of disease, the populations that could be affected, and the controls that can be used to minimize health effects. The assessment may be used to identify possible incentives, or to require or provide pollution-reducing technologies for new energy projects. The assessment may identify technologies to retrofit systems already in service. Experience elsewhere demonstrates that incorporating pollution-reduction technologies achieves both sustainability with renewable fuels and health protection, with overall reduced costs.

Considering Vulnerable Populations

A public health assessment is particularly useful in identifying increased risks to susceptible and vulnerable populations from specific energy sources, as well as how policies and projects may be modified to promote health.

Vulnerable populations include children, the elderly, people with chronic illnesses such as respiratory and cardiovascular disease, people with compromised immune systems, and those who do not have adequate health care. These groups are more likely to experience health problems when they are exposed to harm such as pollutants because of where they live, work or attend school.

For example, the location of a particular project may create a greater burden because of existing pollutant levels due to a nearby transportation corridor, or the geography of the area (such as hollow where temperature inversions are more likely to occur, trapping pollutants near the ground at breathing level). In some areas, pollutants from more distant sources may be experienced at higher concentrations due to certain terrain characteristics or local weather patterns.

A public health assessment can identify these existing conditions and possible controls to minimize the effects of an additional pollution load.

Young children are especially vulnerable to certain environmental pollutants and a public health assessment can be especially valuable in evaluating the health impacts of energy decisions at home and in schools. A public health assessment of Vermont's *Fuels for Schools* program, for example, could identify techology and other controls best suited to achieve effective pollution-control performance and assure minimal emissions in school environments.

Energy plans and policies should not only consider the public health impacts of energy choices, but also the impacts of those choices on particularly susceptible populations. A public health assessment would evaluate potential health impacts and identify strategies to eliminate or control negative health effects.

Conclusions

Decisions about specific energy policies and development of particular energy projects can have profound beneficial results for individuals and society. Neither should occur without a comprehensive evaluation of potential positive and negative public health effects.

A public health assessment need not be an excessive burden on policy makers and project managers. On the contrary, a public health assessment can identify previously unrecognized benefits and costs, and potential modifications and controls to minimize adverse health effects. This knowledge may make another alternative more attractive, or lead to further efforts that eliminate or lessen the concerns to make the original alternativw more effective. The result will be better protection of public health and safety in our energy planning and project approval processes.

Appendix 3—Executive Order, Vermont Climate Cabinet

Governor's Climate Cabinet

WHEREAS, there is broad scientific consensus that the Earth is undergoing a rise in overall atmospheric temperature driven by anthropogenic greenhouse gas emissions that is forecast to have profound effects on global, continental and regional climate conditions. In the northeast United States, the effects are expected to include higher peak summer temperatures; warmer, wetter winters; increased periods of drought; and increased frequency of severe precipitation events; and

WHEREAS, regardless of any reduction of anthropogenic greenhouse gas emissions, there is scientific consensus that the world, the nation and the region will experience changes in climate associated with previous emissions that have the potential to affect both natural ecosystems and the built environment that will need to be adapted to; and

WHEREAS, state government has a critical role to play in reducing statewide greenhouse gas emissions, planning for impending changes in our regional climate, and leading by example; and

WHEREAS, Vermont has the opportunity to become a nationally and internationally recognized leader in transitioning to a more sustainable economy and society, in part through developing and implementing effective approaches to reducing greenhouse gas emissions and to adapting to the coming changes in the climate of the state and the region; and

WHEREAS, cultivating a "green economy" in Vermont will lead to the creation of new jobs and increase Vermont's prosperity.

NOW THEREFORE, pursuant to the authority vested in me as Governor of the State of Vermont, I, Peter Shumlin, do hereby create the Vermont Climate Cabinet.

The Vermont Climate Cabinet shall be chaired by the Secretary of the Agency of Natural Resources, and consist of the Secretaries of Administration, Agriculture Food and Markets, Commerce and Community Development, and Transportation; the Commissioners of the Departments of Economic, Housing and Community Development, of the Department of Buildings and General Services and the Department of Public Service. The Agency of Natural Resources shall provide staff support to the Vermont Climate Cabinet. The Vermont Climate Cabinet may from time to time call upon other state agencies or departments to assist as appropriate in implementing this Order and achieving its purposes.

The Vermont Climate Cabinet shall be advisory to the Governor and shall have the following functions and duties:

1. Provide comprehensive leadership by coordinating climate change efforts across all state agencies and departments.

2. Provide information to Vermonters on all matters relating to a changing Vermont climate, including what to expect in the coming years and actions citizens can take to reduce their emissions of greenhouse gases.

3. Identify strategies to reduce Vermonters' dependence on fossil fuel for transportation, and reduce greenhouse gas emissions by encouraging alternatively fueled vehicles and more efficient vehicle and mobility choices.

4. Improve energy efficiency for existing and new buildings.

5. Foster development of in-state renewable and sustainable energy sources.

6. Partner with municipalities and regional planning and development agencies so that Vermont communities grow sustainably and are resilient to climate change impacts in the future.

7. Improve the understanding of the effects of climate change in Vermont and identify strategies to address these effects in order to protect Vermonters, their property, the state's economic well-being and the state's natural resources and the ecosystem services these resources provide.

8. Advance the recommendations set forth in the Vermont Comprehensive Energy Plan of 2011.

9. Establish policies and programs that expand Vermont's green economy grow green jobs, reduce energy costs to households and the business sector, and improve the wellbeing of working Vermonters while reducing Vermont's greenhouse gas emissions.

10. Implement the recommendations of the Climate Neutral Working Group to foster energy efficiency and use of renewable energy in state buildings, and energy efficient behavior by state employees and contractors.

11. Advise the Governor, the legislature, and Vermonters on ways to ensure that Vermont continues to be a national leader in developing and implementing strategies that effectively address the challenge of climate change and promote a successful and prosperous low-carbon economy.

12. Advise the Governor on the state's role in regional and federal efforts to address climate change and energy security.

13. Identify and secure federal and state funding for climate change mitigation and adaptation efforts in Vermont.

This Executive Order shall take effect upon signing.

Dated this 17th day of May, 2011

Peter Shumlin
Governor

By the Governor

Alexandra MacLean
Secretary of Civil and Military Affairs

Executive Order #05-11

Appendix 4—Modeling Study

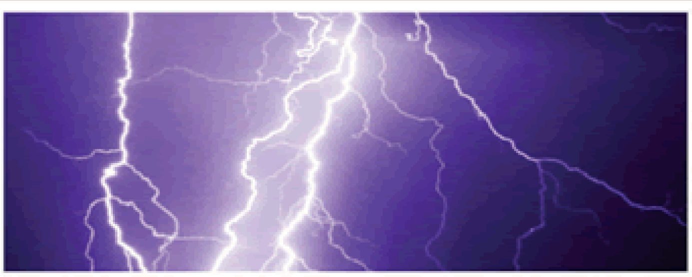
Synapse
Energy Economics, Inc.

Electricity Scenario Analysis

for the

Vermont Comprehensive Energy Plan 2011

REVISED: September 19, 2011



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1. Definition of Scenarios

Synapse was asked to evaluate the costs and benefits associated with alternative energy strategies for Vermont during the plan period, 2012-2031. As detailed below, this modeling task included two parts: *dispatch modeling*, which models the operation of the electric system in Vermont and the rest of New England in order to estimate the cost of electricity and pollutant emissions under each of the scenarios; and *economic impact modeling,* which compares the spending, employment, and gross state product (GSP) effects of the scenarios.

The dispatch modeling is based on a previous dispatch modeling analysis performed by Synapse for the Avoided Energy Supply Cost (AESC) study group and report, completed in 2011. The 2011 AESC Study was sponsored by a group representing all of the major electric and gas utilities in New England as well as efficiency program administrators, energy offices, and utility regulators. For the current study, the Reference Case model was modified to include all existing and expected DSM programs in New England, which had not been included in the AESC study. For Vermont, only DSM investments through 2011 were included in the Reference Case. The updated load forecasts used for Vermont and other New England states are described in Section 2 of this report.

The scenarios modeled were:

1. **Reference Case with no new DSM ("Reference Case")**: This case, intended only as an baseline for illustrating the costs and benefits of the other two scenarios, assumes no further funding of demand-side management (DSM) measures in Vermont after 2011. All other NE states are assumed to continue funding DSM, and the associated energy savings for future programs are set at current or proposed levels. Renewable resources are included in Vermont and New England sufficient to meet the existing minimum renewable portfolio standard (RPS) and other requirements in all New England states.
2. **Proposed DSM Case:** Similar to the Reference Case, except that DSM is implemented in Vermont throughout the plan period (2012 – 2031) following the current DPS proposed budget. The annual incremental energy use and peak load reductions associated with these programs are as forecasted by GDS Associates for this level of spending. The ongoing impacts of DSM spending in 2011 and in prior years are also included. Investments in new renewables are decreased relative to the Reference Case due to the smaller amount required to meet minimum RPS requirements with decreased energy use in Vermont.
3. **High Renewables and Hydro ("High Renewable Case"):** Includes all DSM in the Proposed DSM case, and includes new renewable energy resources to reach the goal of meeting 75% of Vermont's energy use with renewables and hydropower. In contrast to the RPS requirements in the Base and Proposed DSM Cases, existing biomass and hydropower all count towards the 75% renewables goal.

All three scenarios include continued operation of all existing renewable energy and VEPPI resources in Vermont.

The scenarios are summarized in Exhibit 1.

Exhibit 1: Comparison of Energy Future Scenarios. Quantities of generating capacity are reported in Megawatts (MW)

Case:	Reference Case (baseline for evaluating other scenarios)	Proposed DSM Case	High Renewable Case
VT DSM	No new spending after 2011.	Annual spending following DPS proposed budget; savings as estimated by GDS Associates.	As in Proposed DSM Case
VT RPS	RPS target of 25% new renewables on an energy basis by 2025 (ramping smoothly from current & expected) then no growth. Includes FIT new net-metered resources.	As in Reference Case, except reduced to reflect lower load.	75% hydro plus renewables on an energy basis, including Reference Case renewables, existing hydro & HQ.
VT Biomass	Existing resources continue at current levels; 60 MW new biomass by 2013.	As in Reference Case, except that output of McNeil increased due to installation of catalytic converter.	As in Proposed DSM Case; all biomass counts towards 75% goal. Cost premium added to reflect policy.
VT Hydropower	Existing resources (including VEPPI resources) continue at current levels. 6 MW added under FIT in 2013.	As in Reference Case	Expansion of HQ imports to 24 hours; 40 MW of additional hydro contracted to state. Cost premium for all hydro to reflect policy.
VT Feed-in Tariff	50 MW by 2013, no more thereafter; all distributed solar Included in RPS.	As in Reference Case	50 MW by 2013, growing at 5 MW/year thereafter for 10 years. Assume not needed after 2023.
*VT Non-Electric Fuels**	No new spending after 2011.	Consistent with current programs as modeled for the EE impact study.	As in Proposed DSM Case
Surrounding states	Current policies on EE, renewables.	As in Reference Case	As in Reference Case

** Non-electric fuel policies/scenarios were considered in the economic modeling, but do not affect dispatch modeling.*

2. Electricity Scenario Modeling

A. Dispatch Modeling

For each of the three "Vermont energy future" scenarios, Synapse estimated the impact on electric energy market prices using the Market Analytics model, licensed from Ventyx, an ABB Company. The results of this analysis are provided later in this report.

Market Analytics is a production-cost model that simulates the operation of the wholesale electric energy market. The National Electric Reliability Council's (NERC) dataset for the Eastern Interconnection was used in this analysis, with various model inputs revised to more closely reflect up-to-date electricity market conditions, with particular attention to Vermont. These input modifications draw extensively from those made for the Avoided Energy Supply Costs in New England study and subsequent report ("the AESC study"), released in July 2011.

The modeling assumptions and methodology used for the AESC study are described in detail in the AESC report.[1] Updates and modifications to these assumptions and methodology are described below.

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

A primary foundation of any dispatch modeling effort is the projection of peak load and annual energy use in the study area, and in specific sub-areas of interest. For the current study, we base our load forecasts on the CELT load forecasts published by the New England ISO.[2] These forecasts are provided with and without "Passive Demand Resources" (PDR), which is the ISO's term for the combined impact of energy efficiency and distributed generation resources. In order to forecast load for this analysis, we used the (higher) forecast *without* PDR, and then adjusted the forecast to accommodate energy efficiency and distributed generation resources. For all New England states other than Vermont, state or utility energy efficiency program planning reports were used to project future annual incremental energy savings and summer peak load reductions. Because these reports generally do not extend through 2031, for the purposes of this study we assumed the energy savings impacts projected for the last year in the planning reports are repeated annually through 2031.

For Vermont, we use the same CELT forecast for the Reference Case (without "PDR") but adjust this forecast to reflect Vermont DSM investments in 2011 and all prior years. This results in a decreasing DSM impact through the study period as the impact of those investments decays over time, with an average measure life of 11 years. For the Proposed DSM case, we apply the level of energy efficiency program funding for Vermont (the "3% savings scenario") recommended by Vermont DPS beginning in 2012 and continuing throughout the study period. We apply annual incremental energy savings as projected by GDS Associates for this level of spending. These funding and savings data were provided to Synapse by the DPS. In later years, higher levels of incentives are required to induce more customers to participate in efficiency programs; thus each

[1] Hornby, et al., *Avoided Energy Supply costs in New England: 2011 Report*. Prepared for the Avoided Energy Supply Component (AESC) Study Group. July 21, 2011. Available at: http://www.synapse-energy.com/Downloads/SynapseReport.2011-07.AESC.AESC-Study-2011.11-014.pdf

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

constant dollar of utility spending achieves lower savings than it does in the earlier years. Cumulative savings were estimated using an annual constant decay factor based on an 11-year measure life.

The annual savings in Vermont under each scenario is shown in Exhibit 2; for comparison, the total savings in 2031 as a percentage of pre-DSM energy requirements is shown for each of the New England states, under each scenario, in Exhibit 3. The resulting annual energy requirements for Vermont under each scenario are shown in Exhibit 4.

Exhibit 2: Annual energy savings in Vermont under the Reference Case and Proposed DSM scenarios.

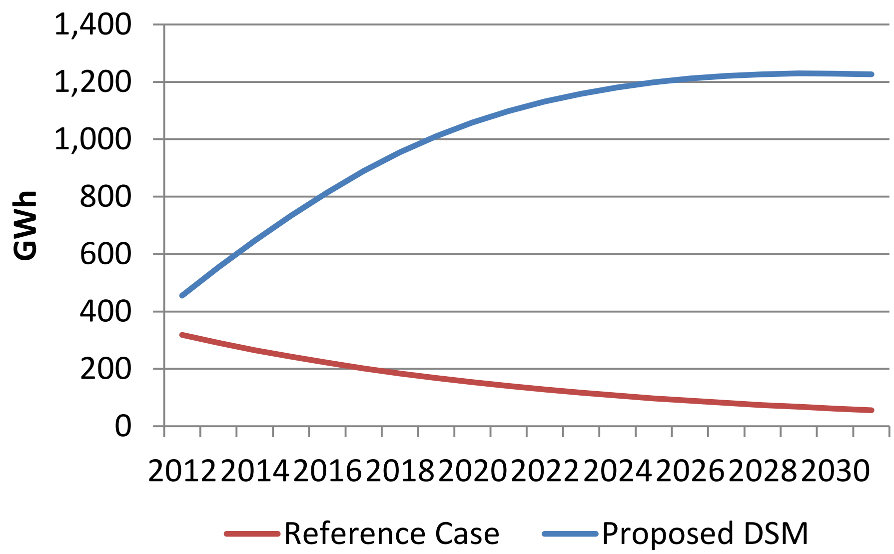


Exhibit 3: 2031 Energy savings in New England states under the Reference Case and Proposed DSM scenarios, as a percent of pre-DSM requirements.

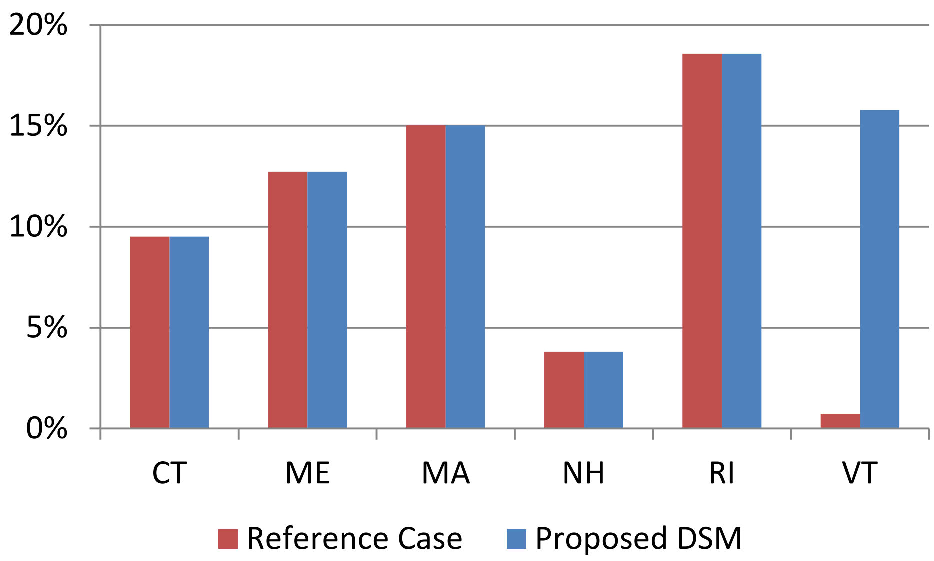
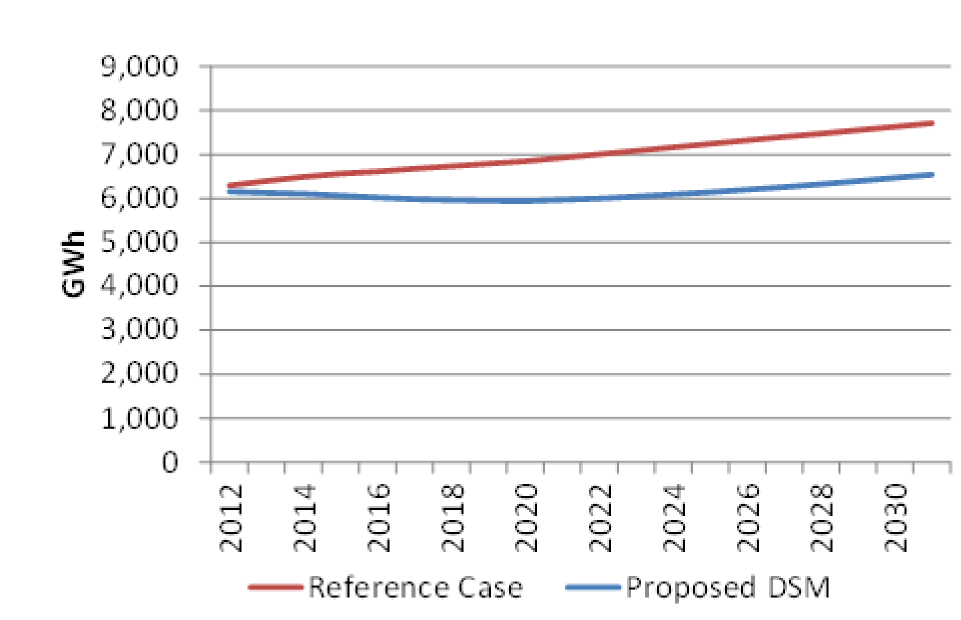


Exhibit 4: Annual energy requirement in Vermont under the Reference Case and Proposed DSM scenarios.



Other Dispatch Model Assumptions

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 resources additions and retirements during the study period. The assumptions used in this study for fuel and emissions prices follow those used for the 2011 AESC study, and are described in detail in the AESC report. Fuel prices were extended to cover the current study period using the compound annual growth rate for the last five years of the AESC study (2021 – 2026). For pricing CO_2 emissions from the electric sector, the floor price from the Regional Greenhouse Gas Initiative (RGGI) was used as the emissions price for carbon dioxide. A federal greenhouse gas regulation program was assumed to supersede the RGGI program beginning in 2018. For this analysis, Synapse' projections of CO_2 emissions prices were used for the period 2018 through 2031.[3]

The transmission system used in this analysis reflects the interface limits of the existing system, as well as ongoing transmission upgrades, including but not limited to those contained in the ISO-New England ("ISO-NE") Regional System Plan. Specifics of the transmission upgrades are detailed in section 2.3.2.3 of the 2011 AESC report.

Resource Additions and Retirements

The modeling analysis assumes that the majority of plants in operation today will continue operating throughout the study period. Assumed existing plant or unit retirements were driven by one of the following factors: 1) inability to comply with future environmental regulations; 2) equipment failure in older, less cost-effective units; 3) the expiration of operating licenses for nuclear and hydro units that are unable to meet the requirements for license extension, including the Vermont Yankee nuclear plant; and 4) space constraints that arise when new generation capacity is constructed at the site of existing capacity and forces the existing capacity to retire. Projected unit retirements during the study period are shown in Exhibit 5.

[3] Johnston, et al. *2011Carbon Dioxide Price Forecast*. February 11, 2011. Available at: http://www.synapse-energy.com/Downloads/SynapsePaper.2011-02.0.2011-Carbon-Paper.A0029.pdf

Exhibit 5: New England generating unit retirements as represented in the dispatch model (all scenarios)

Station Name	Unit Type	Summer Capacity (MW)	Retirement Date	State
Somerset	Stream Turbine	108.5	10/1/2010	MA
Somerset	Gas Turbine	21.8	10/1/2010	MA
St Albans	Gas Turbine	2.2	10/1/2010	VT
Vermont Yankee	Nuclear	604.3	3/21/2012	VT
Salem Harbor	Stream Turbine	83.9	1/1/2013	MA
Salem Harbor	Stream Turbine	80.5	1/1/2013	MA
Bridgeport	Stream Turbine	130.5	1/1/2013	CT
Holyoke Cabot	Stream Turbine	19.3	1/1/2013	MA
Norwalk Harbor	Stream Turbine	162.0	1/1/2015	CT
Norwalk Harbor	Stream Turbine	168.0	1/1/2015	CT
Salem Harbor	Stream Turbine	149.9	1/1/2016	MA
Salem Harbor	Stream Turbine	436.5	1/1/2016	MA
Montville	Stream Turbine	407.4	1/1/2016	CT
Middletown	Stream Turbine	400.0	1/1/2016	CT
Cleary	Stream Turbine	26.0	1/1/2016	MA
Wyman	Stream Turbine	52.0	1/1/2018	ME
Wyman	Stream Turbine	51.0	1/1/2018	ME
Mt. Tom	Stream Turbine	143.4	1/1/2020	MA

New generating resources are added to the modeled electricity market over the course of the study period in order to satisfy requirements for renewable generation under Renewable Portfolio Standards, to meet increasing demand due to future load growth, and to meet capacity gaps that may result from unit retirements. Market Analytics is not a capacity expansion model, and does not add new units when the need arises; therefore, any new units must be added to the model directly.

Renewable Additions

Renewable Portfolio Standards typically mandate that a percentage of electricity sales be met by renewable generation. RPS programs are based on tradable Renewable Energy Credits (RECs) that need not be produced within a state in order to qualify for that state's RPS requirement. Thus renewable generation was modeled to equal the total requirement in New England but not necessarily distributed on a state-by-state basis according to RPS requirements. Because RPS programs require renewable energy production as a percentage of total energy sales, implementation of DSM has the effect of *reducing* the requirement for renewable energy in a state. Thus the Projected DSM scenario has a lower renewable energy requirement than the Reference Case scenario in this study.

Vermont does not currently have an RPS requirement, instead supporting renewable resource development through the Sustainably Priced Energy Enterprise Development (SPEED) program, along with the pilot feed-in tariff designed to support the development of certain small-scale renewable projects, and the provision for net-metered distributed solar resources. The feed-in tariff program calls for the development of 50 Megawatts (MW) of renewable generation by 2013, and qualifying resources include solar, wind, biomass, landfill gas, farm methane, and hydro facilities, subject to maximum size requirements. Renewables were added in the Market Analytics model to meet this 50 MW goal, and the allocation among technologies was determined by examining the Vermont projects that have already been installed or have had their applications approved. These projects total approximately 42.5 MW of installed capacity. Because the bulk of new applications for the feed-in tariff program are from solar projects, new distributed solar resources were added to the model to make up the remaining 7.5 MW of installed capacity.

As requested by DPS staff, our analysis assumes that Vermont *does* adopt an RPS requirement starting in 2012, ramping up to a requirement that 25% of energy sold in the state is matched with Renewable Energy Certificates (RECs) in 2025 and for every year thereafter. New net-metered resources, up to the statutory cap of 4% of peak load, are included in the RPS requirement.

Non-Renewable Generic Additions

After adding planned generating units and renewable additions to meet RPS standards, “generic” units may be added to the model to meet any additional capacity requirements or if justified on economic grounds. However, given the low projected load growth during the study period, state DSM programs, and renewable energy requirements, no such additions were found to be justified under any of the scenarios considered.

B. Economic Modeling

Energy efficiency generates 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 can thus spend additional money in the local economy, spurring job growth. Businesses have lower energy costs that improve their bottom-line, enabling them to be more competitive and to expand production and employment. For the current study, these benefits are quantified and tallied through the study period, the years 2012 through 2031. However, the actual benefits in household and business savings—and the economic benefits that derive from them—would extend for many years beyond the study period, even if no additional energy efficiency investments were made.

The investment in efficiency itself generates economic activity as equipment is produced, sold, installed or maintained by Vermont businesses. Renewable energy investments spur economic activity through installation of technologies such as solar photovoltaic panels or wind turbines. As with energy efficiency equipment, the extent to which the equipment is produced locally and local workers build or run the facility determines its economic impact on the state.

Efficiency investments also cost participants money for their part of the efficient equipment and installation costs. As participants spend money on energy efficiency goods and services, their ability to spend elsewhere is reduced. Further, all ratepayers are negatively impacted by the energy efficiency program costs in their energy bills. The additional costs of renewable investments are also factored into energy rates. These negative impacts offset, in part, the positive impacts from energy-efficiency and renewables-related investments and savings.

The REMI PI+ Model

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 Vermont's energy efficiency programs and renewable energy development. This model is used throughout the US, including by many state and federal government agencies. The model has dynamic functionality to capture structural changes in the regional economy that result from economic inputs and costs.

REMI has built-in baseline forecasts of economic activity that are calibrated to each study region--in this case the State of Vermont. Changes to economic activity represent "policy changes" that affect the trajectory of the state economy—in this study, such changes include changes to consumer spending; to businesses' energy costs; and additional commercial activity and industry demand related to energy efficiency investments. The model results (presented in Sections 3 and 4 of this report) illustrate the impact of each scenario in terms of economic activity and employment in Vermont, relative to the Reference Case.

Background on Economic Impacts

The economic impacts of any new activity depend on the extent to which that new activity affects supporting industries in the region. Economic impacts arise from:

1. Direct economic effects (e.g. spending on goods and services at a construction site or the purchase of a piece of new equipment), and
2. Multiplier effects which include:
    a. Spending on supporting goods and services by the firms providing that direct activity ("indirect" impacts), and
    b. Re-spending of wages earned in the state ("induced" impacts).

In general, energy efficiency and renewable investments create net positive local economic impacts. In other words, more jobs are created through these projects than are lost by the activities they displace, such as electric generation or the sale of fuel oil. This net positive impact is due to the fact that more of the dollars spent on energy efficiency and renewable energy remain in the local economy than do dollars spent on "traditional" electric generation or fossil fuel purchases. Energy efficiency is also more labor-intensive than electricity generation or fuel sales, creating more jobs per dollar spent than electric generation, and the economic benefits of energy efficiency investments continue to accrue throughout the life of each energy efficiency measure. The size of that net impact depends on how the region is defined, the amount of energy savings, and how much of the spending by each affected industry remains within the region.

In this report, we estimate the costs, savings and economic benefits resulting from energy efficiency and renewable energy programs and investments in Vermont during the 20-year study period (2012 – 2031). The results of the study represent the *net new economic activity* generated by the investments: the difference between the economic activity increase associated with new investments in Vermont and the economic activity reduction associated with the costs of the efficiency programs. It does not attempt to quantify the ongoing benefits of energy savings beyond the end of the study period.

Basis for Economic Impacts

The economic modeling through REMI takes into consideration all of the changes in cash flow due to the funding and activities of the efficiency programs. Inputs to the REMI model fall into the following categories:

Energy Efficiency:

- *Program and Participant Spending.* Efficiency investments have an economic impact from equipment that is produced within the region and to the extent that local contractors install the equipment. The program also requires spending on administration and overhead to operate.
- *Participant energy savings.* While users have to invest in upgrades or equipment at the outset, savings start to accrue immediately and continue throughout each efficiency measure's life, which can be a decade or more beyond the time of investment. Households take these savings and spend a portion on other goods, further stimulating the local economy. Businesses realize lower energy costs, freeing up capital for investment. Types of savings include energy (electricity, natural gas, heat and process fuels), water, operations and maintenance, and savings due to the deferred replacement of old equipment.
- *Ratepayer Effects.* All ratepayers are affected by the adoption of an energy efficiency program. The program is funded in part through a Systems Benefits Charge (SBC), assessed as a percentage of each electric bill. Counteracting this additional expense is the reduction in energy prices due to decreased demand for energy in Vermont. This is often referred to as the Demand Reduction Induced Price Effect (DRIPE). Other sources of savings include utility avoided infrastructure costs, savings on Vermont's share of Pooled Transmission Facility (PTF) costs, and savings in capacity costs.

Renewable Energy:

- *Construction, Operations and Maintenance.* The installation and operation of renewable facilities generate activity in the state through the use of local materials and labor to install and run the facilities; to the extent that any of the equipment or material is produced in state this provides a further stimulus.
- *Ratepayer Effects.* Energy consumers pay for the cost of renewable facilities, including a return on investment, in their energy bills. Typically, the construction costs are spread over many years and can be represented as a levelized cost of energy. Once installed, renewable energy resources run at low cost, providing downward pressure on regional and local energy prices.

3. Impact of Energy Efficiency Investments

Investments in energy efficiency produce benefits in terms of consumer savings, and also economic benefits to the state in terms of enhanced economic activity and employment. Section

3A details the direct consumer savings, while 3B examines the broader economic benefits deriving from these savings along with the investments that produce them. As noted earlier, only the costs and benefits that accrue during the study period are quantified, although benefits associated with energy savings would continue to accrue for years beyond that.

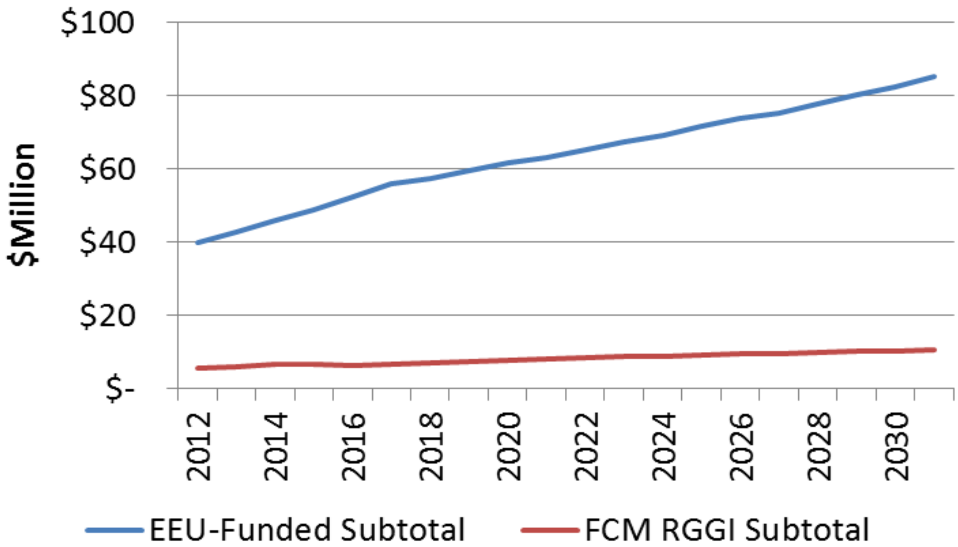
A. Costs and Benefits for Consumers

The analysis of the Proposed DSM Case is based on energy efficiency investments from two sources: funding for the Energy Efficiency Utility (EEU) based on System Benefit Charges on ratepayer bills, and funding from revenues from the New England Forward Capacity Market (FCM) and allowance proceeds from the Regional Greenhouse Gas Initiative (RGGI). For purposes of this study, the EEU revenues are assumed to come from Vermont ratepayers reducing their ability to spend funds on other goods and services. This effect partially offsets the savings associated with energy efficiency investments. The FCM and RGGI revenues are not counted as direct expenditures from Vermont ratepayers; however, RGGI costs are born through somewhat higher electricity rates, and FCM costs are related to utility spending for capacity which is then passed on to ratepayers.

Exhibit 6 shows the annual budget for energy efficiency from each of these sources, as used in the Proposed DSM Case as well as the High Renewable Case.[4]

[4] For the Proposed DSM Case, we modeled the specific measures each year by scaling up Optimal Energy's characterization of Vermont DSM program spending for 2012, described elsewhere in the Comprehensive Energy Plan. However, the program profile changes in 2020 to account for the introduction of the federal lighting standard, which displaces part of the current and near-term state program.

Exhibit 6: DPS-proposed Vermont energy efficiency budget for study period in current-year dollars.



Gross Energy and Energy Cost Savings

Participants in the energy efficiency program save by forgoing the purchase of energy and related expenses. We find that participating residents and businesses in Vermont save $3.74 billion in estimated energy-related spending under the Proposed DSM case over the course of the 20-year study period relative to the Reference Case, in current-year dollars. Exhibit 7 shows the distribution of total savings by type of energy spending. The largest portion of the savings derives from reduced spending on electricity ($2.66 billion, or 71%) while the rest is distributed amongst natural gas, heating fuels, water and operations and maintenance savings.

A small component of energy cost savings is attributable to a reduction in wholesale energy prices as regional demand decreases relative to supply. However, due to its small size relative to the New England electricity market, changes in Vermont load have only a modest impact on regional electricity prices; on average over the study period, prices decrease by 0.5% in the Proposed DSM Case relative to the Reference Case. Thus the primary cost savings benefit of DSM investments in Vermont is directly associated with a decreased quantity of electricity purchased in the state.

Exhibit 7: Cumulative Gross Energy Savings by Type in the Proposed DSM Case relative to the Reference Case (2012-2031, current year dollars.) Values do not include savings that accrue after the end of the study period.

Scenario	Projected DSM Savings ($million)	% of Program Savings
Electricity	$2,657	71%
Avoided Capacity	*$203*	*5%*
Avoided T&D	*$37*	*1%*
Elec. Purchases	*$1,899*	*51%*

Pooled Transmission	*$519*	*14%*
Natural Gas Substitution	-$4	0.1%
Oil, Propane, Kerosene	$250	7%
Operations and Maintenance	$549	15%
Water	$151	4%
Deferred Replacement Credit	$133	4%
Total Gross Savings	**$3,732**	**100%**

Costs to Participants and Ratepayers

Gross savings from DSM are partly offset by ratepayer and participant expenses. Through the System Benefits Charge, ratepayers cover the costs to deliver and administer energy-efficiency programs and financial incentives claimed by participants. Other sources of funding for the program are allowance proceeds from the Regional Greenhouse Gas Initiative (RGGI) and proceeds from sales of demand response resources into the Forward Capacity Market (FCM).

Program participants pay for the portion of energy efficiency investment costs not covered by program incentives. In general, most participants use loans to cover this expense for larger investments; thus these costs are represented as an amortized cost over the estimated lifetime of the investment. The portion amortized and amortization period are shown in Exhibit 8.

Exhibit 8: Assumptions for Participant Financing

Type of Program	% expense of amortized	Years to amortize
New Construction	100%	20
Residential Multi-Family programs	50%	10
Existing Homes/Retrofits	50%	5
Heating Equipment	0%	N/A
Retail Products/Low-income programs	0%	N/A

In the early years of the study period, we assume that program participants pay an average of 52% of the cost of efficiency measures, and ratepayer funds are only required for 48%. For the program to reach greater depth in later years, it is likely that the incentive portion will have to be increased significantly. In this analysis, we assume that by 2031 the incentive will reach 90% of measure costs.

Exhibit 9 shows the total spending of $1.8 billion on program administration, equipment and installation over the course of the plan period. This includes the combined spending from Vermont's energy efficiency program and RGGI and FCM funding for heat and process fuels, as well as participant costs.

Exhibit 9: Total Program and Participant Costs 2012-2031 (million current $)

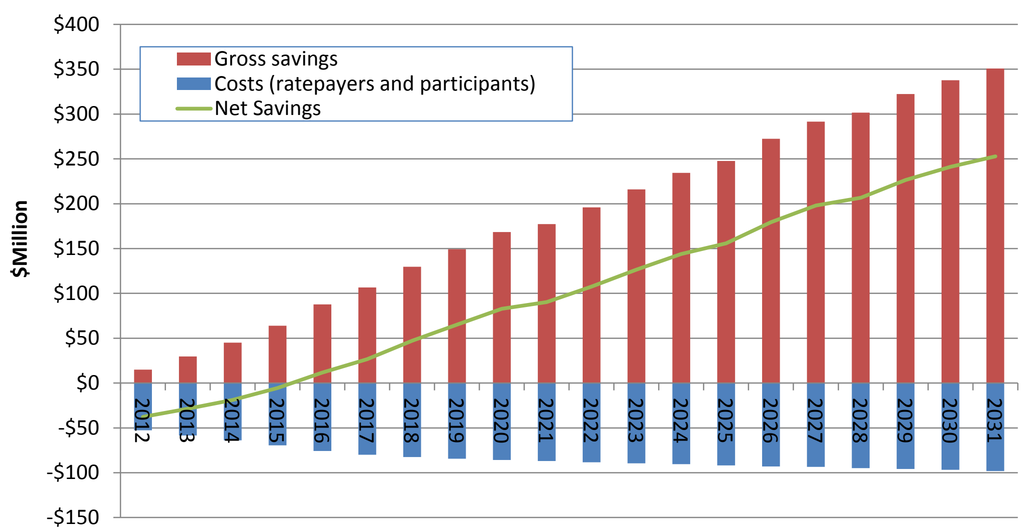
DSM Program Component	Cost
EE Equipment and Installation	$1,126
Participant out-of-pocket costs	*$375*
Incentives	*$751*
Program Delivery/Administration	$690
Total Program and Participant Spending	**$1,816**

Net Savings

The annual program and participant costs and savings, as well as the net savings, are shown in Exhibit 10. The net savings of the program totals nearly $2.1 billion over the 20 year period in current year dollars. As shown below, in the first years the program has a net cost to Vermont. After 2015, the aggregate benefits of the installed efficiency measures cause the program savings to outweigh the costs. These net savings continue to grow as more measures are installed through 2031.

It is important to note that by considering only savings that accrue during the study period, the results significantly *understate* the total net benefits of efficiency spending between 2012 and 2031. This is because new DSM measures are funded in the model through the end of the study period, but the benefits of these measures will continue for a decade or longer beyond the end of the period. Thus, even if Vermont and its citizens were to cease spending on DSM entirely after 2031, considerable energy and financial savings would continue to accrue for a long time thereafter. Because this study only quantifies costs and benefits during the study period, these longer-term benefits have not been included in the current analysis.

Exhibit 10: Gross Savings, Costs and Net Savings Projected DSM Scenario relative to the Reference Case 2012-2031 (current year dollars.) Values do not include savings that accrue after the end of the study period.



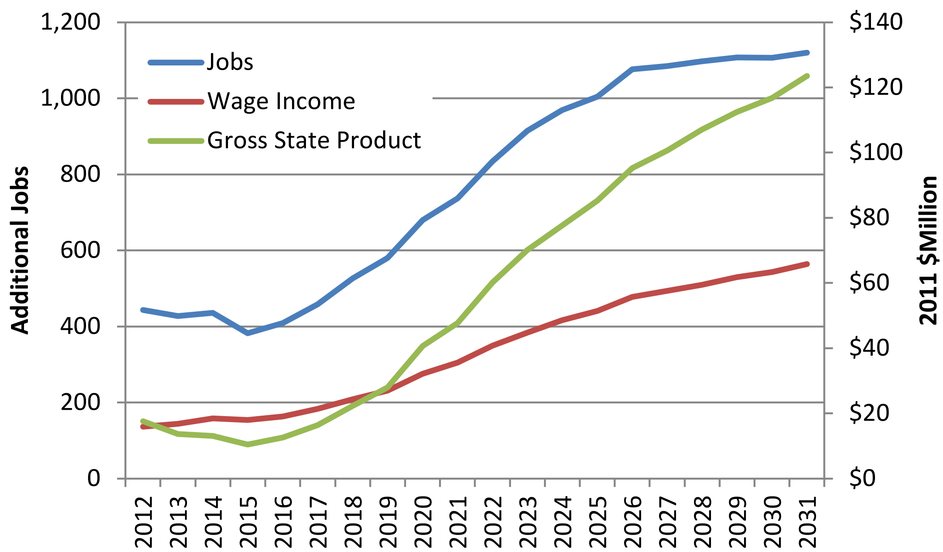
B. Jobs and Economic Benefits for Vermont

Net Economic Impacts

DSM investments and the resulting savings produce value and jobs in the Vermont economy. Under the Proposed DSM Case, we estimate that a total of 15,394 person-years of additional employment will be produced relative to the Reference Case during the study period—an average of 770 additional jobs every year in Vermont. These jobs will generate an additional $778 million in income for Vermonters over the study period in 2011 dollars ($1,098 million in current year dollars), or an average 2011-equivalent salary of over $50,540 per year. Exhibit 11 shows these benefits on an annual basis. Because the wage and GSP benefits are shown in constant dollars, all of the growth shown during the study period may be attributed to the accruing of benefits from an increasing stock of installed DSM measures.

As is the case with energy and cost savings, employment benefits will continue to accrue after the end of the study period. These benefits, which have not been quantified here, derive from the additional spending ability of Vermont households and businesses associated with their lower energy costs after the study period.

Exhibit 11: Additional jobs (left axis) and other economic benefits (right axis, in constant dollars) associated with the Proposed DSM Case relative to the Reference Case, 2012-2031.



The investments and savings under the proposed DSM scenario will also yield $1,704 in gross state product during the study period. In sum, every million dollars spent on energy efficiency (of which $0.89 million comes from ratepayer funds) is projected to produce $0.54 million in gross state product, and $0.86 million in wage income. At the same time, each million dollars spent produces a net savings of $1.84 million for consumers and businesses on electricity costs, and $2.59 million in total savings during the study period. These benefits would continue to accrue after the end of the study period.

The economic benefits on a per-unit basis for the Proposed DSM Case (along with the High Renewable Case) are shown later in this report, in Exhibit 17.

4. Impact of High Renewables Case

For the purposes of this study, we assume that Vermont will institute a state Renewable Portfolio Standard (RPS) goal of obtaining at least 25 percent of the energy purchased in the state from renewable sources by 2025 under all model scenarios.

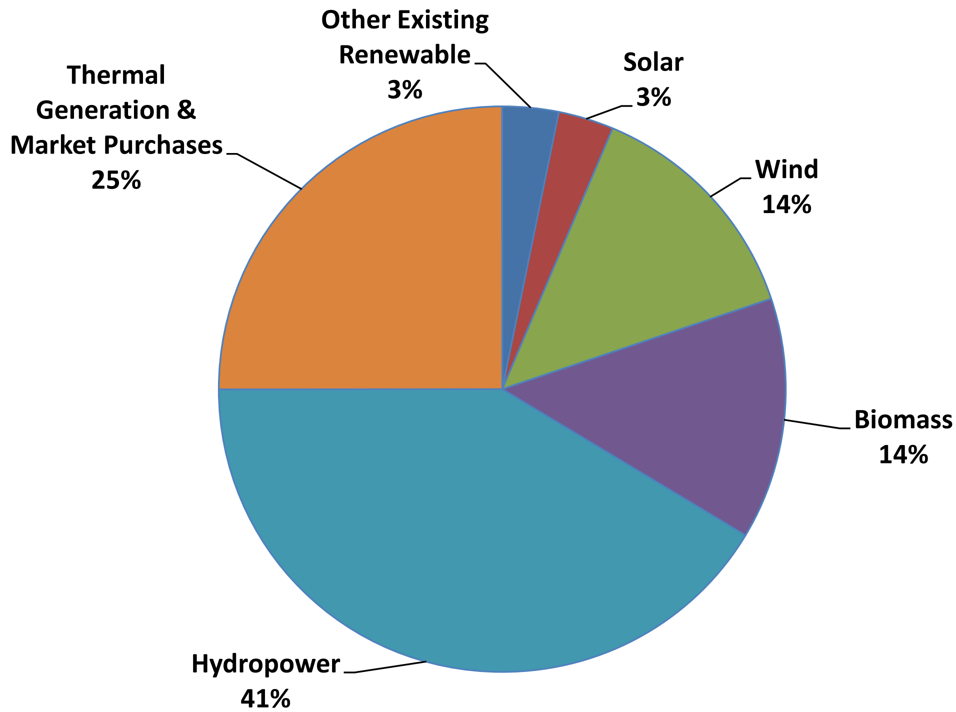
The High Renewable Case expands the renewable energy goal for Vermont from 25% to 75%, while retaining the same level of DSM as the Proposed DSM Case. Unlike for the RPS requirements, existing biomass and hydropower are assumed to count towards the 75% goal.[5] The resource mix for Vermont under this scenario includes the following:

- DSM investments and savings following the current DPS proposal
- Expansion of feed-in tariff from 50 MW to 100 MW, with the additional 50 MW composed of distributed solar phased in from 2015-2025
- Expansion of import contract with Hydro Quebec to cover 24 hours, instead of the current 16-hour-per-day contract reflected in the Reference Case
- 40 MW of additional hydropower contracted to Vermont, with a 35% capacity factor
- Slightly increased wind in Vermont relative to the Proposed DSM Case (75 MW of new wind vs. 66 MW in the DSM case) but still less new wind than under the Reference Case (155 MW), reflecting the lower total energy demand due to DSM investments
- Output from all new and existing biomass and hydropower counted towards 75% goal, and all receives a price premium to reflect the policy mandate

The overall resource mix for the High Renewables Case is shown graphically in Exhibit 12.

[5] High renewables goals such as the one considered here logically must allow a broader range of qualified resources; if not, the paradoxical result would be the destruction of the market for low-or zero-emissions resources such as existing hydropower facilities.

Exhibit 12: Sources for Vermont's electric energy mix in 2025 under the High Renewables Case.



A. Costs and Benefits for Consumers

Construction, Operations and Maintenance Costs

The construction costs were calculated for each technology based on Synapse's assessment of cost and operational parameters for the northeastern United States, as detailed in Appendix A of this report. The construction and operation and maintenance (O&M) expenditure per MW for the region were combined with the MW installed of new renewable capacity to generate Vermont's aggregate investment in new renewable energy resources for each scenario. Exhibit 13 shows the construction and operations and maintenance costs by technology for the High Renewable Case, relative to the Reference Case.

Along with the renewable energy mandate described above, we include aggressive DSM investments in the High Renewable Case relative to the Reference Case, following the Proposed DSM Case. This decreases the energy requirement in Vermont and thus the requirement for renewable energy under the state RPS. As a result, the High Renewable Case actually results in a reduction in wind costs associated with construction ($325 million) and O&M ($61 million) relative to the Reference Case. Conversely, there is an additional $260 million investment in construction of distributed solar resources through the expanded Vermont feed-in-tariff program, along with $13 million in O&M costs associated with these resources during the plan period. This new solar energy, along with renewables from existing, expanded, and out-of-state sources of hydropower and biomass energy contribute to the renewable energy requirements. As with DSM savings, the costs and benefits associated with these resources after the study period are not considered.

Exhibit 13: Renewable Construction and O&M Costs for High Renewable Case (Current Year Dollars) relative to the reference case.

Technology	*Total (2012-2031)*
Solar Construction	$259.2
Wind Construction	-$325.4
Total New Construction	*-$66.2*
Solar O&M	$13.4
Wind O&M	-$61.0
Total O&M	*-$47.6*
Total Spending	**-$113.8**

Ratepayer Effects

Renewable investments affect consumers through higher electricity rates to pay for the incremental cost in new technology. In this study, we assumed that the amortized cost of construction and the ongoing O&M costs would be effectively added to energy costs throughout Vermont. At the same time, utilities and their ratepayers would realize the benefit of the energy and capacity produced by each resource. If the levelized cost of a resource is at or below the market price for energy and capacity, the premium falls to zero. For new solar and wind energy we calculated this by taking the difference between the levelized costs for each technology per Megawatt-hour (MWh) (see Appendix A) and the avoided capacity[6] and energy purchases—this is essentially the "premium" paid for renewable energy. For hydroelectric power that comes from out-of-state, the premium is unknown but would be small—our assumption was $5 per MWh.[7] The premiums for all renewable resources used in this study are shown in Exhibit 14.

[6] Avoided capacity costs were calculated based on the assumption that for the years 2012-2015 the New England capacity market will clear at the minimum de-list price of $1/MW-Month, and that thereafter it will clear at $5/MW-month throughout the study period, reflecting a general surplus of capacity due to RPS requirements and DSM investments throughout the region.

[7] For Hydro Quebec, the current contract mandates that proceeds from any emissions-related premium be shared evenly between Vermont and Quebec, Thus the additional Vermont cost for this resource is $2.50 per MWh.

Exhibit 14: Premiums for Renewable Energy ($2011 per MWh)

Technology	2012	2015	2020	2025	2031
Solar	$189	$142	$113	$92	$54
Wind[8]	$22	$15	$1	$0	$0
Biomass	$81	$75	$67	$54	$36
Hydro Quebec[9]	$2.5	$2.5	$2.5	$2.5	$2.5
Other Hydro	$5	$5	$5	$5	$5

Exhibit 15 shows that for the High Renewables Case, the bill impacts for renewable resources amount to $292 million over 20 years. This represents just under 0.2 cents per kilowatt-hour (kWh) on average for Vermont ratepayers, in 2011 dollars, over the study period.

Exhibit 15: Bill Impacts of Renewable Energy in the High Renewable Case relative to the Reference Case ($2011, unless otherwise noted)

Technology	2012	2015	2020	2025	2031	Total (2012-2031) Million $2011	Total (2012-2031) Million Current Dollars
Bill Impacts (millions)	$1.9	$2.3	$11.2	$15.2	$12.9	$208	$292
Load Forecast (GWh)	6,160	6,067	5,942	6,141	6,542	122,752	122,752
Impact (cents per kWh)	0.03	0.04	0.19	0.25	0.20	0.17	0.24

B. Jobs and Economic Benefits for Vermont

Net Economic Impacts

As with the Proposed DSM Case, the employment, wage income, and gross state product impacts of the High Renewable Case were calculated using the REMI model. Exhibit 16 shows these benefits on an annual basis, in constant dollars. We estimate that the High Renewable Case will generate nearly 15,000 jobs in Vermont and $1.53 billion in Gross State Product, in current dollars, during the study period.

A comparison of Exhibit 16 with Exhibit 11 illustrates that the net economic impacts of the Proposed DSM and High Renewable Cases are quite similar. This is due to the fact that the primary drivers of economic benefits—expanded investments in DSM and savings for Vermont ratepayers—are the same in both cases. These benefits are partially offset in the High Renewable Case by the cost of adding a premium value to numerous resources that would now qualify for

[8] Wind energy reaches "grid parity" after 2020, instead of a negative premium it was assumed that ratepayers would simply pay the same rate for this type in the future years.

special treatment under a broader renewable energy mandate, and by the cost of additional solar energy resources in Vermont relative to conventional resources. The total study-period benefits, and benefits per unit of spending, are shown in Exhibit 17 for Proposed DSM and High Renewable Cases.

Exhibit 16: Additional jobs (left axis) and other economic benefits (right axis, in constant dollars) associated with the High Renewable Case relative to the Reference Case, 2012-2031.

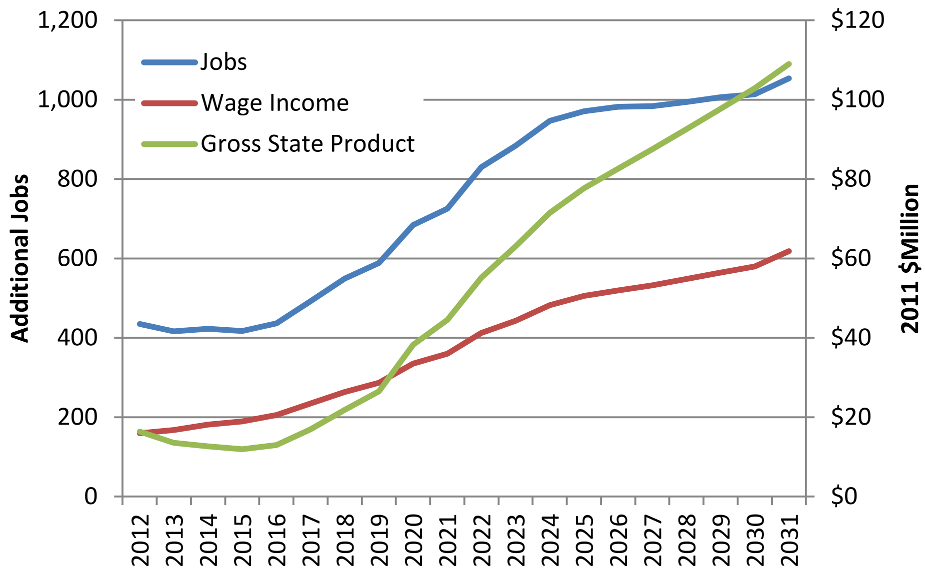


Exhibit 17: Leverage of Program Spending for Proposed DSM and High Renewable Cases, relative to the Reference Case ($2011). Costs and benefits that accrue after the end of the study period are not considered.

Scenario	Proposed DSM	High Renewable
Total Spending ($2011 Million)	$1,079	$1,287
Job-Years Relative to Reference Case	15,394	14,834
Job-years per $ million	14	12
GSP Benefit ($2011 Million)	$1,171	$1,055
$GSP benefit per Dollar Spent	$1.09	$0.82
Wage Income Benefit ($2011 Million)	$778	$759
Wage Income per Dollar Spent	$0.72	$0.59

5. Impact on Regional Pollutant Emissions

One of the primary benefits of implementing aggressive DSM and renewable energy investments in Vermont is to reduce the amount of pollutant emissions associated with the use of electricity by Vermonters. In general, most of these emissions do not take place within Vermont, because most of the electricity used in the state is imported from the surrounding regions. And the electricity that is produced in the state—whether hydropower, biomass, or wind—is unlikely to be displaced by the addition of clean resources such as additional energy efficiency or renewables.

However, the electricity that is imported from the New England Power Pool does come largely from fossil-fired plants, and these are the generating units that are most likely to be displaced by clean resources in Vermont. Using our dispatch model results, we can predict how much of these emissions would be avoided in each of the electricity scenarios, relative to the Reference Case.

Exhibit 18 presents the tons of pollution emissions avoided in New England as a result of each of the electric sector scenarios considered in this study.

Exhibit 18: 2025 and Total Cumulative Avoided Emissions for the Proposed DSM and High Renewable Cases relative to Reference Case (thousand tons). Pollution reduction benefits that accrue after the end of the study period are not considered.

Emission Type	Proposed DSM Case		High Renewable Case	
	2025	*Total (2012-2031)*	*2025*	*Total (2012-2031)*
SO_2	0.1	**2.6**	0.2	**3.4**
NO_X	0.04	**1.0**	0.1	**1.2**
CO_2	117	**2,567**	167	**2,962**

For perspective, the avoided CO_2 emissions benefit for the Proposed DSM Case is the equivalent of removing almost 425,000 cars from Vermont's roads. The High Renewable Case increases this benefit to almost 490,000 cars.[10]

[10] Assuming 12,000 miles traveled per year and an average fuel economy of 22.1 miles per gallon.

Appendix A: Renewable Energy Costs and Assumptions

The following is a description of renewable energy costs and assumptions used in Synapse's analysis.

A. Wind Costs

Exhibit A-1 compares several recent estimates of utility-scale wind project costs. "AEO 2011" refers to the input assumptions developed for EIA's 2011 Annual Energy Outlook. "Lazard" refers to the investment research organization of the same name. The E3 Analytics work was performed in early 2010 for the WECC region's Transmission Expansion Planning Policy Committee. "B&V 2011" is information taken from a May 2011 presentation of inputs to Black & Veatch's Gencost model.

Exhibit A-1: Comparison of Recent Wind Cost Estimates

	AEO 2011	Lazard 2010	E3 Analytics 2010	B&V 2011
Installed Cost ($/kW)	$2,438	$2,250-$2,600	$2,350	$2,000 - $2,500
Fixed O&M ($/kW-yr)	$28.07	$60.00	$50.00	?
Capacity Factor	34%	30%-40%	33%	$32-$42
Energy Cost ($/MWh)	$96	$85-$130	?	?

Since the 2009 – 2010 period, reduced demand has resulted in moderate but significant turbine price reductions, which we believe are reflected in the Black & Veatch estimate of installed costs, but not the others here.

We view wind as a fairly mature technology. We expect that there will be short-term fluctuations in project costs due to supply and demand dynamics in markets for turbines and other key inputs. Over the long term, we expect a trend of very modest cost reductions due to small improvements in technology and installation.

Exhibit A-2 shows our proposed costs for utility-scale wind projects in the Northeast, based on the data in Exhibit A-1 and data from other Synapse project work. Costs are stated in constant 2010 dollars. Installed costs and fixed O&M fall by 1% per decade. There are also modest increases in the capacity factor for new projects. Our fixed charge rate is based on a blended cost of capital to utility, merchant and municipal projects.

Exhibit A-2: Utility-Scale Wind Cost Forecast

	2011	2015	2020	2025	2030
Installed Cost($/kW)	$2,239	$2,228	$2,216	$2,205	$2,239
Fixed O&M ($/kW-yr)	$39.80	$39.60	$39.40	$39.21	$39.80
Capacity Factor	34.0%	34%	34.5%	34.5%	35.0%
Fixed Charge Rate	9.5%	9.5%	9.5%	9.5%	9.5%
Energy Cost ($/MWh)	$93	$93	$91	$91	$89
Energy net of subsidies ($/MWh)	$73	$73	$71	$71	$69

For the purposes of this analysis, we assume that the Production Tax Credit is not renewed after 2015, so unsubsidized costs would be attributed to projects coming on line after that date.

B. Biomass CHP Costs

The price paid for biomass CHP projects under Vermont's SPEED program starts at $121 per MWh and escalates to $141 per MWh in year 20. To represent the capital and O&M costs of these projects, we approximate the costs of a project with a levelized cost of $131 per MWh. We approximate these costs using a discounted cash flow model similar to the one used in developing the Vermont SPEED rates. Exhibit A-3 shows these costs. Note that these are only the project costs allocated to the electric side of the project. Total project costs would be higher. Note also that the federal grant or tax credit available to these projects is irrelevant here, because it will not affect what Vermont ratepayers pay for these projects.

Exhibit A-3: Project Costs Consistent with SPEED CHP Energy Rate

Electric Capacity (MW)	0.55
*Installed Cost ($/kW)	$4,745
Electric Capacity Factor	60%
Annual Output (MWh)	2,891
*Annual Fuel Cost ($)	$53,400
*Annual O&M ($)	$0
Return on Equity	10%
Levelized Cost ($/MWh)	$131

**Costs shown are the portion of total project costs allocated to electricity. Total project costs would be higher.*

C. Solar Photovoltaic (PV) Costs

We focus here on rooftop-mounted PV projects up to 2 MWs in size. This is a significant assumption, because the cost of utility-scale (ground-mounted) projects has fallen considerably over the past 18 months; however, the cost of small projects does not appear to have fallen as much.

Most new PV projects in Vermont will be paid under the SPEED program. Currently the rate for PV is $240 per MWh. Our analysis of current PV prices indicates that this rate is above the total levelized costs of many SPEED-eligible projects, especially the larger ones. This conclusion is supported by the robust PV activity in the SPEED program. Therefore, for this project we assume that new PV projects through 2014 receive the current SPEED rate, but that the rate paid to PV projects after 2014 is consistent with forecasted PV costs.

We present a cost forecast below, but we also acknowledge that this is a very dynamic period in PV markets and there is considerable uncertainty around long-term PV prices.

The cost reductions of 2010 have caused a number of analysts to forecast very low PV costs within 10 to 20 years. For example, a US DOE white paper recently forecasted 2016 prices for utility-scale PV at $2.65 per W_{AC}. In the Northeast (assuming a 22% capacity factor, consistent with a single-axis tracking system), this is consistent with a levelized cost of $107 per MWh with the federal grant, and $145 per MWh without it. While no one is predicting prices for small PV projects in this range, it gives a sense of how rapidly PV markets are changing.

The key driver of falling prices has been the supply side's response to the strong PV demand from Europe over the past five years. New silicon production capacity has come on line, as has new module production capacity. The global market for modules has also become more efficient and competitive. In early 2011 Barclays Capital reported an average selling price (ASP) for silicon panels of $1.95 per W_{DC} in Q1 2010 and a reduction to $1.65 in Q4. They projected a further decline to $1.45 by Q4 2011.

In 2010, Macquarie Capital's cost estimates were in the same range as Barclays' (although they showed a different trend in that year). For 2011, both companies were projecting average prices falling from about $1.65 to $1.45 per W_{DC}. Macquarie forecasted an average price of about $1.20 in Q4 2012.

In fact, module prices have fallen faster than Macquarie predicted. In July 2011 another Wall Street analyst, Jeffries & Co., revised their panel ASP projection to $1.20 – $1.30 per W_{DC} by Q4 2011. This is where Macquarie, in March, was predicting prices would be in Q4 2012.

However, there has also been discussion in the PV trade press about strategic pricing among panel manufacturers. For some months the Chinese government has been heavily subsidizing panel manufacture, and many panels are being sold at prices below cost there. More recently, there has been speculation that strategic pricing is spreading beyond China. This makes it difficult to interpret the 2011 module price drop, and it is reason to be conservative in projecting near-term price reductions from summer 2011 levels.

While there is anecdotal evidence from California markets of 2011 prices that reflect these module price reductions, there is little publicly available project data. So we are left to speculate that entities currently developing projects are enjoying considerably lower module costs than anticipated.

Our recent discussions with companies marketing residential PV systems suggest current costs in the range of $22,500 for a 4 kW system, or around $5,620 per kW_{AC}. With an 18% capacity factor, representative of rooftop mounted systems in the northeast, this translates to about $256 per MWh, with the federal grant. We estimate projects in the 1 to 2 MW range at $4,500 to $4,700 per kW_{AC}. Using the same capacity factor, this produces a levelizied cost range of $209 to $217 per MWh, again including the federal subsidy. These numbers are consistent with the high response to the SPEED program's current PV offer.

Exhibit A-4 shows our recommended PV costs for this project. We assume that the SPEED rate is paid through 2014, and we have approximated capital and O&M costs consistent with this rate for our cost analysis. In 2015 and after, we assume that the SPEED rate is periodically lowered to our forecasted rate. Further, as with wind projects, we assume that the federal subsidy is not renewed after 2015, and we attribute unsubsidized costs to projects installed after that date. We are open to input on these assumptions.

Exhibit A-4. PV Costs used in the analysis

	2011	2015	2020	2025	2030
Installed Cost ($/kW$_{AC}$)	$5,250	$4,300	$4,100	$3,900	$3,500
Capacity Factor	18.0%	18.0%	18.5%	18.5%	19.0%
Fixed O&M	$16.00	$16.00	$16.00	$16.00	$16.00
Inverter Replacement ($/kW-yr)	$12.00	$12.00	$11.50	$11.50	$11.00
Fixed Charge Rate	9.5%	9.5%	9.5%	9.5%	9.5%
Levelized Cost ($/MWh)	$240	$200	$186	$178	$157
Unsubsidized Cost ($/MWh)	$334	$277	$257	$246	$216

The reduction in installed costs forecasted here is consistent with a scenario in which US PV demand continues its rapid rise, module prices fall steadily but not precipitously, and the US supply chain becomes more competitive and efficient. We envision the installed costs at large, ground-mounted projects falling from about $3.70 per W$_{AC}$ today to about $1.90 by 2030. This scenario is more conservative than some other estimates, including the DOE white paper cited above, forecasting installed costs of $2.65 per W by 2016. We believe conservatism is in order due to the significant recent movement in PV prices and the fiscal pressures the country faces, which will make it increasingly difficult to gain support for reauthorizing existing subsidies or authorizing new ones.

Appendix 5—Economic Impacts of Energy Efficiency Investments

Optimal ENERGY Integrated Energy Resources

Economic Impacts of Energy Efficiency Investments in Vermont – Final Report

Prepared for

The Vermont Department of Public Service

by:

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INTRODUCTION

OVERVIEW OF THE STUDY

The goal of this study is to quantify the economic impacts of Energy Efficiency Utility investments in Vermont. The results are based on the 2012 budgets for energy efficiency spending proposed by the Department of Public Service (DPS), including:

- $40.1 million for electric energy efficiency to be performed by Efficiency Vermont (EVT) and Burlington Electric Department (BED), funded by the energy efficiency charge on ratepayers' electric bills, and
- $5.4 million for Heat and Process Fuels (HPF) efficiency to be performed by EVT, funded by revenues from the Regional Greenhouse Gas Initiative (RGGI) and the Forward Capacity Market (FCM).[1]

This study estimates the impact of this single year of additional energy efficiency spending on the State's economy in comparison to having no spending for energy efficiency programs in that year. Actual adopted budgets may differ somewhat from these values but not to a degree that would substantially change the study's findings regarding the economic effects per dollar of spending.

The main spending categories associated with the efficiency programs include:

- the total outlays for installed efficient equipment and practices (relative to the baseline of standard-efficiency equipment and practices), comprised of two parts:
  - the "out-of-pocket" portion of those costs paid by participants , plus
  - the portion of those costs paid by the efficiency programs including any rebates or other incentives paid to program participants or vendors to promote the efficiency measures, and
- other program spending for administration, marketing, technical assistance, and related expenses.

The installation of efficient equipment and practices due to Vermont's efficiency programs results in savings in electricity, heating and process fuels (mostly oil and propane), water, and operation and maintenance costs. These savings and their economic benefits continue for as long as the efficiency measures are operational, which can be up to 20 years or more for the most durable measures. In addition, electric rates are affected by reduced demand for electricity, reduced transmission and distribution expenditures by the State's utilities, and by reduced costs for Pooled Transmission Facilities[2] and related services provided by the New England Independent System Operator.

[1] The energy efficiency activities of Vermont Gas Systems (VGS) were outside the scope of this project.

[2] Pooled Transmission Facilities are generally transmission facilities that operate at 69 kV or higher and which fall under the authority of the New England Independent System Operator (ISO-NE).

The results of this study represent the *net new economic activity* generated by the efficiency investment: the difference between the amount of economic activity increase associated with stimulating related commercial services and industries in Vermont and the amount of economic activity reduction associated with the costs of the efficiency programs. The costs, savings and economic benefits resulting from the efficiency programs were evaluated by sector (residential, commercial, industrial) and modeled over the 20-year study period (2012-2031) using the REMI PI+ economic model, as further described below.

OVERVIEW OF ECONOMIC IMPACTS

The economic impacts of any new activity depend on the extent to which that new activity affects supporting industries in the region. Economic impacts emanate from:

1. direct economic effects (e.g. spending on goods and services at a construction site or the purchase of a piece of new equipment), and
2. multiplier effects which include
    a. spending on supporting goods and services by the firms providing that direct activity ("indirect" impacts), and
    b. re-spending by workers of their wages or disposable income from savings or costs to households ("induced" impacts).

In general, energy efficiency investments create net positive economic impacts in a given region[3]. In other words, usually more jobs are created through these projects than are lost by the activities they displace, such as electric generation or the sale of fuel oil, or spending on other goods and services rather than paying more for efficient equipment. This net positive impact is due to the fact that participants save money on their energy bills, and usually more of the dollars spent on energy efficiency remain in the local economy than dollars spent on "traditional" electric generation or fossil fuel purchases. Energy efficiency is also a more labor-intensive activity than typical generation or fuel sales, so for any given amount of efficiency spending, more local jobs are created than lost by reducing spending on electric generation. The size of that net impact depends on how the region is defined, the amount of energy savings, and how much of the spending by each affected industry remains within that given region.

The range of economic impact results from a new economic activity depends on the metric used to express that impact. This report provides estimates of two economic multipliers for the energy efficiency program evaluated. One is the ratio of change in Gross State Product (GSP) to the program spending. The other is the ratio of change in wage income to the program spending. Arguably, the most useful measure is *net job-years created per million dollars in program spending*. This measure represents the change in employment in the region due to the program's

[3] *Economic Impacts and Potential Air Emission Reductions from Renewable Generation & Efficiency Programs in New England*, prepared for the Regulatory Assistance Project by Synapse Energy Economics, April 2005.

total spending.[4] For studies that only capture the direct jobs associated with energy efficiency, the results show between three and ten *job-years per million dollars in program spending* (depending on program type and the specific region).[5] When including total economic impacts (direct, indirect and induced activity) the impacts are much higher, as with this study which shows an estimated impact of 43 job-years per million dollars.

The findings of this report are consistent with other recent studies on the economic impacts of efficiency investments. A report for Environment Northeast showed impacts between 36 and 60 job-years per million dollars spent (depending on the state) due to energy efficiency.[6] One study in Wisconsin showed between 75 and 250 job-years per million dollars over 25 years (depending on the program type).[7]

REPORT STRUCTURE

The following section of the report provides a summary of the results of the economic modeling, after which we provide a detailed explanation of the study methodology. Appendix A provides a summary of the data sources and assumptions used in the study. Appendix B then provides a description of the industries (goods and services categories) used in the economic model. Unless otherwise stated, all tables and figures are the product of Optimal Energy and/or Synapse Energy Economics.

[4] Unlike other indicators discussed below, this number is not a typical economic multiplier since the denominator (program spending) does not include participants' out-of-pocket spending on energy efficiency.

[5] *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth*, Ernest Orlando Lawrence Berkeley National Laboratory, September 2010. (http://eetd.lbl.gov/ea/emp/reports/lbnl-3987e.pdf)

[6] *Energy Efficiency: Engine of Economic Growth*, Environment Northeast, and EDR Group, October 2009.

[7] *Focus on Energy Evaluation*, State of Wisconsin Public Service Commission, March 2010, PA Consulting and EDR Group.

SUMMARY OF RESULTS

Energy efficiency generates 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 the equipment is produced, sold, installed or maintained by Vermont businesses.

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 our 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.

Table 1 shows the resulting net economic impacts in terms of job-years of employment (the equivalent of one full-time job for one year), personal income, Gross State Product (GSP),[8] and output (i.e., business sales). Program operations for the year 2012 are estimated to generate a net increase of nearly 1,900 job-years and $220 million in GSP in Vermont over 20 years. The largest impact year is 2012 itself, since this is when new equipment and installation are purchased. Some participants pay for these investments in one lump sum while others that seek financing begin paying them off over time. In the following years, positive net benefits continue due to energy cost savings to participants and price effects that occur for all ratepayers.

If the analysis considers the separate impacts from electricity efficiency and heating process fuels (HPF) programs, the latter is responsible for around one-sixth of the total first year employment impacts or 65 job-years. The "All Years" employment impact for HPF is slightly higher (85 job-years). Therefore, most of the employment impacts from heating fuel programs are felt in the first year due to the purchase and installation of new heating efficiency equipment. In reviewing the HPF results, it should be noted that the HPF program is in its early stages and currently has limited funding. The limited funding leads to a limited amount of savings associated with lower heating bills over the life of efficiency measures, and thus the investment has modest impact over the long term. Also, since use of heating fuel will decrease, the positive impacts from savings are partially counteracted by the loss in activity from heating fuel distribution and delivery services. Limited funding also leads to a higher percentage of the budget allocated to administrative costs than what is likely to be allocated over larger budgets (economies of scale reduce administrative costs). In addition, because the program is in its early stages, it is likely that ramp up costs – including initial program design and development – limit

[8] The Gross State Product (GSP) captures the additional value-added activity produced in Vermont. It generally refers to the additional wage income, plus the additional profits of production and services in Vermont.

the amount of fuel savings. Thus, a continued and/or increased investment in thermal efficiency is likely to increase the economic benefit ratio for this sector.

Table 1: Total Economic Impacts of Vermont Energy Efficiency Programs (2011$)

Impact Type	2012			All Years		
	Elec.	HPF	Total	Elec.	HPF	Total
Jobs (job-years)	305	65	370	1,808	85	1,894
Personal Income (million)	$11.3	$2.5	$14	$96	$1.9	$98
Gross State Product (million)	$11.5	$2.2	$14	$215	$4.7	$220
Output (million)	$17	$5	$22	$344	$7	$351

Another perspective for measuring the efficacy of the programs is to present the impacts as value produced per dollar of program spending, as shown below in Table 2 for the planned 2012 energy efficiency program budget of $45.5 million ($44.4 million in 2011 dollars).[9] Dividing the economic impacts above by that amount shows that this one-year investment creates a net gain of 43 job-years per million dollars of program spending and a net increase of nearly five dollars of cumulative Gross State Product (GSP) for every dollar spent. This impact is largely due to the electricity program which creates 46 job-years per million dollars of program spending and a ratio of over five for GSP impacts compared to the budget ($39.1 million). Heating and process fuels (HPF) program exhibits much lower impacts per dollar since fewer of the associated equipment is produced in-state and its energy savings are small compared to the electricity program. Another important metric is personal income. For every dollar of program spending, an additional two dollars is generated in Vermonters' income over 20 years. In terms of gross energy savings, the programs create over six dollars for every dollar spent on the program. These impacts take on more significance when we consider that Vermont's energy efficiency programs will continue to operate for multiple years, compounding these net benefits.

[9] Values in the report have not been discounted for the future value of money unless otherwise stated. Impacts were modeled using 2011 constant dollars (2011$). Therefore, 2012 dollars are adjusted downwards assuming a 2.6% long-term inflation rate to calculate "job-years per million dollars" and the two multipliers. The program spending refers to dollars funded from the efficiency charge to ratepayers and from RGGI and FCM revenues.

Table 2: Leverage of Program Spending

Program Spending Metric	Electric	HPF	All
Total Budget (million, 2011$)	$39.1	$5.3	$44.4
Job-years per million	46	16	43
$GSP/$Budget	5.5	0.9	5.0
$Personal Income/$Budget	2.5	0.4	2.2
$Energy Savings/$Budget[10]	6.6	2.7	6.1

[10] If the energy savings and program budget were discounted at a real rate of 5.6%, these ratios would be 4.6 for electricity, 1.6 for HPF, and 4.2 collectively.

METHODOLOGY

THE REMI PI+ MODEL

We used the PI+ model developed by REMI (Regional Economic Models Inc.) to estimate the economic impacts of Vermont's energy efficiency programs. This model is used throughout the US, including by many state and federal government agencies. The model is dynamic and sophisticated, capturing structural changes in the regional economy that result from a direct stimulus.

REMI has built-in baseline forecasts of economic activity that are calibrated to each study region (in this case the State of Vermont). Changes to economic activity represent "policy changes" that affect the trajectory of the state economy—in this study this includes changes to consumer spending, businesses' energy costs, and additional commercial activity and industry demand related to energy efficiency investments. The model results show the difference in these alternative forecasts from the original baseline, representing what is expected to occur in the future over and above what would have occurred in the State's economy absent any changes in policy.

CASH FLOWS CAPTURED IN THE ECONOMIC MODEL

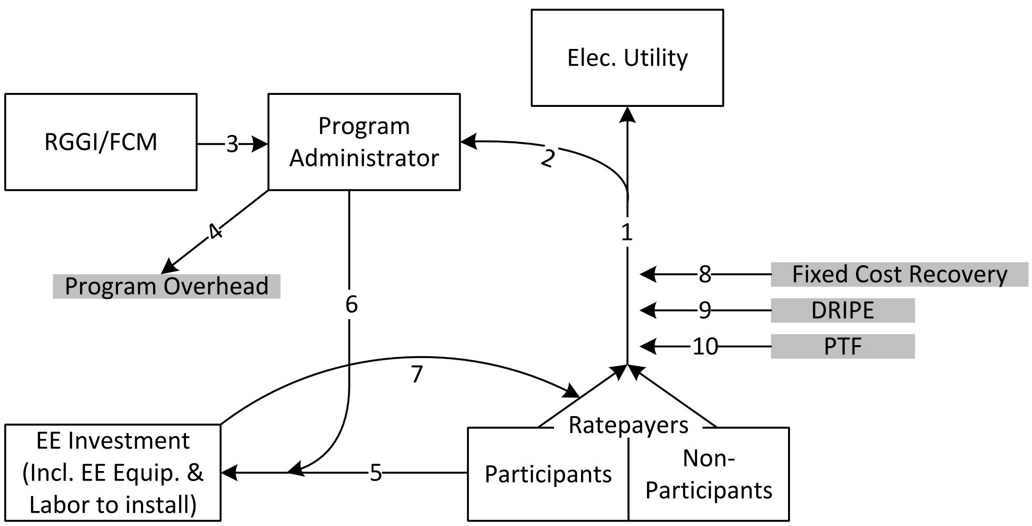
The economic modeling through REMI takes into consideration all of the changes in cash flow due to the funding and activities of the efficiency programs. Inputs to the REMI model fall into three broad categories:

- **Program and Participant Spending –** Efficiency investments have an economic impact from equipment that is produced within the region and to the extent that local contractors are installing the equipment. These investments are comprised of both participant costs and incentives contributed by the program administrators. The program also requires spending on administration and overhead to operate.
- **Participant net energy savings.** While users have to invest in upgrades or equipment at the outset, savings start to accrue after these costs have been offset (usually several years after installation) and continue throughout the efficiency measure's useful life. Households take these savings and spend a portion on other goods further stimulating the local economy. Businesses have lower costs, freeing up capital for investment and improving competitiveness. Types of savings include energy (electricity, natural gas, heat and process fuels), water, operations and maintenance, and savings due to the deferred replacement of old equipment.
- **Ratepayer Effects.** All ratepayers are affected by the adoption of energy efficiency programs. The program is funded by all customers, who pay a Systems Benefits Charge (SBC) as a percentage of their electric bill. Counteracting this additional expense is the downward pressure on energy prices due to decreased demand for energy in Vermont. Specifically, impacts

due to Demand Reduction Induced Price Effect (DRIPE), utility avoided costs, and avoided contributions to Pooled Transmission Facilities (PTFs) managed by the New England Independent System Operator (ISO-NE).

Energy efficiency investments are modeled in REMI as transfers of money from one party to another (from ratepayers to various industries in and out of state), whereas savings due to investments are modeled as increased discretionary spending for residents and lower energy costs for businesses that participate. Both are considered cash flows. To conceptualize the interactive effects of these cash flows (in the way that REMI does), it is useful to look at an illustration. Figure 1 represents the various cash flows and how they relate, with explanations provided below the figure.

Figure 1. Cash Flow Diagram of Vermont's Energy Efficiency Investment



1. Payments by electric ratepayers via their electric bills.
2. The surcharge on electric bills collected to fund electric energy efficiency programs (EVT and BED).
3. Allowance auction revenues provided to the Heat and Process Fuels (HPF) program administrator (Efficiency Vermont) from the Regional Greenhouse Gas Initiative (RGGI), and revenue provided to EVT for demand resources from the Forward Capacity Market (FCM).
4. Payments to EVT and BED for program administration, core supporting services, and other non-incentive costs used to deliver the energy efficiency programs.
5. The incremental cost of energy efficient equipment, above the cost of baseline equipment, paid by those installing the efficient equipment due to the efficiency programs.

6. The incentive contributed toward efficient equipment and technical assistance to contractors. This activity reduces market barriers to energy efficiency investments such as first cost and lack of awareness.
7. The energy efficient equipment reduces the energy consumption of the end-user, resulting in lower utility bills.
8. Items 8, 9 and 10 all impact customer electric rates due to reduced electric consumption. Item 8 shows impacts in customer electric rates due to fixed cost recovery, since they are not supplying as much electricity.
9. Reductions in customer electric rates due to Demand Reduction Induced Price Effects (DRIPE).
10. Reductions in customer electric rates due to Vermont's reduced contributions to Pooled Transmission Facilities (PTF) and ancillary services provided by the New England Independent System Operator.

DEVELOPEMENT OF INPUTS TO THE REMI MODEL

The basis for the development of economic impacts due to the electric portion of efficiency investments was the Demand Resource Planning Project (DRP) conducted by Vermont Energy Investment Corporation (VEIC) and Optimal Energy for the DPS in the spring of 2011. The DRP was a detailed measure-level analysis whose savings and spending targets were close to those recommended by the DPS and used for this study. Measure incentive and market penetration levels were thus adjusted in the DRP study to match the desired yields ($/MWh) for this analysis. Additional adjustments were made for the inclusion of BED (the VEIC DRP only included EVT), as well as for the effects of geotargeting (which lowered savings per dollar invested). The strength of this approach lies in the fact that once the necessary changes to spending and savings were made, the energy impacts and associated costs were readily available by sector, program, and measure over the 20-year study period.

The basis for the economic impacts due to the non-electric portion of efficiency investments was an efficiency potential analysis of the Heating and Process Fuel (HPF) as part of the 2011 DRP project developed by VEIC. Developed in response to the Vermont Energy Efficiency and Affordability Act (2008), which established new, aggressive goals for increasing building thermal efficiency, the plan provides high-level strategies and anticipated savings for efficiency services beginning in 2012. The energy impacts are based on the anticipated savings while key assumptions such as average measure life and incremental cost were developed from a review of the individual program designs.

Once the energy savings were estimated by sector and year, they were multiplied by average retail rates[11] to determine the net benefits to end users. They were also used to determine the total reduced supply requirements for the utilities.

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[11] See Appendix A for further detail on the source and development of retail rates for electricity, natural gas, and heat and process fuels

PROGRAM AND PARTICIPANT SPENDING

The energy efficiency program requires significant resources to operate but these expenditures also induce economic activity for industries and services that operate in Vermont. Firstly, the program calls upon technicians, administrators, and other professionals to operate. Secondly, participants in the program must purchase efficient equipment and install them in their home or business. These purchases include more efficient appliances, light bulbs, furnaces, etc., some of which must be installed by professional contractors.

Table 3 below shows the one year spending of $67.1 million on program administration, equipment, and installation. The program overhead and delivery cost (including technical assistance, marketing, and administrative costs) is $23.3 million.[12] The investments in equipment and installation total $43.8 million, of which some is covered by financial incentives ($21 million) to purchase efficient equipment; participants then pay the remainder of the costs of investment "out-of pocket" ($22.7 million).

Table 3: Program and Participant Costs (2011$)

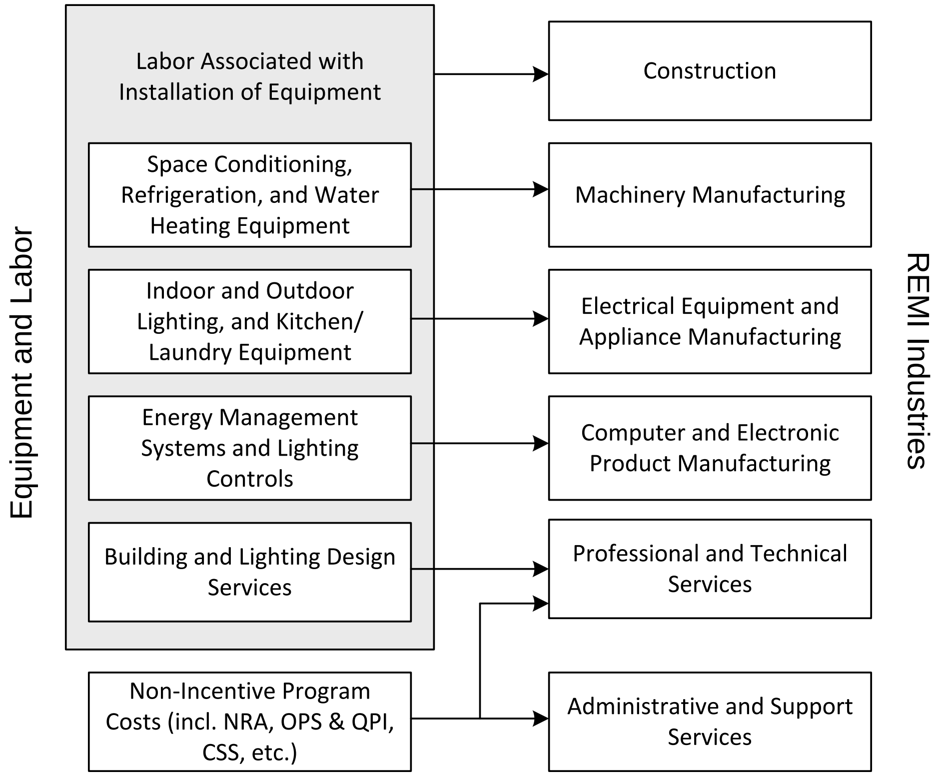
Spending Category	$Million
Total Equipment and Installation	$43.8
Participant out-of-pocket costs	*$22.7*
Incentives	*$21.0*
Program Delivery/Administration	$23.3
Total Program and Participant Spending	**$67.1**

This activity creates an initial stimulus in the local economy for the first year of the program's operation. Moreover, this stimulus is only felt by a handful of industries, namely those associated with energy efficient equipment and its installation. The magnitude of the impact felt by each industry depends on the total incremental cost associated with a given industry's corresponding equipment/services, and the amount purchased. The process of matching equipment with industries was, with a few exceptions, based on the equipment's end-use. A more granular, measure-level approach could not be taken due to the limited set of industries in the REMI model (e.g. *Electrical Equipment and Appliance Manufacturing* encompasses both indoor and outdoor lamps and ballasts, as well as household appliances such as clothes washers and dishwashers). Figure 2 below shows the general mapping of equipment and labor categories to REMI industries[13].

[12] Despite the significant positive economic impacts shown in this report, it is important to recognize that these costs, too, are significant. Efforts should continue to ensure that programs are as efficient as possible, to maximize both the efficiency savings and economic benefit associated with those savings.

[13] See Appendix B for detailed descriptions of the REMI industries.

Figure 2. Mapping Equipment and Labor Investments to REMI Industries

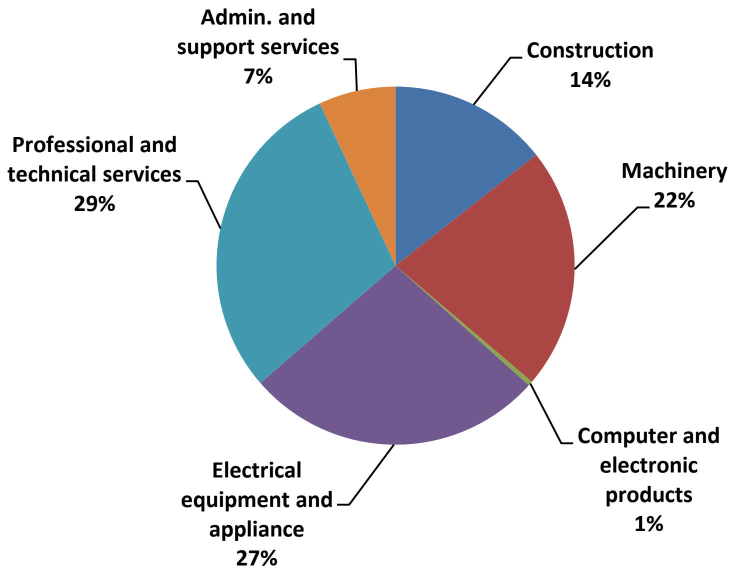


NRA = Non-Resource Acquisition. OPS & QPI = Operations and Quantifiable Performance Indicators, which comprise EVT's performance incentive. CSS = Core Supporting Services, mainly marketing and information technology services.

The mapping of equipment and labor categories to REMI industries was conducted on a program-by-program basis. This was due to the fact that the portion of the incremental cost due to labor was most easily estimated by program (e.g., labor costs were estimated to be near 0% for retail products programs, but upwards of 30% for the low-income program).

Figure 3 below shows the proportion of the total investments going to each industry. The extent of economic impacts depends on the amount of each activity provided in Vermont. Program administration (professional, technical, administration and support services) and installation of equipment (construction) were both considered largely in-state activities since the program is run in Vermont and would most likely call on local contractors for installation. However, the production of efficient equipment (machinery, computer and electronics, electronic equipment and appliances) will not all take place in-state. The economic model uses assumptions for the portion of demand that is provided locally for each of these industries to ensure that only the local production is counted in Vermont's economic impact.

Figure 3. Distribution of Program and Participant Spending by Industry



ECONOMIC BENEFITS OF ENERGY SAVINGS

Participants in the energy efficiency program save by forgoing the purchase of energy and related expenses that they would have without the program. Over the course of 20 years, residents and businesses participating in the efficiency programs save over $247 million in estimated energy-related spending. The savings directly related to the electric efficiency investments were modeled using Optimal Energy's Portfolio Screening Tool. Benefits from the Heat and Process Fuels programs are based on projected spending and savings for 2012 developed by Vermont Energy Investment Corporation (VEIC). Table 4 shows the distribution of total savings by type of energy spending. Not surprisingly, the majority of savings is attributed to spending on electricity ($207.6 million, 84%) while the rest is distributed among heating fuels, water and operations and maintenance savings.

All ratepayers are also subject to the responses of prices due the decreases in energy demand afforded by participants. In this case, ratepayers experience an initial cost due to utilities increasing rates to recover fixed costs. However, this force is counteracted by the savings from reduced transmission from Pooled Transmission Facilities (PTF), and DRIPE (Demand Reduction Induced Price Effects) which refers to a drop in prices due to the reduction of demand. This amounts to $25 million in savings due to rate effects, also shown in Table 4. See Appendix A for the data sources and assumptions for each of these components.

Table 4: Cumulative Gross Benefits from Energy Savings by Type (2012-2031, 2011$)

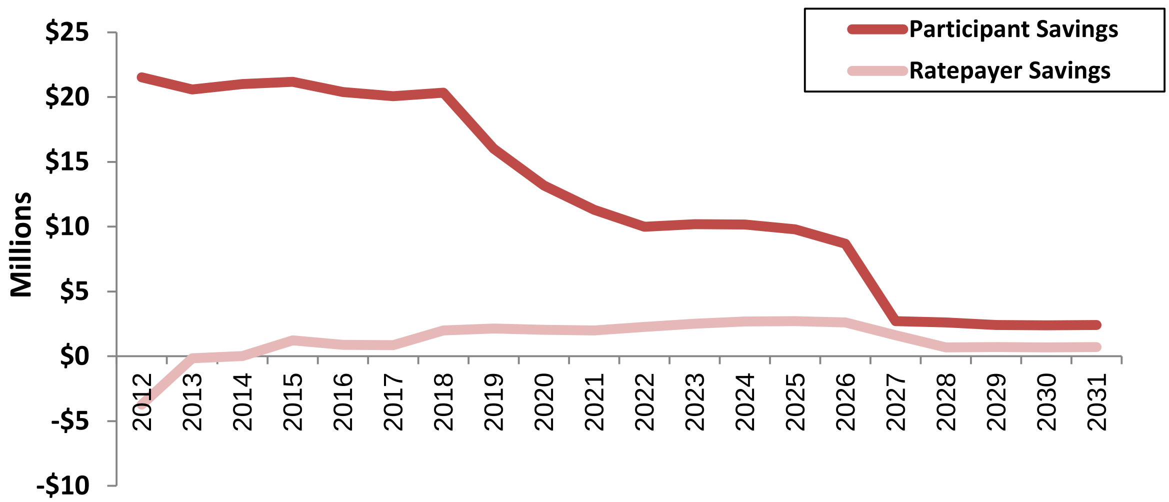
Energy Spending[14]	Gross Benefits (million)	Percent of participant savings
Electricity	$207.6	84%
Oil, Propane, Kerosene	$13.8	6%
O&M	$20.1	8%
Water	$5.6	2%
Participant Savings	**$247**	**100%**
Ratepayer Savings[15]	**$25**	**-**
Total Gross Savings	**$272**	**-**

Figure 4 shows the estimated gross benefits (presented above) for participants and ratepayers distributed by year. The timing of these benefits is based on assumptions of deterioration of efficiency investments (by type of equipment) over time. Likewise, the savings resulting from these investments taper off as the equipment becomes less efficient or expires. It is important to note that these effects were estimated for one year's spending in 2012. A program with continued funding year-to-year would not show this decrease over time since new efficiency would be perpetually coming on-line each year (though the program benefits would change from year to year as prices for equipment and energy change, and due to increases in the baseline efficiency of new equipment, from which program savings are measured).

[14] Natural gas savings were excluded since they were close to nothing (-$100,000 or .-04% of total savings).

[15] "Ratepayers" here refers to the effects on participants and non-participants due to changes in rates. This also includes deferred replacement credits awarded to participants (nearly $6 million).

Figure 4. Participant and Ratepayer Gross Benefits on Energy Expenses by Year (2011$)

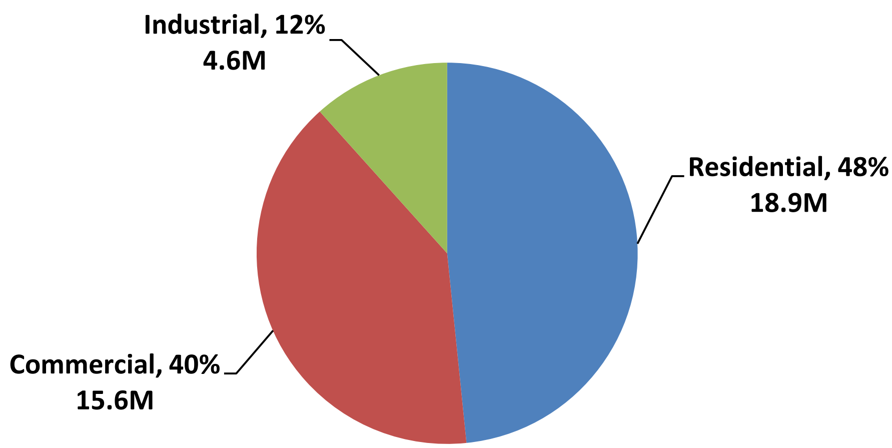


COSTS TO PARTICIPANTS AND RATEPAYERS

Of course, the gross benefits come at the expense of ratepayers and participants. All electric ratepayers are subject to an additional charge that funds the energy efficiency program. This Systems Benefit Charge (SBC) amounts to $39.1 million (2011$) which goes towards the costs to deliver and administer the program ($20.6 million) and financial incentives that participants claim when investing in efficiency ($18.5 million). The remaining funding for the HPF program comes from RGGI and FCM (Forward Capacity Market).[16] Figure 5 shows the source of the SBC by ratepayer sector.

[16] Ratepayers throughout the region pay for these costs as internalized in rates. Thus, the economic cost to the state of raising these revenues is already incorporated into the model and not considered an additional a cost for this study.

Figure 5. System Benefit Charge Collections by Sector (2011$)



Source: Vermont Department of Public Service, 2010 Collections by Rate Class

The financial incentives (funded by ratepayers) only cover a portion of the investments needed to participate. In aggregate, participants pay the majority of the total investment of $43.8 million as shown previously in Table 3. However, in reality, not all of these costs would be incurred up-front by the participants. Many will take out loans to cover the additional expense. Larger investments are more likely to require outside funding, though smaller investments often contribute to general borrowing to meet cash flow needs. This would mean that the participants amortize the cost—pay a monthly charge including interest and principal of the loan for the equipment. With this in mind, we developed estimates of how much of each type of investment would be paid up-front (with the remainder amortized over a longer period) and the average length of the amortization period.

Table 5: Assumptions for Participant Financing

Type of Program	% of expense amortized	Years to amortize
New Construction	100%	20
Residential Multi-Family programs	50%	10
Existing Homes/Retrofits	50%	5
Heating Equipment	0%	N/A
Retail Products/Low-income programs	0%	N/A

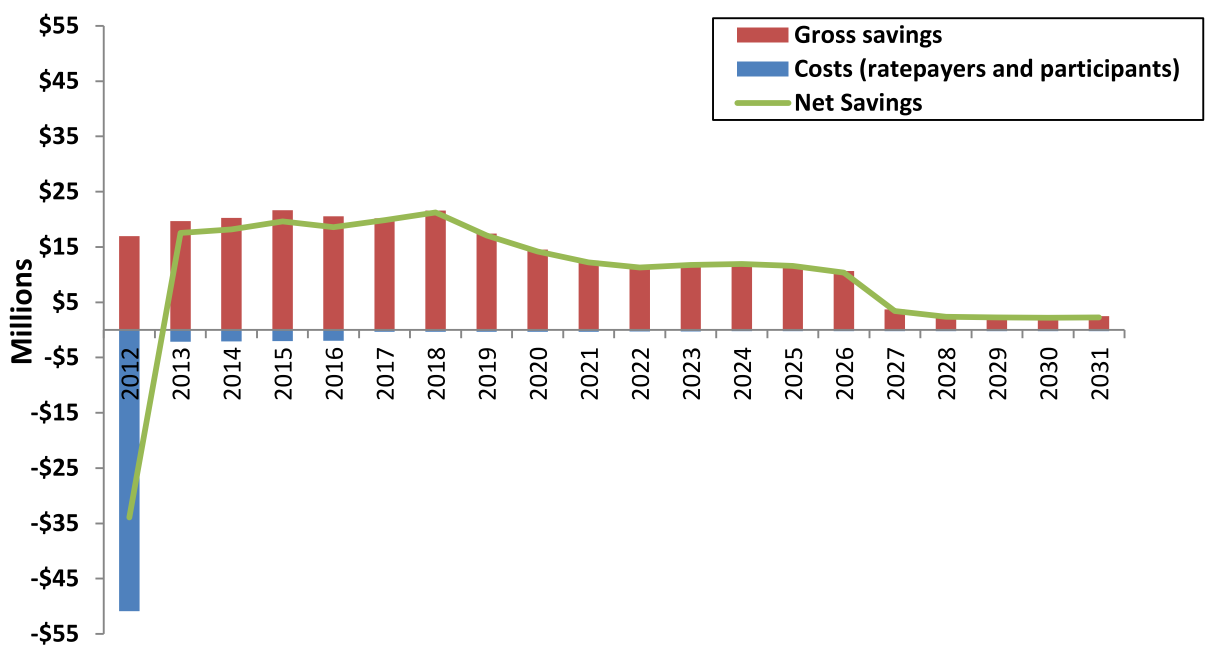
Due to the costs of borrowing, the participants pay a higher amount than if they would have paid "out-of-pocket" in the first year. Using the assumptions above, the total participant spending over 20 years is $25.1 million[17] (instead of the original $23 million). Even though the total costs are higher, distributing the costs over the years also means that participants overall expend less in the first year. In sum, this results in higher economic impacts in 2012 and slightly lower impacts in the future years.

NET SAVINGS FOR PARTICIPANTS AND RATEPAYERS

In order to capture how the program affects residents and businesses, the net savings (gross savings minus the costs associated with the program) is the most important indicator. Cumulatively, the net savings is $208 million for the 20-year period. Figure 6 shows the gross savings, costs and net savings (difference between the two) by year. Initially, net savings are negative since a portion of the investments are paid for out-of-pocket in the first year and all ratepayers are paying an extra charge on their energy bills. Throughout the 20-year period, households and businesses continue to pay for the amortized portion of their initial efficiency investments but save on energy spending. All ratepayers pay the first year charge but save in future years due to downward pressure on rates. Capturing the path of these net savings from year to year is crucial for determining the economic impacts.

For households, net savings represents additional money to spend elsewhere in the Vermont economy: restaurants, retail, and entertainment to name only a few. Participating businesses in Vermont experience a reduction in fuel cost savings that increases their bottom line. This cost savings can then be invested elsewhere, translating into more production and resulting jobs.

Figure 6. Net Savings, Gross Savings and Costs by Year (2011$)



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[17] We amortized based on the term of the loan, an average interest rate of 6% (typical rate for a home equity loan) and adjusting to 2011 real dollars.

APPENDIX A: SUMMARY OF DATA SOURCES AND ASSUMPTIONS

This appendix catalogues the data sources and assumptions used for this study that are not described in the body of the report.

Summary of Key Analysis Assumptions

Factor	Value	Source
Real Discount Rate	5.6%	DPS rate used in statewide screening tool for cost-effectiveness analysis
Long-term Inflation Rate	2.6%	Long-term average inflation rate for cost-effectiveness analysis used in statewide screening tool
Average electric line loss factor	9.5%	Weighted average of VT (10%) and BED (3.05%) average line losses
EEC collections by sector	48% Res 40% Com 12% Ind	Provided by DPS for 2010 for EVT and BED
Electric sales split by sector	42% Res 39% Com 19% Ind	Calculated from Itron sales forecast, not including sales from Self-Managed Energy Efficiency Program participant sales
Heating and Process Fuels (HPF) incentive spending split by sector	75% Res 17% Com 8% Ind	HPF analysis performed by VEIC in 2011 for the DPS
Benefit for Pooled Transmission Facilities and ancillary services provided by ISO-NE ($/kWh)	$0.0216	Regional Network Service (RNS) Rate Forecast, 2012-2015 ($0.015/kWh in 2012), plus $0.0066/kWh for ancillary fixed charges (provided by Paul Chernick, Resource Insight Inc.). A flat rate was used for the forecast period, though the RNS Rate is forecast to escalate in the coming years. The benefits are assumed to occur one year after the actual savings.[18]

[18] The RNS is calculated on a $/kW-Year basis, but is converted to $/kWh for ease of use in this report.

Inclusion of Burlington Electric Department (BED) Programs - The savings from electric efficiency programs were based on a 2011potential study analysis performed for the DPS by VEIC and Optimal Energy. That analysis only modeled EVT's program activity. The analysis was therefore adapted to fit the portfolio spending and savings targets recommended by the DPS, and to include both BED and EVT. An implicit assumption in the adjusted DRP analysis is that BED and EVT have efficiency programs with similar savings and spending composition. This is reasonable because BED's impact is relatively small compared to EVT; adjusting the forecast to account for BED's unique program characteristics (e.g., greater portion of C&I savings, higher concentration of multifamily buildings) would not significantly affect the results.

Electric Avoided Costs – Based on *Avoided Energy Supply Costs in New England: 2011 Report* (Synapse Energy Economics, July, 2011).

HPF Incentive Costs – Based on a detailed budget projection for the 2011 HPF programs, provided by VEIC. The total incentive costs were calculated to be 76% of the resource acquisition budget.

HPF Participant Costs – Estimated by sector based on review of program designs and corresponding electric programs.

Average Retail Electric Rates – Based on 2010 VT utility revenues and sales by sector, adjusted to 2011$ for inflation. The 2012 average retail rates by sector were estimated to be:

$0.158/kWh	Residential
$0.136/kWh	Commercial
$0.096/kWh	Industrial.

Retail rates for the years 2013-2031 were based on the 2012 estimates, escalated in proportion to the wholesale electric rates forecasted for those years in the 2011 AESC (July 2011, Synapse Energy Economics).

Average Retail Natural Gas Rates – Based on 2010 EIA retail prices by sector for VT, adjusted up for inflation. The 2012 rates ($/MMBtu) by sector were estimated to be: $17.06 – Residential, $12.5 – Commercial, $6.97 – Industrial. Retail rates for the years 2013-2031 were based on the 2012 estimates, escalated in proportion to the wholesale gas rates forecasted for those years in *Avoided Energy Supply Costs in New England: 2011 Report* (Synapse Energy Economics, July, 2011).

Average Retail Heat and Process Fuels Rates – Based on *Avoided Energy Supply Costs in New England: 2011 Report* (Synapse Energy Economics, July, 2011), Appendix E, Petroleum Fuels. Residential rates are for Distillate Fuel Oil. Commercial and Industrial rates are a weighted average of Distillate and Residual Fuel Oil based on a 5-year average from EIA data for Vermont (commercial was 86% distillate, 14% residual, while industrial was 78% distillate and 22% residual). The 2012 average retail rates by sector were estimated to be:

$26.22/MMBtu	Residential
$16.61/MMBtu	Commercial
$9.39/MMBtu	Industrial.

Retail rates for the years 2013-2031 were based on the 2012 estimates, escalated in proportion to the wholesale HPF rates forecasted for those years in the 2011 AESC report.

DRIPE Benefits – Calculated as the sum of energy and capacity benefits for Vermont, on a per kWh saved basis, from the *Avoided Energy Supply Costs in New England: 2011 Report* (Synapse Energy Economics, July, 2011),.

Incentive Spending as % of Total Program Budgets – Based on historical program splits as captured in the DRP analysis. The percent of total program budgets going toward incentives is laid out in the following table:

Programs	Residential	C&I
New Construction	9%	65%
Retail Products	81%	81%
Retrofit	55%	69%
Efficient Equipment	n/a	75%
Low-Income	59%	n/a
Multifamily	37%	n/a
HPF	76%	76%

In-state vs. Out-of-state Economic Activity – spending on goods and services in the REMI model can be input as either "local" or "general". If it's input as local, the economic activity generated by that spending is confined to the state. If it's general, the REMI model redistributes the spending between in-state and out-of-state based on its preprogrammed understanding of VT's economy. Costs (participant and incentive) associated with equipment were input as general, whereas costs associated with installation of equipment and technical services were input as local.

APPENDIX B: INDUSTRIES USED IN THE REMI MODEL

The following "REMI industries" correspond to subsectors of the North American Industrial Classification System (NAICS) that were applied in this study. Each represents a general set of related sub-industries, and thus provides only limited precision compared to the real-world impacts of energy efficiency investments. Brief descriptions and examples of sub-subsectors are provided for each as a means of clarifying their selection as appropriate proxies in the REMI modeling.

Construction: The construction sector comprises establishments primarily engaged in the construction of buildings or engineering projects. Construction labor may be related to new work, additions, alterations, or repairs and maintenance. Relevant subsectors include:

- Residential Building Construction
- Nonresidential Building Construction
- Foundation, Structure, and Building Exterior Contractors
- Building Equipment Contractors

Machinery Manufacturing: The machinery manufacturing sector comprises establishments engaged in creating end products that apply mechanical force to perform work. This includes machinery used in a variety of commercial and industrial applications. Relevant subsectors include:

- Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing
- Air Purification Equipment Manufacturing
- Industrial and Commercial Fan and Blower Manufacturing
- Heating Equipment Manufacturing
- Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing
- Pump and Compressor Manufacturing

Electrical Equipment and Appliance Manufacturing: Industries in the Electrical Equipment, Appliance, and Component Manufacturing subsector manufacture products that generate, distribute and use electrical power including electric lamp bulbs, lighting fixtures, and parts; both small and major electrical appliances and parts; electric motors, generators, transformers, and switchgear apparatus. Relevant subsectors include:

- Electric Lamp Bulb and Part Manufacturing
- Lighting Fixture Manufacturing
- Small Electrical Appliance Manufacturing

- Household Refrigerator and Home Freezer Manufacturing
- Household Laundry Equipment Manufacturing

Computer and Electronic Product Manufacturing: Industries in the Computer and Electronic Product Manufacturing subsector manufacture computers, computer peripherals, communications equipment, and similar electronic products, and establishments that manufacture components for such products. Relevant subsectors include:

- Computer and Peripheral Equipment Manufacturing

Professional and Technical Services: Industries in the Professional and Technical Services subsector engage in processes where human capital is the major input. These establishments make available the knowledge and skills of their employees, often on an assignment basis, where an individual or team is responsible for the delivery of services to the client. The distinguishing feature of this subsector is the fact that most of the industries grouped in it are almost wholly dependent on worker skills. Relevant subsectors include:

- Accounting, Tax Preparation, Bookkeeping, and Payroll Services
- Architectural Services
- Engineering Services
- Building Inspection Services
- Interior Design Services
- Industrial Design Services
- Computer Systems Design and Related Services
- Environmental Consulting Services
- Marketing Consulting Services
- Other Scientific and Technical Consulting Services

Administrative and Support Services: Industries in the Administrative and Support Services subsector group establishments engaged in activities that support the day-to-day operations of other organizations. The processes employed in this sector (e.g., general management, personnel administration, clerical activities, cleaning activities) are often integral parts of the activities of establishments found in all sectors of the economy. Relevant subsectors include:

- Office Administrative Services
- Facilities Support Services
- Business Support Services
- Other Support Services

Appendix 6—Forest Management for Bioenergy

Forest Management for Bio-Energy

Demands placed on forests include biomass used for electricity, thermal applications, and potentially for transportation (cellulosic ethanol) along with lumber, pulp, recreation, aesthetics, and environmental services. Analysis of forest-related management issues encompasses the entire resource, regardless of varying potential end uses. The analysis of demand for electric power also applies to management of forests under thermal and transportation sections. Thus, this section applies to all uses of woody biomass for energy.

Forests are renewable but limited in extent and growth rate. The extent of forest in Vermont and the region is expected to decline, a trend already in progress in neighboring states. Through judicious application of forest management options, forest growth may be increased somewhat. There is speculation about how much of an increase in forest growth might be achieved, but no agreement. Although over the past century Vermont has been increasing its forest cover, the past 20 years of forest inventory data for Vermont show a declining growth rate. This decline is recognized as a natural result of a maturing forest.

Vermont is about 78% forested (4.6 million acres). Area of forestland is a critical foundation for wood supply. The overall forest contains 324,958,303 green tons of wood in live trees, 40% of which is considered at this time to be of quality not suited to paper or lumber or wood product manufacturing. The growth of the total live tree population is approximately 5,524,000 green tons per year. The growth of the so-called low-grade fraction of the inventory is approximately 2,382,000 green tons per year. Although growth has been declining, total inventory is still increasing, though the rate of increase has been slowing. [1,2]

Wood Supply - Since at least 1977 there have been a series of wood supply studies commissioned specifically for energy interests. Some of these studies have been more quantitative than others. All have arrived at the same conclusion: there is some margin of increase in wood harvesting that can be attained on a sustained basis in Vermont and the market region. The range of projected volume that can be harvested in addition to the current volume of wood fuel harvest has been estimated to be 200,000 to 3,000,000 green tons per year. The breadth of this range reflects different assumptions about the current and projected state of the forest, how forests grow, the state of the forest products economy, and the nature of the additional demand. Wood supply projections are very sensitive to changes in growth rate and harvesting capacity. These are dynamic factors which makes reliable projection a challenge. Less dynamic but also influential are forest accessibility and general forest products demand. Assumptions that incorporate expectations of stable or increasing forest growth, a stable or growing forest products economy, and stable or increasing access to forests for harvesting lead

[1] *Vermont's Forest Resources 2010; Morin, Randal, et al. USDA Forest Service Res. Note NRS-105 Pg. 1*

[2] *Forest Inventory and Analysis Database, Forest Inventory and Database Online (FIDO), USDA Forest Service*, http://fiatools.fs.fed.us/fido/index.htm

to projections at the upper end of the range. Assumptions in the opposite direction tend to deliver lower expectations of new harvest volume.

ANR chooses to use the moderate harvest intensity scenario as given in the Biomass Energy Resource Center (BERC) 2010 wood fuel availability assessment.[3] The volume of low-grade wood available in Vermont above and beyond current use is given at 900,000 green tons per year. Projects in progress at this time and proposed for initiation in the near future may provide additional information that better describes a potential sustained yield range. The moderate scenario figure from BERC is chosen because the assessment is the most transparent available. That transparency allows open discussion of the estimate. The assumptions used for that assessment were developed in consultation with a variety of people in the region familiar with forest inventory and modeling, with forest economics, with logging and wood energy, and with private land demographics. They are not, however, accepted by all.

Whatever the most reliable estimate of wood availability may be, the diverse and independent nature of the supply side makes any *a priori* partition of that supply to designated energy uses questionable. Under such circumstance, it can be proposed that price signal alone will determine how the resource is distributed. Financial incentives can be developed to direct wood toward preferred uses, and in the past, this has been done at both the state and federal levels – though not necessarily with a fully consistent policy in effect. Absent that application of policy, the largely unregulated forest products market will continue to aggregate tens of thousands of individual decisions that are in large part, but not totally, influenced by price.

Privately owned forestland yields an estimated 93% of the forest harvest volume each year.[4] This shows that the 14% of the forest held by government and other owners contributes a lesser volume than the share of acreage would predict. In other words, the forest products economy is close to complete dependency on the owners of private land. Policies chosen to encourage greater production of forest products must include strong consideration of the interests of these landowners.

Forest Products Economy - Projections of available wood for harvest in excess of current production are dependent on the forest economy. Productive capacity of the forest products sector has been declining in response to declining demand for forest products. The state of the sawlog market generally drives harvesting potential, though a few examples exist showing the possibility of adequate pulpwood price making harvest feasible.

Production of wood for fuel is a function of the forest products sector. Almost all logging in the region is organized around the fullest range of products possible from any given woodlot: sawlogs and veneer logs, pulpwood and fuelwood, including residential firewood. The principle of highest and best use has been standard for several decades by landowners, loggers, foresters

[3] *Vermont Wood Fuel Supply Study, 2010 Update. Biomass Energy Resource Center. 2010. Pg. 29*

[4] *Morin, et al. (2010)*

and wood using businesses. Highest and best use ensures that any tree harvested will be partitioned and those parts sold into the market that pays the highest price. In other words, highest and best use is about making sure that a sawlog does not end up as firewood.

Steady decline of pulp and paper manufacturing in the region has reduced the demand for pulpwood, a lower grade of wood than sawlogs. The growing demand for wood fuel is expected to replace the market losses in pulpwood and possibly exceed historic pulpwood demand levels.

Whatever the resource base may be from which additional wood may be harvested, the productive capacity of the forest products sector plays a significant role in whether what is available may be fully obtained. Loggers and foresters as well as wood processing businesses all play a role in making a wood fuel sector viable.

Over the past 15 years the number of sawmills has declined. This matters for two reasons: First, local demand for sawlogs has declined with the loss of mills; second, wood chips from sawmills have played a dominant role in the growing wood energy market in the region, and loss of mills means loss of that fuel product. As mill chip volume has declined, growing demand for wood chips has had to be met directly from the forest. Logging businesses are faced with a substantial capital investment to acquire one or more chippers and transportation equipment including live bottom trailers.

Prices paid for forest products play a dominant role in the choice to harvest and what to harvest, how far to ship products, and how to assign wood to different markets. In times of high sawlog prices, it is possible to harvest larger volumes of low priced products, like fuelwood. In times of higher process for low-grade trees, it is possible to increase harvest in that category. In times of depressed prices for all forest products, a harvest may not be possible.

The energy market for wood also varies, and so affects the price paid for the product and the value to the landowner and logger. Wood for pellet manufacturing is frequently the same as for pulpwood in terms of quality specifications. The wood for power plant use has a specification similar to residential firewood but lower specification than for pellets. Both power plants and pellet manufacturers can use softwood, hardwood or both. Power plants can also make use of tops and limbs that cannot be used as residential firewood or for making pellets. The residential firewood market has become differentiated as more automated firewood processors come on line. These processors work best with wood that meets specifications closer to pulpwood. Wood for institutional heat, such as schools and colleges, generally uses a paper-grade chip, which as the name implies, is similar stock to pulpwood.

There is no specification established for wood to be used in making ethanol or bio-oil but current expectations are that it will fall between the power plant and firewood specifications. Forest extent and growth are limited. The forest products sector also has limits to production. The certainty of demand for wood from Vermont from users outside the state will further limit what is available for in-state use. The constraints on wood availability limit how much energy demand can be satisfied through Vermont’s resource.

Furthermore, we can expect that a hierarchy of use will continue based on price. Price for wood fuel for electric generation will be limited by the regulated price for electricity. Price for wood for ethanol and bio-oil production will be limited by the transportation sector expectations on affordability. Price for wood for combined heat and power systems will be less limited since efficiency will be higher and thermal use is not regulated. However, CHP wood will still be subject to expectations of affordability and will be somewhat limited by electricity price. Price for wood for thermal only applications, particularly space heating, is limited the least both due to its efficiency and because it competes with more expensive fossil fuels, primarily in the forms of oil and propane.

Since landowners, foresters, and especially loggers make highly independent decisions regarding each of the nearly 30,000 privately owned forest parcels[5], behavior driven by price alone is unlikely. Still, past behavior regarding allocation or forest products to various markets shows that price paid to loggers and landowners plays a major role.

Forest Sustainability – Most all acknowledge that additional forest wood use should be "sustainable"; however, there is no one single measure of forest sustainability. There is no widely agreed upon sustainability assessment approach. There are, instead, a mix of measures and comparisons commonly used.

The most common surrogate for forest sustainability is the so-called "growth to removals" ratio. This ratio compares forest growth to volume of wood harvested. Growth measures the increase in size of trees as a volume plus the volume of trees growing into a minimum diameter since a previous measurement. Removals may also include with harvest volume the land area removed from accessibility or developed.

A positive growth-to-removals ratio indicates that a forested area is growing in volume and/or extent faster than it is being harvested. The growth-to-removals ratio indicates what is known as *sustained yield* of forest products. When applied to the state, the reliability is acceptable. Growth estimates for subdivisions of the state will provide less reliability because the sample size decreases.
Latest forest inventory data show a growth to removals ratio for Vermont at 2.25 to 1; that is 2.25 times the volume of wood harvested remains in the forest as growth added to the total. This ratio has been declining since 1983 when it was about 3 to 1 and about 2.5 to 1 in 1997.[6]

The key factor for sustainability is forest health. The state's forest health monitoring program shows that the majority (>85%) of the forest area is considered healthy.[7] Forest health can serve

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[5] *Data obtained from USDA Forest Service National Woodland Owner Survey,* http://apps.fs.fed.us/fia/nwos/tablemaker.jsp

[6] *Morin, et al (2010)*

[7] *2010 Vermont Forest Health Highlights, Vt. Division of Forests, URL:*

as a more general surrogate for other factors including soil productivity, forest resilience, and human influence.

Biodiversity is a critically important factor for sustainability. Forest ecosystems are diverse. Loss of diversity is a practical concern because it can reduce forest growth. Measures of biodiversity in Vermont indicate that threats posed by climate change, invasive plants, exotic pests and diseases, land use change and wood demand can diminish biodiversity.

Given the relatively positive state of the forest and the fact that a surplus of wood is available for harvest, it is generally believed that the past use of the forest has been sustainable. With the positive condition as a starting point there is general acceptance among natural resource professionals, given the present state of knowledge, that harvesting more wood can be done sustainably, accounting for all forest values of interest.

One of the keys to harvesting more wood, especially for energy for which steady local supply is more critical than for other forest products, will be a robust and adaptive forest monitoring program. Monitoring forest condition and sustainability is already done but the extent of that work must be expanded into more categories and more depth for what is measured. This will be essential as more energy consumers both within and outside Vermont look towards the same forest resources to meet increasing demands for electric, thermal and potentially transportation power sources.

Harvesting biomass from our forests also has implications for entire ecosystems, which include wildlife. Effective future planning must consider not only the benefits of harvesting biomass, but also the existing ecosystem functions and intrinsic value of forests. A comprehensive planning approach will enable Vermont to meet its ongoing biomass harvest needs while minimizing the negative effects on things like wildlife corridors and breeding areas, vegetative buffers around lakes and streams that protect water quality, habitat for fish, and a wide variety of other species, etc.

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www.vtfpr.org/protection/documents/Final2010ConditionReport.pdf, *Pg. 1*