The Vermont 25x'25 Initiative

2009 Progress Report, Recommendations, and Work Plan Priorities

Prepared for

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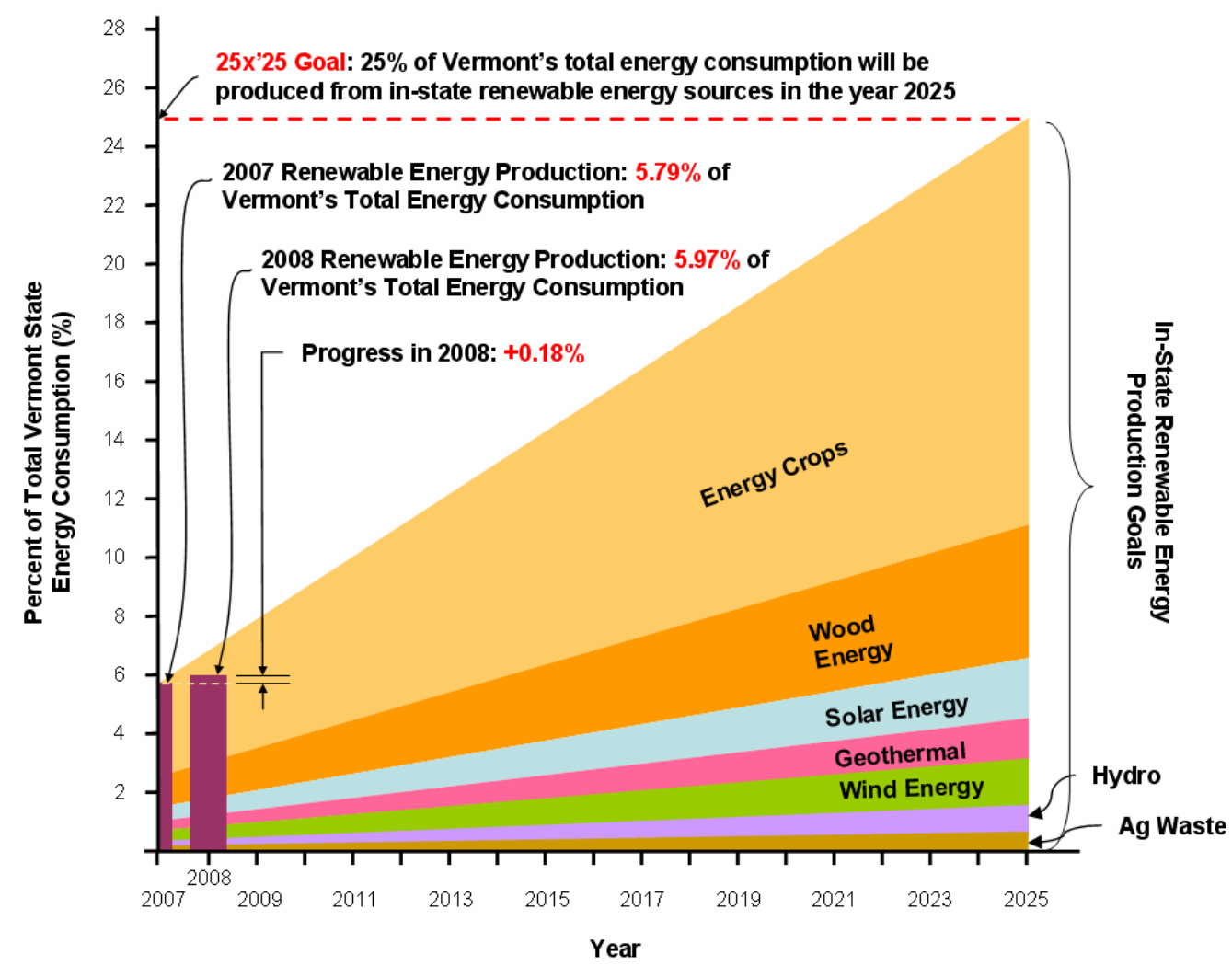
Executive Summary

Renewable Energy Progress Report for 2008

At the end of 2008, Vermont produced nearly 6% of its total energy needs from in-state renewable energy sources, with Vermont farm and forest feedstocks accounting for more than 80% of these sources. And, as illustrated in the figure below, the number is rising: During the past year, Vermont made incremental progress toward the goal of producing 25% of its total energy consumption from in-state renewable energy sources by the year 2025 – increasing the amount of energy derived from in-state renewable energy sources by 0.18% from 2007 levels. The vast majority of these gains came from increases in the use of wood chips for institutional heating, farm methane production, and small-scale solar hot water systems.



This annual rate of increase is notable but it is not sufficient to achieve the Vermont 25x'25 goal, which will require an annual growth rate of approximately 1% in renewable energy generation over the next 17 years. While this rate of renewable energy implementation is not necessarily expected in the Initiative's early years (greater amounts of renewable energy are anticipated to

come online in later years as fossil-based energy prices rise and environmental pressures increase), it is important to continue to build support, generate momentum, and bring focus to renewable energy sector strategies needed to achieve the Initiative's goal.

To this end, the Vermont 25x'25 Steering Committee developed findings on two fronts during 2008: (1) recommendations for consideration by the Vermont State Legislature and other state policymakers; and (2) a series of sector-specific 2009 work plan priorities designed to guide the efforts of the Initiative's members and stakeholders in the coming months and years.

Key Legislative Recommendations for 2009

The Vermont 25x'25 Initiative Steering Committee strongly recommends legislative action on the following items during 2009:

1. **Workers' Compensation**. Address the disproportionately high worker compensation rates for the logging and agricultural sectors in Vermont. This is a major issue for logging contractors and directly affects capacity to harvest forest biomass.
2. **Land Inheritance Taxation**. Reduce the tax barriers to passing land ownership from one generation to the next without creating pressure to subdivide land.
3. **25x25' Initiative Funding**. Identify funding that will allow the Vermont 25x'25 Initiative to develop year-round monitoring capacity. This will enable the tracking and reporting of in-state renewable energy production, policy developments, programmatic progress, and other Initiative-related developments during the course of each year of the Initiative.

Key Vermont 25x'25 Work Plan Priorities for 2009

The work plan priorities below build on findings outlined in the Vermont 25x'25 *Preliminary Findings and Goals* report published in January of 2008, and were developed by subcommittees working in the following focus areas: *Cross-Cutting Issues*, *Financing Issues*, *Permitting Issues*, *Technical Assistance*, *Innovation in Technology*, and *Market Forces*. Further details and additional priorities are provided in the full report that follows.

1 <u>Cross-Cutting 2009 Work Plan Priorities:</u>

1.1 ***Develop Vermont 25x'25 Monitoring Capacity***. Develop Vermont 25x'25 Initiative monitoring capacity with staff and/or consultants charged with tracking and reporting renewable energy production, policy developments, programmatic progress, and other Initiative-related developments during the course of each year of the Initiative.

1.2 ***Complete Renewable Energy Atlas of Vermont***. This resource will indicate where renewable energy resources exist at town and county levels; will include specific information on different technologies and resource links; will be GIS-based; and will include an interactive website.

2 <u>Financing 2009 Work Plan Priorities:</u>

2.1 ***Develop pool of potential lenders by providing guidance on renewable energy proposals***. For example:

- Make independent technical review available to potential lenders
- Provide examples of potentially unfamiliar business structures (e.g., farms including energy production in their business models)

- Develop a sample financial benchmarking system for assessing the strength of proposed projects
- In the case of municipal developers, provide economic feasibility study funding

2.2 ***Support initiatives to find and leverage future sources of funding for the Clean Energy Development Fund (CEDF)*** beyond January 2012 and ensure existing funds for the program remain available.

2.3 ***Support initiatives to find and leverage additional ongoing sources of funding for non-electric generation-type renewables, including biofuels***. As part of this effort, support existing and emerging partnerships between federal and state organizations.

3 Permitting 2009 Work Plan Priorities:

3.1 ***Create a web-based regulatory and procedural guidance toolbox***. Objectives of the toolbox will be to guide potential renewable energy project developers, stakeholders, and related permitting agencies through the regulatory process, improve communications, and provide a mechanism for feedback to help overcome regulatory barriers.

3.2 ***Create a renewable energy ombudsman position*** to help facilitate the regulatory and communication aspects of renewable energy development.

3.3 ***Create benefit balance strategies*** to improve the ability of regulators to balance the societal benefits of renewable energy projects against societal costs such as environmental impact, rate impact, etc.

4 Technical Assistance 2009 Work Plan Priorities:

4.1 ***Draft an oilseed crop production "best practices" handbook***.

4.2 ***Conduct workshops for farmers interested in growing oilseed crops***. Specific topics may include: growing, harvesting, drying, storing oilseeds; using straight vegetable oil in tractors; value-added culinary oil opportunities; use of meal in livestock rations; and grant writing support to access public funds.

4.3 ***Update, expand, and revise the Biomass Energy Resource Center's Wood Supply Model*** to incorporate up-to-date resource inventory data and include additional supply and demand analysis and econometric capabilities.

5 Innovation in Technology 2009 Work Plan Priorities:

5.1 ***Support efforts to develop small-to-medium manure digesters that are scaled for farms with fewer than 500 cows***.

5.2 S***upport the continued development of its algae-based biodiesel projects*** due to their benefits to nutrient management and energy production.

5.3 ***Encourage a cellulosic ethanol production feasibility analysis***.

6 Market Forces 2009 Work Plan Priorities:

6.1 ***Monitor the revision of the Sustainable Priced Energy Enterprise Development (SPEED) program rules***.

6.2 ***Assess the Use Value Appraisal (UVA) Program*** to determine the potential benefits and impacts of broader enrollment.

The above work plan priorities are intended to provide specific and actionable guidance to the Vermont 25x'25 Steering Committee and subcommittees, policymakers, state agriculture and energy organizations, businesses, other Initiative stakeholders, and all that recognize and embrace the spirit and purpose of the Vermont 25x'25 Initiative vision: to invigorate our state's working landscape and rural economies, while reclaiming Vermont's energy future as our own.

1.0 Introduction

The purpose of this report is to (1) describe the Vermont 25x'25 Initiative and related Vermont energy production and structural progress made during 2008, and (2) provide a series of key recommendations and related work plans important to reaching the goals of the Initiative. Specifically, this report aims to provide:

1. An overview of the history, goals and structure of the Vermont 25x'25 Initiative.
2. A status report on the amount of energy production from the various sectors, technologies, and feedstocks identified in the Vermont 25x'25 *Preliminary Findings and Goals* report published in January of 2008.
3. Specific recommendations and actionable work plan priorities considered crucial to achieving the Vermont 25x'25 Initiative's goals. These recommendations are intended to serve both as guidelines and specific action items for the Vermont 25x'25 Steering Committee and subcommittees, policymakers, state agriculture and energy organizations, businesses, and other Initiative stakeholders.

Establishment and Goals of the Vermont 25x'25 Initiative

The Vermont 25x'25 Initiative comprises a broad coalition of agricultural, energy, and policy professionals. Supported by Vermont legislative and executive resolutions, the Initiative's aim is to develop a plan for providing 25% of Vermont's total energy needs from in-state renewable resources by the year 2025 – primarily from Vermont's farms, forests, and working lands.

The Initiative is a state-level alliance that functions within the framework of the National 25x'25 program, the goals of which have received the endorsement of the Vermont State Legislature, Governor Douglas, and President Bush. The vision of the National 25x'25 program is as follows: *By 2025, America's farms, forests and ranches will provide 25 percent of the total energy consumed in the United States, while continuing to produce safe, abundant, and affordable food, feed and fiber*. National 25x'25 is a diverse alliance of agricultural, forestry, environmental, conservation and other organizations and businesses that are working collaboratively to advance the goal of securing 25% of the nation's energy needs from renewable sources by the year 2025. National 25x'25 is led by a national steering committee composed of volunteer leaders.

The National 25x'25 goal has been endorsed by nearly 800 partners, 30 governors, 14 state legislatures and the U.S. Congress through The Energy Independence and Security Act, which was signed into law by President Bush on December 19, 2007. National 25x'25 is a special project of the Energy Future Coalition (EFC). The EFC is a broad-based non-partisan public policy initiative that seeks to bring about change in U.S. energy policy to address overarching challenges related to the production and use of energy. The Vermont 25x'25 Initiative has officially adopted this national goal and has begun the work of determining specifically how Vermont can achieve these objectives using in-state resources.

Management and Governance of the Vermont 25x'25 Initiative

The Vermont 25x'25 Initiative functions as an independent coalition of farmers, energy professionals, state employees, and business people, all with a shared goal of securing Vermont's energy future, safeguarding the environment, and encouraging the thoughtful use of Vermont's farms and forestlands for energy production. The Vermont 25x'25 Initiative received administrative support from staff at the Vermont Department of Public Service through 2007. In

2008, the Vermont Agency of Agriculture assumed administrative responsibility for the Initiative. Initiative steering committee and subcommittee members are listed in Appendix B.

Note to Readers

In considering this report's analyses and conclusions, readers should note the following:

1. This report presents an array of sectors, technologies, and resources that collectively offer a possible means for achieving the overall Vermont 25x'25 Initiative goal. However, the sectors and technologies discussed are at various stages of maturity. Some of these technologies are currently commercially viable, others may reach commercial viability and market acceptance in the coming decades, and some may prove unfeasible for any number of reasons. Future resource availability can also, in some cases, be difficult to estimate. Readers should be aware that findings and conclusions presented are sometimes based on the "best guess" of the Vermont 25x'25 Initiative Steering Committee and that these estimates are in the context of an evolving energy landscape.
2. This report is intended to convey an estimate of the *technical potential* for each of the renewable energy and energy efficiency sectors addressed. Environmental and economic impacts of the energy goals and sector development strategies presented are beyond the scope of this report, but should be given careful consideration before adopting policies that support the proposed goals and potential solutions.
3. In many cases, these technical analyses do not consider the conversion efficiencies or greenhouse gas emission characteristics of the applicable end-use technologies. These will be areas for further consideration and refinement as the work of the Vermont 25x'25 Initiative progresses.

2.0 Renewable Energy Production Progress

Vermont made incremental progress in 2008 toward the goal of producing 25% of its renewable energy by 2025, increasing the percentage of the state's energy consumption derived from in-state renewable energy sources by 0.18% from 2007 levels.[1]

In 2007 we estimated that about 9.8 trillion British Thermal Units (BTUs) of energy was produced from Vermont's farm, forest, and selected statewide renewable energy sources. This was equal to 5.79% of Vermont's estimated energy load of 169 trillion BTUs of consumed in 2004 – the most recent data available at the time.

Several new renewable energy projects came online in Vermont during 2008. Collectively, these projects are capable of producing an estimated 42 billion BTUs – an increase of 0.43% in the amount of the state's energy derived from renewable energy sources from 2007 levels. At the same time, the state's total energy consumption fell about 3% – from 169 trillion BTUs to 164 trillion BTUs in 2006 (again, the most recent data available).[2] Taken together, the increase in renewable energy production and the drop in energy consumption brought the total percentage of the state's energy load met from in-state renewable sources to 5.97% in 2008.

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[1] In some cases, renewable energy credits (RECs) produced from Vermont-based renewable energy sources are sold outside of the state to help satisfy renewable energy production requirements elsewhere. This is the case for several manure digestion projects, as well as other electricity generating technologies. However, the Vermont 25x'25 considers in-state generation to include Vermont-based projects, regardless of where the resultant RECs are sold.

[2] U.S. Energy Information Administration, http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=VT#overview.

Figure 1 below illustrates Vermont's energy produced from in-state renewable sources in 2007 and 2008, as well as the projected growth of energy sectors and respective Vermont 25x'25 renewable energy production goals.

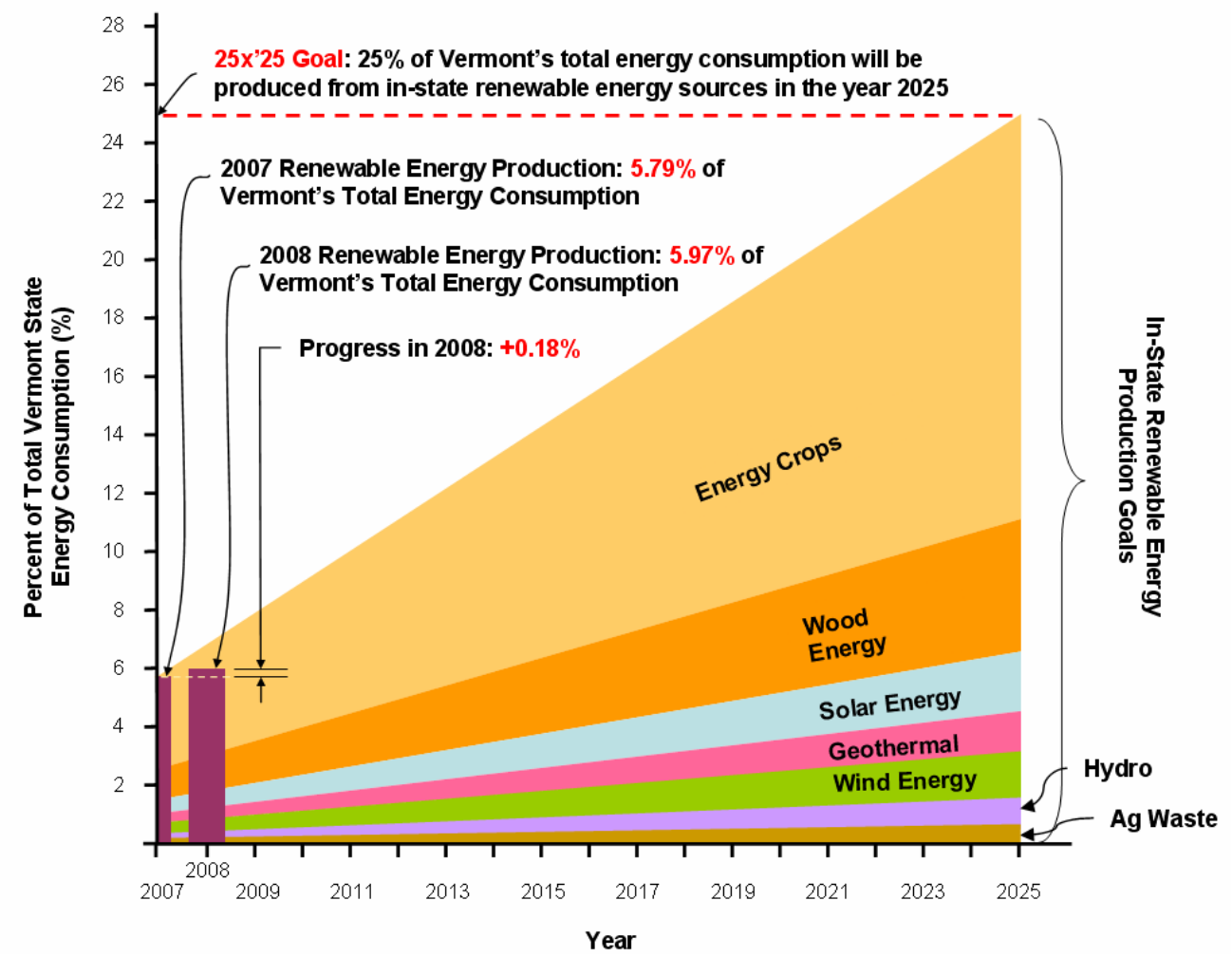

Figure 1 Current energy consumption and energy production goals from in-state renewable sources

As seen in Figure 1, the state made progress toward the Vermont 25x'25 goal during 2008, though not sufficient to meet the linear trajectory illustrated. Meeting that trajectory would require an increase in annual renewable energy production of approximately 1% each year until 2025. However, it should be noted that a linear progression toward the Vermont 25x'25 goal in the Initiative's early years is not necessarily expected; greater amounts of renewable energy are anticipated to come online in eventual years as fossil-based energy prices increase and environmental pressures continue to mount.

Figure 1 also illustrates zero growth in Vermont's total energy consumption between 2007 and 2025. This highlights the fact that energy conservation and energy efficiency are particularly important to meeting the Vermont 25x'25 goal. Achievement of this goal is premised on the assumption that efficiency and conservation measures – given sufficient technology, policy, regulatory, and economic support – can hold Vermont's total energy use in 2025 at or below present-day levels. While zero growth in state energy consumption may appear to be an

aggressive goal, it is in fact achievable *and* cost-effective, as illustrated in several recent studies described in Appendix C: *The Role of Energy Efficiency in Meeting Vermont 25x'25 Goals*. In fact, these studies indicate that negative load growth may be achievable given the appropriate conditions.

Vermont's Current and Projected Renewable Energy Production

Table 1 below identifies the various sectors, technologies, and feedstocks – as developed by the Vermont 25x'25 steering committee – as well as current energy production levels, change in energy production levels during 2008, and energy production goals for the year 2025. Data sources and calculations for values in Table 1 can be found in Appendix D and are based on the most recent data available.

According to the most recent U.S. Energy Information Administration data, Vermont used 164 trillion BTUs in 2006 to meet all of its residential, commercial, industrial, and transportation needs.[3] This is a decline from 169 trillion BTUs consumed in 2004. The primary difference between the two years was a 13% drop of the use of heating fuels – likely due to the fact that 2006 was a very mild winter, and 2004 was a relatively cold one. Heating degree days in Burlington for 2004 totaled 7,735. In 2006, this figure dropped by 13% to 6,717. Current percentages of energy production within each sector and technology in Table 1 are based on the 2006 value.

The Vermont 25x'25 Initiative's goal for energy efficiency is that efficiency technologies and practices will result in no net growth in Vermont's energy load by the year 2025. Thus, we assume that Vermont's total energy usage in 2025 will again total 164 trillion BTUs. Given this assumption, the Vermont 25x'25 Initiative anticipates that 26.48% (43.4 trillion BTUs) of Vermont's energy needs could technically be met from renewable energy sources, with 20.87% derived from farm and forest resources and 5.61% derived from statewide resources.

Table 1 Vermont's Current and Projected Energy Production from Renewable Energy Sources

Sector & Technology	Energy Type	Current Energy Production (Billion BTU)	Current Percentage of State Energy Load	Change during 2008 (Billion BTU)	Energy Production in 2025 (Billion BTU)	Percentage of State Energy Load in 2025
Energy Crops						
Algae-Based Biodiesel	Liquid	0	0	-	7,800.0	4.76%
Crop-Based Biodiesel	Liquid	Negligible	Negligible	-	520.0	0.32%
Grain Ethanol	Liquid	Negligible	Negligible	-	45.6	0.03%
Cellulosic Ethanol from Crops	Liquid	0	0	-	6,650.0	4.05%
Crop/Substrate Digestion	Heat, Electric	0	0	-	969.0	0.59%
Grass Pellets	Heat, Electric	Negligible	Negligible	-	3,240.0	1.99%
Sector Total			Negligible	-		**11.72%**
Agricultural Waste						
Manure Digestion	Electric	35.0	0.02%	6.0	444.0	0.27%
Manure Fuel Cell	Electric	0	0	-	135.0	0.08%
Sector Total		**35.0**	**0.02%**	**6.0**		**0.35%**

[3] U.S. Energy Information Administration, http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=VT#overview.

Sector & Technology	Energy Type	Current Energy Production (Billion BTU)	Current Percentage of State Energy Load	Change during 2008 (Billion BTU)	Energy Production in 2025 (Billion BTU)	Percentage of State Energy Load in 2025
Wood Energy[4]						
Firewood[5]	Heat	5,160.0	3.15%	-	5,800.0	3.54%
Wood Pellets	Heat, Electric	327.0	0.20%	-	1,550.0	0.95%
Wood Chips for Electric Only	Electric	1,200.0	0.73%	-	1,720.0	1.05%
Wood Chips for Heat	Heat	549.0	0.33%	29.0	707.0	0.43%
Cellulosic Ethanol from Wood	Liquid	0	0	-	1,600.0	0.98%
Wood in CHP Applications	Heat, Electric	760.0	0.46%	-	3,060.0	1.87%
Sector Total		**7,996.0**	**4.87%**	**29.0**		**8.80%**
Wind Energy						
Small- to Medium-Scale	Electric	3.5	Negligible	0.5	71.8	0.04%
Commercial-Scale	Electric	37.5	0.02%	-	2,080.0	1.27%
Sector Total		**41.0**	**0.02%**	**0.5**		**1.31%**
Solar Energy						
Photovoltaic	Electric	6.2	Negligible	2.1	1,080.0	0.66%
Solar Hot Water	Thermal	22.9	0.01%	4.4	1,850.0	1.13%
Sector Total		**29.1**	**0.01%**	**6.5**		**1.79%**
Hydroelectricity						
Large Hydro (in-state)	Electric	1,320.0	0.80%	-	1,320.0	0.80%
Small Hydro	Electric	396.0	0.24%	-	620.0	0.38%
Sector Total		**1,716.0**	**1.04%**	-		**1.18%**
Geothermal						
Ground Source Heat Pump	Heat, Electric	8.8	0.01%	-	2,180.0	1.33%
Sector Total		**8.8**	**0.01%**			**1.33%**
Sector & Technology Total		**9,825.9**	**5.97%**	**42.0**	**43,442.4**	**26.48%**

Table 2 below lists renewable energy projects that came online in the period between January 1, 2008 and December 31, 2008. For electric-generation projects greater than 15kW in rated capacity, "online" is defined as operational (i.e., not in testing mode) and producing useful power, heat, or liquid fuel. The 25x'25 Initiative defines "online" as (1) operational (i.e., not in testing mode) and producing useful power, heat, or liquid fuel; and/or (2) having received 2008 funding through one of Vermont's various incentive programs, such as the Vermont Clean Energy Development Fund, Vermont Small-Scale Renewable Energy Incentive Program, and those offered by Green Mountain Power and Central Vermont Public Service.

[4] A portion of the forest products used for energy in Vermont originates outside of the state (e.g., in New York, New Hampshire, and Canada). Vermont is also an exporter of forest products that are used for energy elsewhere. The Vermont 25x'25 considers in-state energy generation to include all wood used in the state, regardless of its origin. There are existing plans and efforts to increase in-state production of both wood pellets and wood chips.

[5] Firewood use data is sourced from the *Vermont Residential Fuel Wood Assessment*, 1997-1998. The survey and report are currently being updated.

Table 2 Vermont renewable energy projects brought online during 2008

Project Name	Location	Technology	System Capacity	Estimated Energy Production (Billion BTU/year)
Agricultural Waste				
Neighborhood Energy LLC	Coventry	Manure Digestion	200 kW	5.97
Wood Energy[6]				
Wood Chips for Heat	Bennington, Weathersfield, Harwood, Danville, Whitingham	Wood Chips for Heat	5,100 tons/year of green wood chips (5 systems)	29.0
Wind Energy				
Small-scale wind	Statewide	Small-Scale Wind	106.1 kW (25 systems)	0.49
Solar Energy				
Solar PV at National Life	Montpelier	Photovoltaic	72 kW	0.27
Solar PV at Farm-Way	Bradford	Photovoltaic	60.5 kW	0.26
Small-scale PV	Statewide	Photovoltaic	393 kW (109 systems)	1.57
Small-scale solar hot water	Statewide	Solar Hot Water	12.2 MBTU/day (166 systems)	4.46
Sector & Technology Total				**42.02**

Renewable Energy Technology Review and Case Studies

In establishing the Vermont 25x'25 Initiative's goals and resource assessments, we divided our analysis into two major categories: (1) a farm- and forest-specific category, which includes the sectors of *energy crops*, *agricultural waste*, and *wood energy*; and (2) a non-farm and forest-specific category, which includes *wind energy*, *solar energy*, *hydroelectricity*, *geothermal energy*, and *energy efficiency*. Resource assessments for the first category are limited strictly to energy that can be derived from resources inherent to Vermont's farms, forests, and working lands. Resource assessments for the second category consider energy that could be derived and/or conserved on a statewide level, including both farm and forest as well as non-farm and non-forest locations.

A. Farm- and Forest-Specific Renewable Energy Technologies

Following is a discussion of farm- and forest-specific renewable energy resources that is being developed to meet the Vermont 25x'25 goals, including energy crops, agricultural waste, and wood energy. Cumulatively, these sectors currently provide approximately 4.88% of Vermont's total energy needs. By 2025, these sectors together could provide roughly 20.87% of the state's energy needs, assuming (1) statewide energy efficiency strategies are exploited sufficiently to hold the state's energy usage in 2025 at or below present-day levels, and (2) the associated technical, regulatory, financing, and market challenges facing these sectors are adequately addressed.

[6] With a sharp rise in fossil-based energy prices, the consumption of firewood energy also likely increased in 2008. However, 2008 firewood energy consumption quantities were not available as of the publication this report. A detailed study of Vermont's current firewood energy consumption is due from the Vermont Department of Forests, Parks, and Recreation on April 1, 2009.

Energy Crops

Energy crops, also called "bioenergy crops," are fast-growing crops that are grown for the specific purpose of producing energy from all or part of the resulting plant. Depending on the specific feedstock, energy from crops can be converted to electricity, heat, and/or liquid fuels. Electricity is typically derived from crops either by (1) combusting crops and utilizing the resulting heat energy to power an electric generator or turbine, or (2) producing flammable gases by processing crops in a digesting system, and then burning the gases to power an electric generator or turbine. Heat energy is produced by combusting crops directly or processing crops into a pelletized form and combusting the pellets.

Case Study: Homegrown Biodiesel at State Line Farm

State Line Biofuels is Vermont's first on-farm facility making biodiesel from oilseed crops grown on-site. The Williamson family has owned State Line Farm in Shaftsbury since 1936. John and Betsey Williamson and their children produce maple and sorghum syrup, honey, and hay for local markets.

Since 2006, the farm has been at the center of an effort to develop a pilot scale, farm-based biodiesel and ethanol production system coupled with a set of oilseed crop (sunflower, canola, soybean) trials. Other farms participating in the project include Clear Brook Farm in Shaftsbury, and Borderview Farm in Alburgh. This work has been supported by the Vermont Sustainable Jobs Fund, the U.S. Department of Energy, Senator Patrick Leahy's office, the University of Vermont's Center for Sustainable Agriculture, and the High Meadows Foundation

So far, the farm has produced 2,450 gallons of biodiesel from crops grown on-site – and could ultimately produce 300,000 gallons of fuel annually using their existing equipment.

Photo Credits: Vermont Sustainable Jobs Fund

Liquid energy is generally derived from crops by producing oil-bearing seeds, then crushing the seeds to produce vegetable oils that can be further processed into fuels for vehicles and heating systems. Alternatively, oil may be derived by cultivating and crushing certain types of algae. Ethanol fuels are produced through a process of fermenting grains or potentially any cellulosic material. Work plan recommendations and priorities for developing the energy crop sector to the point where it can satisfy 11.72% of Vermont's energy needs in 2025 are provided in section 4 below.

Agricultural Waste

In addition to animal manure, agricultural wastes can include agricultural residues such as cornhusks, rice hulls, peanut shells, grass clippings, and leaves. Because Vermont has relatively low levels of these materials, the Vermont 25x'25 Initiative is limiting its analyses to energy that can be derived from livestock manure. Energy is typically derived from manure through an anaerobic digestion process in which flammable gases are produced and burned to power an electric generator or turbine. Use of livestock manure to produce electricity in an

electric fuel cell is an emerging technology also expected to hold promise for on-farm energy generation. Food and other agricultural wastes will be promising material for digestion, but not enough data has been gathered to develop reliable estimates of its potential.

Agricultural waste in the form of on-farm manure digestion is currently generating less than a tenth of a percent of Vermont's energy needs. However, there is potential for manure digestion and manure fuel cell technologies to produce more than a third of one percent of the State's energy load by 2025, assuming associated technical assistance, financing, permitting, and market challenges are adequately addressed. Work plan recommendations and priorities for developing the agricultural waste sector to the point where it can satisfy 0.35% of Vermont's energy needs in 2025 are provided in section 4 below.

Case Study: Power from Cows at the Maxwell Neighborhood Farm

The Maxwell Neighborhood Farm in Newport was started in 1957 by Maurice and Lois Maxwell. The farm has 850 milking cows and has won several farm management awards, including the 2003 Vermont Dairy Farm of the Year.

In 2008 – with support from the Clean Energy Development Fund, USDA, and CVPS's Cow Power™ program – the farm installed an anaerobic methane digester. The system operates by diverting manure waste from the existing lagoon (where it would otherwise release methane into the atmosphere) into a concrete digester. The resulting biogas fuels a generator that creates electricity that is then supplied to the grid.

The generator began producing electricity in early December, 2008 and is expected to produce about 1,750,000 kilowatt-hours annually. The Vermont Electric Cooperative purchases the electricity and CVPS purchases the renewable energy credits produced by the system.

In addition to renewable electricity, the system produces liquid effluent that is applied as a readily absorbed fertilizer on nearby fields, and solids are used as an ideal cow bedding material.

Photo Credits: Vermont Department of Public Service

Wood Energy

Vermont's forestlands account for about 75% of the state's land area, and constitute significant potential as an energy source. Wood from forests can be used in several forms, including as firewood in residential applications, as chips in electric generation and space heating, and as wood pellets in residential and commercial applications. In addition, technologies relating to the gasification of wood products are evolving, as are those that seek to develop liquid fuel from woody biomass.

Vermont has a long tradition of using wood for energy and wood is still the most widely used local, renewable source in the state, currently accounting for nearly 5% of Vermont's energy

needs.[7] Wood is used to generate electricity at in-state power facilities such as those in Burlington and Ryegate – as well as thermal energy in thousands of homes, businesses and institutional settings. Given Vermont's biomass resource, and assuming judicious use of that resource, the potential for meeting (and sustaining) a substantial portion of Vermont's energy needs from its forests by 2025 is significant.

Case Study: Biomass Heat and Power at Middlebury College

Committed to reducing its carbon footprint while controlling its energy costs, Middlebury College broke ground in 2007 on an $11 million biomass gasification plant. After the system comes online in early 2009, it will provide about 50% of the school's heating and cooling needs via the campus district energy system. Steam from the boiler will help fuel the college's cogeneration system, producing roughly 20% of the campus's electricity requirements.

As a test project to determine if it can grow enough biomass to meet up to half of its system's needs, the college is cultivating ten acres of fast-growing willow shrubs on nearby fallow farmland.

With or without the willow, the project will:

- Reduce the college's greenhouse gas emissions by 40%
- Benefit the local economy – especially the forest-products and farming sectors
- Serve as a learning and demonstration lab for biomass gasification technology in action

Photo Credits: Biomass Energy Resource Center, www.vinostory.com

In 2025, 1.5 million green tons of sustainably harvested forest products in the form of chunk wood, chips, and pellets could be made available from Vermont's forests for energy and other uses – in addition to the approximately 1.5 million tons that are currently being harvested.[8] Assuming 500,000 tons of the additional harvest is dedicated to the production of cellulosic ethanol and 1,000,000 tons is dedicated to the production of electric and thermal energy (with a strong preference for combined-heat-and-power technologies), wood energy could constitute nearly nine percent of Vermont's energy needs in 2025.[9] Work plan recommendations and priorities for developing the wood energy sector to the point where it can satisfy 8.80% of Vermont's energy needs in 2025 are provided in section 4 below.

[7] 2008 wood energy consumption quantities were not available as of the publication of this report. A detailed study of Vermont's firewood consumption is due from the Vermont Department of Forests, Parks, and Recreation on April 1, 2009.
[8] Personal communication with Paul Frederick, Vermont Division of Forestry, Dec. 2007.
[9] Assuming a green-wood moisture content of 50%.

B. Statewide Renewable Energy Technologies

This section includes a discussion of renewable energy and energy efficiency resources that must be tapped to meet the Vermont 25x'25 goal, including wind energy, solar energy, hydroelectricity, geothermal energy, and energy efficiency. While most of these sectors and their associated technologies may feature farm and forest applications (e.g., wind energy can be well-suited to farms), we do not limit our resource assessment strictly to these locations but rather consider resources available on a statewide level.

Cumulatively, these sectors currently provide 1.08% of Vermont's total energy needs. By 2025, these sectors together could provide roughly 5.61% of the state's energy needs, assuming (1) statewide energy efficiency opportunities are exploited sufficiently to hold the state's energy usage at or below present-day levels, and (2) the associated technical, regulatory, financing, and market challenges are adequately addressed.

Wind Energy

Wind energy is the conversion of wind energy into a useful form, such as electricity, using wind turbines. Most modern wind power is generated in the form of electricity by converting the rotation of turbine blades into electrical current by means of an electrical generator. Wind energy is used in large-scale wind farms for national electrical grids as well as in small individual turbines for providing electricity to rural residences, businesses, or grid-isolated locations.[10]

Vermont has extensive experience with wind energy at all scales and was the location of the world's first large-scale electricity-producing windmill at Grandpa's Knob on the border of Castleton and West Rutland in 1941. Vermont is also home to one of the first modern commercial wind farms east of the Mississippi – and the largest wind installation when it was completed in 1997 – as well as numerous medium and small-scales turbines powering farms, businesses, and homes. As of January 1, 2008, 92 net-metered small- to medium-scale wind systems had been granted Certificates of Public Good, according to the Department of Public Service. 2008 saw the construction of 25 additional systems, bringing the total installed capacity of small- to medium-scale wind systems in Vermont to approximately 795 kW.

Approximately 0.02% of Vermont energy needs are currently generated from wind resources. The Vermont 25x'25 goal for this sector is that in-state wind energy at all scales will satisfy 10% of the state's current electricity usage, including 12 MW of installed small- to medium-scale wind turbines on farms. These goals translate into wind energy meeting 1.31% of Vermont's energy needs by 2025, given the appropriate technology, policy, regulatory, and financing support.

Work plan recommendations and priorities for developing the wind energy sector to the point where it can satisfy 1.31% of Vermont's energy needs in 2025 are provided in section 4 below.

[10] http://en.wikipedia.org/wiki/Wind_power

Solar Energy

Solar energy is defined as any of several technologies used for deriving useful energy from the sun's light. Solar energy can be used for many applications, including space heating, water heating, pool heating, drying applications, and electric generation by solar photovoltaic (PV) technologies.

Case Study: Going Solar at National Life Group

Gov. Jim Douglas and National Life CEO Thomas H. MacLeay stood together in November of 2008 in a rooftop ceremony to commission the company's new solar photovoltaic system and to praise the public-private financial partnership that made the project possible.

A $200,000 Clean Energy Development Fund grant helped finance the $500,000, 73 kW system. MacLeay said the combination of the state grant, federal and state tax credits, and a solar incentive program from Green Mountain Power Company (GMP) all made the project feasible. The SolarGMP program, which works with existing "net-metering" programs, pays customers for all solar energy generated at a rate of six cents per kWh above and beyond any net-metering payments.

The system is expected to produce about 10% of National Life's electrical needs – or about 75,000 kilowatt-hours a year – enough to power 10 to 15 typical Vermont homes.

NATIONAL LIFE GROUP®

Photo Credits: Solar Daily, National Life Group, Barre-Montpelier Times Argus

As of January 1, 2008, 304 solar PV net-metered systems with a cumulative rated capacity of 923 kW had been granted certificates of Public Good, according to the Department of Public Service. In 2008, an additional 109 PV systems were installed, bringing the total grid-connected installed capacity to 1,316 kW. According to the Vermont Council on Rural Development's *Vermont Energy Digest*, Vermont also had about 300 PV systems not connected to the electricity grid, as well as approximately 500 solar water heater systems as of April 2007.[11] 2008 saw the addition of 166 additional solar hot water systems funded by the Vermont Small-Scale Renewable Energy Incentive Program.

Approximately 0.01% of Vermont's energy needs are currently generated from solar PV and solar hot water resources. The Vermont 25x'25 Initiative's goals for this technology are that in-state solar PV and solar hot water resources will satisfy 5% of the state's current electric use and 10% of the energy needed for providing hot water. These goals translate into solar energy meeting 1.79% of Vermont's energy needs by 2025, given the appropriate technology, policy, regulatory, and financing support. Work plan recommendations and priorities for developing the

[11] *The Vermont Energy Digest*, Vermont Council on Rural Development, April 2007, p. 48.

solar energy sector to the point where it can satisfy 1.79% of Vermont's energy needs in 2025 are provided in section 4 below.

Hydroelectricity

Hydroelectric energy is a technology by which the kinetic energy from flowing water is converted to electricity via a turbine or generator. In large hydroelectric operations, water is dammed (or impounded) on one side of the generator and flow through the generator is closely controlled. Small-scale hydroelectric systems – typically, smaller than 10 MW – generally utilize a run-of-the-river design in which no water is impounded and electricity is generated as water flows through the facility.

Vermont currently produces approximately 500,000 MWh – or about 1% of its energy needs – from in-state hydroelectric facilities. The opportunities for the construction of new large (10MW or greater in capacity) hydroelectric facilities are minimal due to the fact that Vermont's waterways are largely utilized for facilities of this scale. However, as of 2005, Vermont had 138 MW of small, in-state hydroelectric capacity and may have potential for up to 15 MW – at both on-farm and non-farm locations – of additional capacity, when environmental and economic factors are considered.[12] As with other energy sources, the environmental impacts (including water quality issues) associated with the deployment of hydroelectricity facilities must be considered and addressed in a detailed environmental impact assessment of any potential system sites.

The Vermont 25x'25 Initiative's goal for this technology is that 15 MW of additional in-state hydroelectric resources – mainly in the form of small hydro system and existing facility system upgrades – be installed by 2025. When combined with existing resources, this amount of installed capacity will satisfy 1.18% of Vermont's energy needs by 2025, given the appropriate technology, policy, regulatory, and financing support. Work plan recommendations and priorities for developing the hydroelectricity sector to the point where it can satisfy 1.18% of Vermont's energy needs in 2025 are provided in section 4 below.

Geothermal Energy

Geothermal energy utilizes the heat from the earth to provide energy for space heating or electricity generation. In some areas of the country, high-temperature underground reservoirs are used to produce electricity via a generator. In Vermont, which lacks near-surface high-temperature water, the most applicable geothermal technology uses a process in which the relative stable temperature of the ground below frost line is used to provide (or supplement) residential space heating and cooling, and on-farm refrigeration, ventilation, heating and cooling. Known as geothermal heat pumps or ground source heat pumps (GSHPs), this technology is well-established, having been in used in Vermont and elsewhere for more than 60 years.

According to the *Vermont Energy Digest*, GSHPs can be used virtually anywhere in Vermont. Currently, there are an estimated 200 residential GSHPs in operation in the state and a small

[12] Ibid, p. 52.

number of commercial systems in Vermont.[13] Also, a number of Vermont dairy farms are using geothermal technologies to supplement their refrigeration systems. Currently installed systems provide about 0.01% of the state's total energy needs, assuming that GSHPs can reduce by 50% a residential home's overall energy use needed for space heating, water heating, and air-conditioning energy requirements.[14]

The Vermont 25x'25 Initiative's goal for this technology is that in-state geothermal energy will reduce statewide fossil fuel used in space and hot water heating by 5% by the year 2025. When combined with existing resources, this amount of installed capacity will satisfy 1.33% of Vermont's energy needs by 2025, given the appropriate technology, policy, regulatory, and financing support. Work plan recommendations and priorities for developing the geothermal energy sector to the point where it can satisfy 1.33% of Vermont's energy needs in 2025 are provided in section 4 below.

Energy Efficiency

The term "energy efficiency" relates to a reduction in the amount of energy consumed by an end-user. Efficiency measures can occur through behavioral changes, efficient technologies, building retrofits, and other strategies. Inasmuch as energy efficiency reduces the need to create new generation capacity, it is an energy resource, and a very cost-effective one at that. On the wholesale level, the implementation of energy efficiency technologies can cost less than 75% of the cost of purchasing newly generated energy. Energy efficiency is applicable to electrical energy, thermal applications, and transportation fuels.

Vermont has long been a leader in the electrical efficiency sector, thanks in large part to the creation of the Vermont's Energy Efficiency Utility, *Efficiency Vermont*. In 2007, Vermont's efficiency savings were approximately 1.8% of what electricity sales would have been without efficiency, offsetting electric energy load growth despite an increase in the number of electric customers. The Vermont Department of Public Service estimated that without the savings attributed to Efficiency Vermont, electric supply would have grown at an average rate of 1.4%.[15]

The potential for further electrical savings is significant: A recent study from the Vermont Department of Public Service estimated that economically achievable electrical savings could be as high as 19% of electricity sales in 2015.[16] Vermont farmers were the first group to utilize energy efficiency programs with a pilot study conducted by the Vermont Agency of Agriculture and UVM Extension, then with the utilities, and now with Efficiency Vermont. The dairy farms have been through at least two rounds of efficiency improvements, with more to come as efficiency technologies and practices improve.

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[13] Ibid, p. 55. (VCRD source: Orio, Matt, of Water Energy Distributors. Personal communication, March 2007.) 2008 figures were unavailable.
[14] Ibid, p. 54.
[15] *Efficiency Vermont 2007, Preliminary Executive Summary, 2007.*
[16] *Vermont Electric Energy Efficiency Potential Study: Final Report*, Vermont Department of Public Service, January 2007, p. 1.

Vermont also has substantial potential to save energy in the thermal and transportation sectors. A recent study commissioned by the Vermont Department of Public Service found that there is significant cost-effective potential to reduce the use of heating oil, propane, kerosene, and wood through energy efficiency measures.[17] Transportation, while harder to quantify, constitutes Vermont's largest use of energy and features significant potential for efficiency measures. Transportation efficiency strategies may include the increased use of mass transportation, carpooling initiatives, speed limit reductions, the use of alternative fuels and vehicle technologies, and the increase in federal efficiency standards for vehicles.

The Vermont 25x'25 Initiative's goal for this sector is that implementation of in-state energy efficiency policies and practices will keep Vermont's total energy use in 2025 at or below present-day levels, given the appropriate technology, policy, regulatory, and financing support. Work plan recommendations and priorities for developing the energy efficiency sector to the point where it can maintain energy consumption in 2025 to present-day levels are provided in section 4 below.

3.0 Policy, Structural, and Programmatic Progress

In addition to an increase in renewable energy production, significant policy, structural, and programmatic progress was also made toward the Vermont 25x'25 goal in 2008. Highlights include:

- **Regional Greenhouse Gas Initiative**. Two auctions for greenhouse gas emission allowances for electric power plants located in 10 Northeastern states were conducted in 2008. Vermont reaped more than $1.3 million from these auctions – funds that are expected to be used for state energy efficiency programs.
- **The Renewable Energy Atlas of Vermont**. Led by the Vermont Sustainable Jobs Fund (VSJF), this will be a geographic information system (GIS)-based website that will educate Vermonters about the renewable energy resources and opportunities in their communities. Working with the Vermont Center for Geographic Information, Green Mountain Power, USDA Natural Resources Conservation Service, and Vermont's 25x'25 Initiative, VSJF is currently assembling solar, wind, small hydro, woody biomass, biofuels (biodiesel and grass pellets), biodigester (methane and waste-to-energy), and geothermal data layers for the entire state. Once completed, Vermonters will be able to visit the Renewable Energy Atlas of Vermont website, click on their town, county, or group of towns, select an energy resource, and see a map and analysis of what's possible in their region based on currently available data and methods. The project will be completed in 2009 and is being funded, in part, by a U.S. Department of Energy congressionally directed award through the Office of U.S. Senator Patrick Leahy.
- **State Legislation**. This past year saw the passage of Act 92 into law, which establishes goals for in-state energy production, requirements for smart metering, a fuel efficiency fund and a program for non-regulated fuels, as well as further expansion of the net metering program that includes micro-combined heat and power units, mandates for utilities to offer renewable energy pricing programs, and revisions to the *Sustainably Priced Energy for Economic Development* (SPEED) program. The law also mandates that a Vermont Comprehensive Energy Plan be completed by January 15, 2009, and that the Vermont Department of Public Service report on the merits of a public power authority.

[17] *Vermont Energy Efficiency Potential Study for Oil, Propane, Kerosene, and Wood Fuels: Final Report*, Vermont Department of Public Service, January 2007, p. 1.

- **REAP Grant Program**. The Vermont Agency of Agriculture's *Renewable Energy for Agriculture Program* (REAP) continues to provide grants to farmers and/or businesses working with farmers to help plan and implement renewable energy technologies on Vermont's farms.
- **Clean Energy Development Fund**. The Clean Energy Development Fund was signed into law in 2005 to promote the development and deployment of cost-effective and environmentally sustainable electric power resources for the long-term benefit of Vermont electric customers. Since 2007, it has awarded over $12 million to renewable energy projects in Vermont, including:
    - *Small-Scale Renewable Energy Incentive Program*: $2,700,000 granted, resulting in 79 wind systems, 344 solar PV systems, and 297 solar hot water systems.
    - *Large-Scale Grants Program*: $7,000,000 granted, resulting in 20 feasibility studies completed, 14 farm-methane-related projects, 7 combined-heat-and-power (CHP) systems, 12 solar photovoltaic systems, five small hydroelectric systems, and one wind system.
    - *Loan Program*: $1,450,000 loaned toward one CHP system and one farm methane digester project.
    - *Municipal Technical Assistance Program*: $17,693 granted to conduct pre-feasibility studies and construction of renewable energy systems.

4.0 Vermont 25x'25 2009 Legislative Recommendations & Work Plan Priorities

The Vermont 25x'25 Steering Committee developed findings on two fronts during 2008: (1) recommendations for consideration by the Vermont State Legislature and other state policymakers; and (2) a series of sector-specific 2009 work plan priorities designed to guide the efforts of the Initiative's members and stakeholders in the coming months and years.

Key Legislative Recommendations for 2009

The Vermont 25x'25 Initiative Steering Committee strongly recommends legislative action on the following items during 2009:

1. **Workers' Compensation**. Address the disproportionately high worker compensation rates for the logging and agricultural sectors in Vermont. This is a major issue for logging contractors and directly affects capacity to harvest forest biomass.
2. **Land Inheritance Taxation**: Reduce the tax barriers to passing land ownership from one generation to the next without creating pressure to subdivide land.
3. **25x25' Initiative Funding**. Identify funding that will allow the Vermont 25x'25 Initiative to develop year-round monitoring capacity that will enable the tracking and reporting of in-state renewable energy production, policy developments, programmatic progress, and other Initiative-related developments during the course of each year of the Initiative.

Key Vermont 25x'25 Work Plan Priorities for 2009

At the outset of 2008, the Vermont 25x'25 Initiative Steering Committee established subcommittees charged with developing specific 2009 work plan priorities deemed crucial to (1) furthering the objectives of the Vermont 25x'25 Initiative, (2) defining an actionable work plan for upcoming months and years, and (3) achieving the Initiative's ultimate goal of producing 25% of Vermont's energy needs from renewable energy sources by 2025. These finding are intended to guide the efforts of not only the Vermont 25x'25 Steering Committee and subcommittees, but also of legislators, the state agriculture and energy communities, interested state organizations, businesses, and other Initiative stakeholders.

Subcommittees were formed to address the following areas: *Cross-cutting Issues*, *Financing Issues*, *Permitting Issues*, *Technical Assistance*, *Innovation in Technology*, and *Market Forces*. The highest work plan priorities are provided below and a comprehensive list of work plan priorities are outlined in Appendix A.

1 Cross-Cutting Issues

Cross-cutting issues are intended to address the efficacy and efficiency of the Vermont 25x'25 Initiative itself. These work plan priorities have been developed by the entire Vermont 25x'25 Steering Committee and are provided in Table 3 below.

Table 3 Cross-Cutting Issues Subcommittee 2009 Work Plan Priorities

Work Plan Priority 1.1: **Develop Vermont 25x'25 Monitoring Capacity**. Develop Vermont 25x'25 Initiative monitoring capacity with staff and/or consultants charged with tracking and reporting renewable energy production, policy movement, programmatic progress, and other Initiative-related developments during the course of each year of the Initiative.				
Applicable Sectors/Technologies	***Execution Timeframe***	***Legislative Action***	***Funding Needed***	***Organizational Partners***
All	Ongoing	Funding	$50,000 in year one, $20,000 ongoing	Vermont 25x'25 Steering Committee
Work Plan Priority 1.2: **Complete *Renewable Energy Atlas of Vermont***. This resource will indicate where renewable energy resources exist at town and county levels; will include specific information on different technologies and resource links; GIS-based; interactive website will be developed.				
Applicable Sectors/Technologies	***Execution Timeframe***	***Legislative Action***	***Funding Needed***	***Organizational Partners***
All	End of 2009	None	$50,000	Vermont Agency of Agriculture; Vermont Center for Geographic Information; Vermont Sustainable Jobs Fund

2 Financing Issues

The charge of the Financing Issues subcommittee was to investigate and recommend solutions to the financing hurdles that may hinder current and future growth in the energy sector as the state significantly increases local energy production. Work plan priorities for 2009 are provided in Table 4 below.

Table 4 Financing Issues Subcommittee 2009 Work Plan Priorities

Work Plan Priority 2.1: **Develop pool of potential lenders by providing guidance on renewable energy proposals**. For example, such guidance could make independent technical review available to potential lenders; provide examples of potentially unfamiliar business structures (e.g., farms including energy production in their business models); develop a sample financial benchmarking system for assessing the strength of proposed projects; and, in the case of municipal developers, provide economic feasibility study funding.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All	2010	None	Yes	Renewable Energy Vermont; Vermont Agency of Agriculture; Vermont Department of Public Service; Vermont Economic Development Authority; Vermont Energy Investment Corporation; Vermont Sustainable Jobs Fund; U.S. Department of Agriculture

Work Plan Priority 2.2: **Support initiatives to find and leverage future sources of funding for the Clean Energy Development Fund (CEDF)** beyond January 2012 and ensure existing funds for the program remain available.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All electricity-generating renewable energy sources	2012	Commit future revenue streams to CEDF	$6 million per year to maintain current programs	Renewable Energy Vermont; Vermont Department of Public Service; Vermont Energy Investment Corporation

Work Plan Priority 2.3: **Support initiatives to find and leverage additional ongoing sources of funding for non-electric generation-type renewables**, **including biofuels**. As part of this effort, support existing and emerging partnerships between federal and state organizations.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All non-electricity-generating renewable energy sources	Short-term	Source revenue streams to fund this initiative	$3-$6 million per year	Biomass Energy Resource Center; Renewable Energy Vermont; Vermont Agency of Agriculture; Vermont Department of Public Service; Vermont Energy Investment Corporation; Vermont Sustainable Jobs Fund

Work Plan Priority 2.4: **Encourage the review, monitoring, and monetization of renewable attributes** (i.e., carbon offsets, renewable energy credits) associated with renewable energy production

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All	Short-term	None	Yes, for additional staffing necessary to fill this role (plus authorization for staffing if it is to be housed in government).	Renewable Energy Vermont; Vermont Agency of Agriculture; Vermont Department of Public Service; Vermont Department of Forests, Parks & Recreation; Vermont Energy Investment Corporation; Vermont Sustainable Jobs Fund

3 Permitting Issues

The charge of the Permitting Issues subcommittee was to investigate the permitting requirements for various renewable energy technologies, to make recommendations related to permitting that assure safeguards are in place to protect the public, and to develop permitting processes that are streamlined, predictable, and practical. Work plan priorities for 2009 are provided in Table 5 below.

Table 5 Permitting Issues Subcommittee 2009 Work Plan Priorities

Work plan priority 3.1: **Create a web-based regulatory and procedural guidance toolbox**. Objectives of the toolbox will be to guide potential renewable energy project developers, stakeholders, and related permitting agencies through the regulatory process, improve communications, and provide a mechanism for feedback to help overcome regulatory barriers. Key elements of the toolbox will include:

- Clearly defined regulatory requirements for project developers
- Flow charts for major permitting processes with key decision points
- Comprehensive permitting information, with existing statutory authority, rules, regulations, procedures, and necessary forms.
- Joint renewable energy project "pre-feasibility assessments" developed by all interested permitting agencies and departments
- Glossary of terms that defines and standardizes project-related language (i.e. "agriculture" and "energy production")
- Compilation of all existing laws, rules, policies and guidance documents related to renewable energy
- Consistent approach across state government with regard to application of standards that may change as the project progresses

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All	Medium-term	None	$25,000	Natural Resources Board, Renewable Energy Vermont; Vermont Agency of Administration, Vermont Agency of Agriculture; Vermont Agency of Natural Resources; Vermont Department of Public Service; Vermont Sustainable Jobs Fund

Work plan priority 3.2: **Create a renewable energy ombudsman position**. Create a renewable energy ombudsman position, the role of which will be to:

- Improve communications between business, government and citizens in relation to project proposals and their regulatory requirements
- Harmonize renewable energy project regulatory implementation across state government
- Establish formal protocols between state agencies and departments so that there is transparency to developers and stakeholders in how the regulators communicate amongst themselves
- Establish a web-based, self-service portal that provides checklists that can be used to "do homework" on regulatory requirements

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*

All	Medium-term	None	$75,000	Natural Resources Board, Renewable Energy Vermont; Vermont Agency of Administration, Vermont Agency of Agriculture; Vermont Agency of Natural Resources; Vermont Department of Public Service; Vermont Sustainable Jobs Fund

Work plan priority 3.3: **Create benefit balance strategies**. The permitting subcommittee will investigate the creation of strategies to improve the ability of regulators to balance the societal benefits of renewable energy projects against societal costs such as environmental impact, rate impact, etc. Strategies should be developed in workshops of stakeholders and can include targeted legislative changes; evaluation and quantification of environmental benefits of renewable energy generation; accounting for carbon impact; and societal cost/benefit analysis.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All	Medium-term	None	None	Natural Resources Board, Renewable Energy Vermont; Vermont Agency of Administration, Vermont Agency of Agriculture; Vermont Agency of Natural Resources; Vermont Department of Public Service; Vermont Sustainable Jobs Fund

4 Technical Assistance

The charge of the Technical Assistance subcommittee was to identify the existing technical assistance network and to make recommendations on what improvements are needed to assure that entities that wish to produce renewable energy have the technical assistance they require Work plan priorities for 2009 are provided in Table 6 below.

Table 6 Technical Assistance Issues Subcommittee 2009 Work Plan Priorities

Work Plan Priority 4.1: Draft an oilseed crop production "best practices" handbook.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
Oilseed energy crops	End of 2009	None	$25,000	UVM Extension; Vermont Agency of Agriculture; Vermont Sustainable Jobs Fund

Work Plan Priority 4.2: Conduct workshops for farmers interested in growing oilseed crops. Specific topics may include: growing, harvesting, drying, storing oilseeds; using straight vegetable oil in tractors; value-added culinary oil opportunities; use of meal in livestock rations; and grant writing support to access public funds.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
Oilseed energy crops	End of February, 2009	None	None	UVM Extension; Vermont Agency of Agriculture; Vermont Sustainable Jobs Fund

Work Plan Priority 4.3: **Update, expand, and revise the Biomass Energy Resource Center's Wood Supply Model** to incorporate up-to-date resource inventory data and include additional supply and demand analysis and econometric capabilities.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*

Wood energy	End of 2009 and every five years thereafter	None	$50,000	Biomass Energy Resource Center; Vermont Department of Forests, Parks & Recreation

5 Innovation in Technology

The charge of the Innovation in Technology subcommittee was to identify emerging technologies that will make sense at a Vermont scale and determine the most appropriate way to integrate those technologies into use in Vermont. Work plan priorities for 2009 are provided in Table 7 below.

Table 7 Innovation in Technology Subcommittee 2009 Work Plan Priorities

Work Plan Priority 5.1: Support the many efforts underway to develop small-to-medium manure digesters that are scaled for farms with fewer than 500 cows.				
Applicable Sectors/Technologies	***Execution Timeframe***	***Legislative Action***	***Funding Needed***	***Organizational Partners***
Agricultural waste, manure digestion	2010	None	None	U.S. Department of Agriculture; Vermont Agency of Agriculture; Vermont Department of Public Service
Work Plan Priority 5.2: Support the continued development of its algae-based biodiesel projects due to their benefits to nutrient management and energy production.				
Applicable Sectors/Technologies	***Execution Timeframe***	***Legislative Action***	***Funding Needed***	***Organizational Partners***
Energy crops, algae-based biodiesel	2010	None	None	U.S. Department of Agriculture; Vermont Agency of Agriculture; Vermont Department of Public Service
Work Plan Priority 5.3: Encourage a cellulosic ethanol production feasibility analysis.				
Applicable Sectors/Technologies	***Execution Timeframe***	***Legislative Action***	***Funding Needed***	***Organizational Partners***
Energy crops, cellulosic ethanol	2012	None	None	Vermont Agency of Agriculture; Vermont Department of Forests, Parks & Recreation

6 Market Forces

The charge of the Market Forces subcommittee was to identify new market opportunities and improvements that will enhance renewable energy technology, as well as to identify and make recommendations for improvement of market forces that are unnecessarily impeding the swift adoption of renewable technologies. Work plan priorities for 2009 are provided in Table 8 below.

Table 8 Market Forces Subcommittee 2009 Work Plan Priorities

Work Plan Priority 6.1: Monitor the revision of the *Sustainable Priced Energy Enterprise Development* (SPEED) program rules.				
Applicable Sectors/Technologies	***Execution Timeframe***	***Legislative Action***	***Funding Needed***	***Organizational Partners***
All electricity generating renewable energy sources	Short-term	None	None	Renewable Energy Vermont; Vermont Businesses for Social Responsibility

Work Plan Priority 6.2: **Assess the Use Value Appraisal (UVA) Program** to determine the potential benefits and impacts of broader enrollment. The question of whether the program is Vermont's most effective means to promote forest management on private lands – and for providing the raw material for biomass energy projects – should be addressed. The possibility exists that rule changes could expand the number of enrolled acres, but with that expansion would come potentially significant administrative burdens.				
Applicable Sectors/Technologies	***Execution Timeframe***	***Legislative Action***	***Funding Needed***	***Organizational Partners***
All farm- and forest-based feedstocks (e.g., energy crops, wood energy)	Ongoing	None	None	Forestry Roundtable as convened by Vermont Natural Resources Council; Vermont Current Use Tax Coalition; Vermont Department of Forests, Parks & Recreation; Vermont Department of Taxes; Vermont Forest Products Association

5.0 Conclusion

This second report of the Vermont 25x'25 Initiative is the most recent effort to articulate the nature of the Initiative's goals, progress, and plans. Immediate next steps for Initiative stakeholders are presented in the work plan priorities above, and function as our collective "marching orders" for 2009 and beyond.

In addition to the considerable progress and excitement that the Initiative has engendered thus far, the 25x'25 Steering Committee anticipates that its work will be further supported in 2009 at the state and federal levels by the increased attention being given to the role of renewable energy and agricultural issues in fostering a green economy. As such, the Steering Committee enthusiastically restates its commitment to the 25x'25 goal, and will spend 2009 tracking progress, gathering stories, coordinating efforts, fostering partnerships, and engaging stakeholders and a broader Vermont audience in an overarching effort to catalyze renewable energy development, invigorate Vermont's agricultural economy, and secure the future of a state and place of immeasurable worth.

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APPENDIX A – Comprehensive Vermont 25x'25 Subcommittee Work Plan Priorities

1 Cross-Cutting Issues

Work Plan Priority 1.1: **Vermont 25x'25 Monitoring Capacity**. Develop Vermont 25x'25 Initiative monitoring capacity with staff and/or consultants charged with tracking and reporting renewable energy production, policy movement, programmatic progress, and other Initiative-related developments during the course of each year of the Initiative.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All	Ongoing	Funding	$50,000 in year one, $20,000 ongoing	Vermont 25x'25 Steering Committee

Work Plan Priority 1.2: **Complete *Renewable Energy Atlas of Vermont***. This resource will indicate where renewable energy resources exist at town and county levels; will include specific information on different technologies and resource links; GIS-based; interactive website will be developed.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All	End of 2009	None	$50,000	Vermont Agency of Agriculture; Vermont Center for Geographic Information; Vermont Sustainable Jobs Fund

2 Financing Issues Subcommittee

Work Plan Priority 2.1: **Develop pool of potential lenders by providing guidance on renewable energy proposals**. For example, such guidance could make independent technical review available to potential lenders; provide examples of potentially unfamiliar business structures (e.g., farms including energy production in their business models); develop a sample financial benchmarking system for assessing the strength of proposed projects; and, in the case of municipal developers, provide economic feasibility study funding.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All	2010	None	Yes	Renewable Energy Vermont; Vermont Agency of Agriculture; Vermont Department of Public Service; Vermont Economic Development Authority; Vermont Energy Investment Corporation; Vermont Sustainable Jobs Fund; U.S. Department of Agriculture

Work Plan Priority 2.2: **Support initiatives to find and leverage future sources of funding for the Clean Energy Development Fund (CEDF)** beyond January 2012 and ensure existing funds for the program remain available.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All electricity-generating renewable energy sources	2012	Commit future revenue streams to CEDF	$6 million per year to maintain current programs	Renewable Energy Vermont; Vermont Department of Public Service; Vermont Energy Investment Corporation

Work Plan Priority 2.3: **Support initiatives to find and leverage additional ongoing sources of funding for non-electric generation-type renewables**, including biofuels. As part of this effort, support existing and emerging partnerships between federal and state organizations.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All non-electricity generating renewable energy sources	Short-term	Source revenue streams to fund this initiative	$3-$6 million per year	Biomass Energy Resource Center; Renewable Energy Vermont; Vermont Agency of Agriculture; Vermont Department of Public Service; Vermont Energy Investment Corporation; Vermont Sustainable Jobs Fund

Work Plan Priority 2.4: **Encourage the review, monitoring, and monetization of renewable attributes** (i.e., carbon offsets, renewable energy credits) associated with renewable energy production

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All	Short-term	None	Yes, for additional staffing necessary to fill this role (plus authorization for staffing if it is to be housed in government).	Renewable Energy Vermont; Vermont Agency of Agriculture; Vermont Department of Public Service; Vermont Department of Forests, Parks & Recreation; Vermont Energy Investment Corporation; Vermont Sustainable Jobs Fund

3 Permitting Issues Subcommittee

Work plan priority 3.1: **Create a Web-based Regulatory and Procedural Guidance Toolbox**. Objectives of the toolbox will be to guide potential renewable energy project developers, stakeholders, and related permitting agencies through the regulatory process, improve communications, and provide a mechanism for feedback to help overcome regulatory barriers. Key elements of the toolbox will include:

- Clearly defined regulatory requirements for project developers
- Flow charts for major permitting processes with key decision points
- Comprehensive permitting information, with existing statutory authority, rules, regulations, procedures, and necessary forms.
- Joint renewable energy project "pre-feasibility assessments" developed by all interested permitting agencies and departments
- Glossary of terms that defines and standardizes project-related language (i.e. "agriculture" and "energy production")
- Compilation of all existing laws, rules, policies and guidance documents related to renewable energy
- Consistent approach across state government with regard to application of standards that may change as the project progresses

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All	Medium-term	None	$25,000	Natural Resources Board, Renewable Energy Vermont; Vermont Agency of Administration, Vermont Agency of Agriculture; Vermont Agency of Natural Resources; Vermont Department of Public Service; Vermont Sustainable Jobs Fund

Work plan priority 3.2: **Create Renewable Energy Ombudsman Position**. Create a renewable energy ombudsman position, the role of which will be to:

- Improve communications between business, government and citizens in relation to project proposals and their regulatory requirements
- Harmonize renewable energy project regulatory implementation across state government
- Establish formal protocols between state agencies and departments so that there is transparency to developers and stakeholders in how the regulators communicate amongst themselves
- Establish a web-based, self-service portal that provides checklists that can be used to "do homework" on regulatory requirements

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All	Medium-term	None	$75,000	Natural Resources Board, Renewable Energy Vermont; Vermont Agency of Administration, Vermont Agency of Agriculture; Vermont Agency of Natural Resources; Vermont Department of Public Service; Vermont Sustainable Jobs Fund

Work plan priority 3.3: **Create benefit balance strategies**. The permitting subcommittee will investigate the creation of strategies to improve the ability of regulators to balance the societal benefits of renewable energy projects against societal costs such as environmental impact, rate impact, etc. Strategies should be developed in workshops of stakeholders and can include targeted legislative changes; evaluation and quantification of environmental benefits of renewable energy generation; accounting for carbon impact; and societal cost/benefit analysis.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
All	Medium-term	None	None	Natural Resources Board, Renewable Energy Vermont; Vermont Agency of Administration, Vermont Agency of Agriculture; Vermont Agency of Natural Resources; Vermont Department of Public Service; Vermont Sustainable Jobs Fund

4 Technical Assistance Subcommittee

Work Plan Priority 4.1: Draft an oilseed crop production "best practices" handbook.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
Oilseed energy crops	End of 2009	None	$25,000	UVM Extension; Vermont Agency of Agriculture; Vermont Sustainable Jobs Fund

Work Plan Priority 4.2: Conduct workshops for farmers interested in growing oilseed crops. Specific topics may include: growing, harvesting, drying, storing oilseeds; using straight vegetable oil in tractors; value-added culinary oil opportunities; use of meal in livestock rations; and grant writing support to access public funds.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
Oilseed energy crops	End of February, 2009	None	None	UVM Extension; Vermont Agency of Agriculture; Vermont Sustainable Jobs Fund

Work Plan Priority 4.3: **Update, expand, and revise the Biomass Energy Resource Center's Wood Supply Model** to incorporate up-to-date resource inventory data and include additional supply and demand analysis and econometric capabilities.

Applicable Sectors/Technologies	*Execution Timeframe*	*Legislative Action*	*Funding Needed*	*Organizational Partners*
Wood energy	End of 2009 and every five years thereafter	None	$50,000	Biomass Energy Resource Center; Vermont Department of Forests, Parks & Recreation

Work Plan Priority 4.4: **Conduct a comprehensive analysis of existing manure digesters in the state**. Data collected should relate to how well they work, capital cost, on-going financials, operations, and optimization issues. One outcome should be a decision matrix for which farms are best suited for specific technologies.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
Manure digestion	End of 2009	None	None	Central Vermont Public Service; Vermont Agency of Agriculture; University of Vermont

Work Plan Priority 4.5: Create an online decision tree tool for residential use of wood. The tool should address which wood fuel is right for the individual user: cord wood, chips, or pellets.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
Wood energy	Medium-term	None	None	University of Vermont; Vermont Department of Forests, Parks & Recreation; Vermont Department of Public Service

5 Innovation in Technology Subcommittee

Work Plan Priority 5.1: Support the many efforts underway to develop small-to-medium manure digesters that are scaled for farms with fewer than 500 cows.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
Agricultural waste, manure digestion	2010	None	None	U.S. Department of Agriculture; Vermont Agency of Agriculture; Vermont Department of Public Service

Work Plan Priority 5.2: Support the continued development of its algae-based biodiesel projects due to their benefits to nutrient management and energy production.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
Energy crops, algae-based biodiesel	2010	None	None	U.S. Department of Agriculture; Vermont Agency of Agriculture; Vermont Department of Public Service

Work Plan Priority 5.3: Encourage a cellulosic ethanol feasibility analysis.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
Energy crops, cellulosic ethanol	2012	None	None	Vermont Agency of Agriculture; Vermont Department of Forests, Parks & Recreation

Work Plan Priority 5.4: Support research and development – and/or a pilot plant – for reprocessing agricultural plastics into useful products or energy.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
Agricultural waste	Immediately	None	None	Vermont Agency of Agriculture; Vermont Agency of Natural Resources; Vermont state waste districts

Work Plan Priority 5.5: Support demonstration sites for hydroelectric energy recovery in municipal water systems.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
Hydroelectricity	Immediately	None	None	Vermont Agency of Natural Resources; Vermont state utilities; municipalities

Work Plan Priority 5.6: **Encourage research and development of battery-powered tractors charged with on-farm renewable sources** to determine if the concept is practical.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
All electricity-generating sources	Immediately	None	None	Vermont Agency of Agriculture; Vermont Department of Public Service; Vermont Technical College

Work Plan Priority 5.7: **Encourage research and development of winter geothermal cooling of milk (beyond using water)**. These efforts should address whether this geothermal approach is a cost-effective alternative to utilizing Freon-based coolers that also produce hot water. Winter temperatures are low enough that cooling milk to 40ºF is possible through geothermal means.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
Geothermal	Immediately	None	None	Vermont Agency of Agriculture

Work Plan Priority 5.8: **Encourage and support research and development of bio-refined fuels**. Butanol and other biofuels can be refined in ways similar to cellulosic ethanol.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
Energy crops, biofuels	2012	None	None	Vermont Agency of Agriculture; Vermont Agency of Natural Resources

Work Plan Priority 5.9: **Track progress of LED technology** and stand ready to support rapid technology deployment through organizations such as Efficiency Vermont.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
Efficiency	2010	None	None	Efficiency Vermont; Vermont Agency of Agriculture; Vermont Department of Public Service

6 Market Forces Subcommittee

Work Plan Priority 6.1: **Monitor the revision of the *Sustainable Priced Energy Enterprise Development* (SPEED) program rules**.

Applicable Sectors/Technologies	Execution Timeframe	Legislative Action	Funding Needed	Organizational Partners
All electricity generating renewable energy sources	Short-term	None	None	Renewable Energy Vermont; Vermont Businesses for Social Responsibility

Work Plan Priority 6.2: **Assess the Use Value Appraisal (UVA) Program** to determine the potential benefits and impacts of broader enrollment. The question of whether the program is Vermont's most effective means to promote forest management on private lands – and for providing the raw material for biomass energy projects – should be addressed. The possibility exists that rule changes could expand the number of enrolled acres, but with that expansion would come potentially significant administrative burdens.				
Applicable Sectors/Technologies	***Execution Timeframe***	***Legislative Action***	***Funding Needed***	***Organizational Partners***
All farm- and forest-based feedstocks (e.g., energy crops, wood energy)	Ongoing	None	None	Forestry Roundtable as convened by Vermont Natural Resources Council; Vermont Current Use Tax Coalition; Vermont Department of Forests, Parks & Recreation; Vermont Department of Taxes; Vermont Forest Products Association
Work Plan Priority 6.3: **Make existing tools for evaluating energy project feasibility available to broader audience**.				
Applicable Sectors/Technologies	***Execution Timeframe***	***Legislative Action***	***Funding Needed***	***Organizational Partners***
All	Short-term	None	None	Biomass Energy Resource Center; Efficiency Vermont; Renewable Energy Vermont; University of Vermont; Vermont Agency of Agriculture; Vermont Department of Public Service; Vermont Sustainable Jobs Fund
Work Plan Priority 6.4: **Investigate incentives that promote efficient uses of the finite biomass resources**.				
Applicable Sectors/Technologies	***Execution Timeframe***	***Legislative Action***	***Funding Needed***	***Organizational Partners***
Wood energy	Short-term	None	None	Biomass Energy Resource Center; Vermont Department of Forests, Parks & Recreation
Work Plan Priority 6.5: **Explore and encourage development of business structure options for energy project ownership and development**.				
Applicable Sectors/Technologies	***Execution Timeframe***	***Legislative Action***	***Funding Needed***	***Organizational Partners***
All	Short-term	None	None	Renewable Energy Vermont; Vermont 25x'25 Steering Committee; Vermont Department of Economic Development

APPENDIX B – Vermont 25 x ’25 Steering Committee and Subcommittee Members

Steering Committee Members and Affiliations:

- David Lane, Vermont Agency of Agriculture (Vermont 25x’25 Initiative Chair)
- Jane Clifford, Green Mountain Dairy
- Paul Costello, Vermont Council on Rural Development
- Jackie Folsom, Vermont Farm Bureau
- Robert Foster, National 25x’25 Initiative Steering Committee (Vermont 25x’25 Initiative Vice Chair, Innovation in Technology Subcommittee Chair)
- Paul Frederick, Vermont Department of Forests, Parks, and Recreation
- Ellen Kahler, Vermont Sustainable Jobs Fund (Technical Assistance Subcommittee Chair)
- Kelly Launder, Vermont Department of Public Service
- John Malcolm, Vermont House of Representatives
- Anne Margolis, Vermont Department of Public Service
- Carolyn Moulton, Vermont Agency of Agriculture
- David O’Brien, Vermont Department of Public Service
- Andrew Perchlik, Renewable Energy Vermont (Market Forces Subcommittee Chair)
- John Sayles, Vermont Agency of Natural Resources (Permitting Issues Subcommittee Chair)
- William Sayre, Associated Industries of Vermont
- Dan Scruton, Vermont Agency of Agriculture
- Adam Sherman, Biomass Energy Resource Center
- Harvey Smith, U.S. Department of Agriculture (Financing Issues Subcommittee Chair)
- Dick Valentinetti, Vermont Agency of Natural Resources
- Netaka White, Vermont Sustainable Jobs Fund
- Lini Wollenberg, UVM Center for Sustainable Agriculture

Vermont Congressional Staff Steering Committee Members:

- Patricia Coates, Office of U.S. Representative Peter Welch
- Jenny Nelson, Office of U.S. Senator Bernie Sanders
- Robert Paquin, Office of U.S. Senator Patrick Leahy

Financing Issues Subcommittee Members and Affiliations:

- Harvey Smith, U.S. Department of Agriculture (Chair)
- Jo Bradley, Vermont Economic Development Authority
- Michael Farmer, Yankee Farm Credit
- Jeffrey Frost, AgRefresh
- Arne Hammerlund, Chittenden
- Scott Johnstone, Vermont Energy Investment Corporation
- Dave Lane, Vermont Agency of Agriculture
- Anne Margolis, Vermont Department of Public Service
- David Robinson, U.S. Department of Agriculture
- Janice St. Onge, Vermont Sustainable Jobs Fund

Permitting Issues Subcommittee Members and Affiliations:

- John Sayles, Vermont Agency of Natural Resources (Chair)
- Rob Achilles, Vermont Agency of Agriculture

- Jim Porter, Vermont Department of Public Service
- Dick Valentinetti, Vermont Agency of Natural Resources

Technical Assistance Subcommittee Members and Affiliations:

- Ellen Kahler, Vermont Sustainable Jobs Fund (Chair)
- Ela Chapin, Vermont Farm Viability & Enhancement Program, VHCB
- Heather Darby, University of Vermont Extension
- Robert DeGues, VT Department of Forests, Parks and Recreation
- Joan Richmond Hall, Vermont Technical College
- Paul Hines, University of Vermont College of Engineering
- Robert Jenkins, University of Vermont College of Engineering
- Bill Jordan, VT Department of Public Service
- Steve Paddock, VT-Small Business Development Center
- Lini Wollenberg, UVM Center for Sustainable Agriculture
- Stephanie Zehler, Vermont Agency of Agriculture

Innovation in Technology Subcommittee Members and Affiliations:

- Robert Foster, National 25x'25 Initiative Steering Committee (Chair)
- Lori Barg, Community Hydro
- Mark Blanchard, Vermont Experimental Program to Stimulate Competitive Research (EPSCoR)
- Paul Frederick, Vermont Department of Forests, Parks, and Recreation
- Kelly Launder, Vermont Department of Public Service
- Dan Scruton, Vermont Agency of Agriculture
- Adam Sherman, Biomass Energy Resource Center
- Netaka White, Vermont Sustainable Jobs Fund

Market Forces Subcommittee Members and Affiliations:

- Andrew Perchlik, Renewable Energy Vermont (Chair)
- Paul Frederick, Vermont Department of Forests, Parks, and Recreation
- Lawrence Mott, New Generation Partners
- William Sayre, Associated Industries of Vermont
- Adam Sherman, Biomass Energy Resource Center
- Netaka White, Vermont Sustainable Jobs Fund
- Helen Jordan(VAAFM Assistance)
- Koi Boynton, Vermont Agency of Agriculture

APPENDIX C – The Role of Energy Efficiency in Meeting Vermont 25x'25 Goals

The exploitation of energy efficiency opportunities is particularly important to meeting the Vermont 25x'25 goals, as the type and amount of *new* renewable energy resources is based on the assumption that energy efficiency – given the appropriate technology, policy, regulatory, and financing support – will hold Vermont's total energy use in 2025 at or below present-day levels, as illustrated in the scenario shown in Figure A1 below. [18]

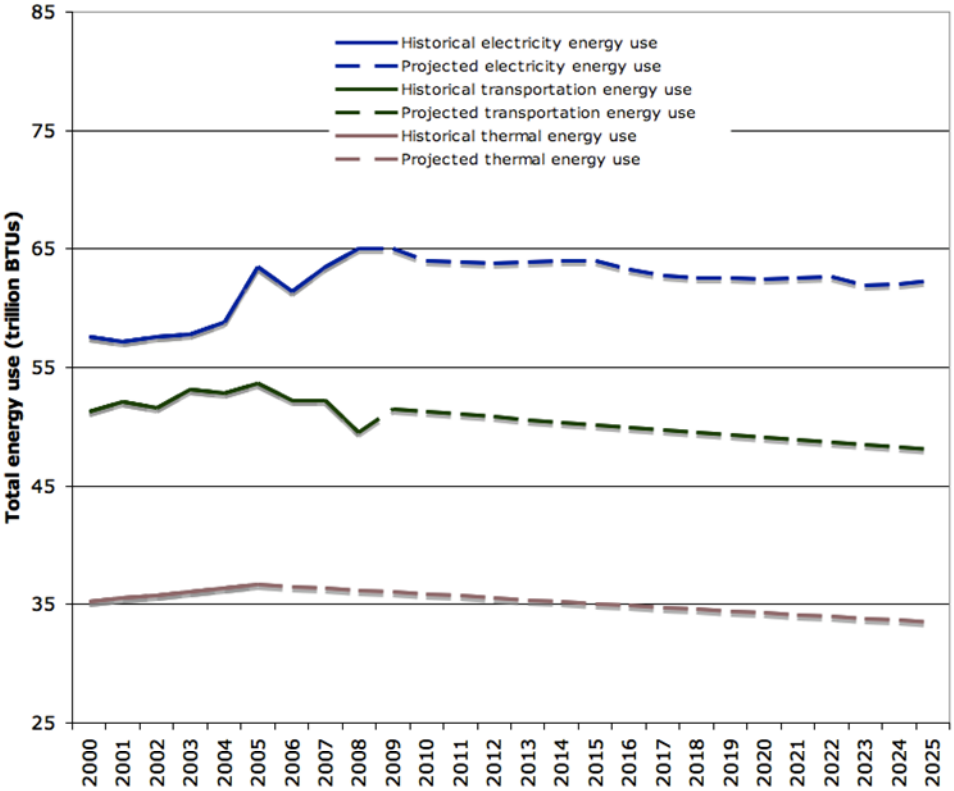

Figure A1 Vermont's historic and projected energy usage

[18] **Electrical Load Projections Note**: Historical electrical energy use data was obtained from a 2007 report developed by GDS Associations, entitled "Vermont Electric Energy Efficiency Potential Study." Future electrical use projections were obtained from the 2009 Vermont Comprehensive Energy Plan, Table II-5, and assume new demand side management contracts. Each kWh was assumed to be equivalent to 10.23 kBTU, after conversion and transportation losses. Sources: Energy Information Administration (http://www.eia.doe.gov/emeu/mecs/mecs94/ei/elec.html), and WorldChanging: http://www.worldchanging.com/archives/002437.html)
Thermal Load Projections: Historical rates of thermal load growth and 2005 thermal load data (in tBTU) were obtained from a 2007 report completed by GDS Associates entitled "Vermont Energy Efficiency Potential Study for Oil, Propane, Kerosene and Wood Fuels Report". GDS associates also calculated the potential for reduction in thermal loads by 2015. Projected load data was used by projecting historical load growth forward to 2015, and rescaling the total based on the "maximum cost effective load reductions possible" developed by GDS Associates. A linear trendline was fitted to 2005, 2010, 2015, and 2020 data to estimate values through 2025.
Transportation Energy Use Projections: Historical data on statewide gasoline purchases from 2000-2008 was obtained from the Vermont Joint Fiscal office (http://www.leg.state.vt.us/jfo/Transportation.htm), and a 2008 "Vermont Transportation Energy Report" developed for Vermont Clean Cities Coalition. A linear trendline was fitted to the data to estimate purchases through 2025. Gtven the suite of policy factors, technological innovations, and market forces that will drive future transportation energy use, these projections should be seen as approximations with high levels of uncertainty.

Between 1990 and 2007, energy use in Vermont grew 25% to 164 trillion BTUs. This growth was driven primarily by a 10% increase in population, economic growth of 56%, and steady increases in personal vehicle use and commuting distances. However, several recent studies suggest that through aggressive policies and funding of efficiency measures, Vermont has the ability to levelize – or even reduce – total growth in state energy consumption between 2009 and 2025 using a range of technically feasible and cost-effective approaches. This contention is supported by the following studies and research.

Electrical Efficiency: The Vermont Department of Public Service (DPS) estimates that Vermont's background electrical load growth is 1.4% annually, largely driven by increasing residential home sizes and appliance use. However, thanks to aggressive energy efficiency efforts (Vermont spends more per capita on electric-efficiency programs than any other state) electric loads have remained stable in recent years. The DPS projects that the state's electricity consumption will decline slightly through 2028, assuming current demand side management (DSM) programs are expanded and sustained for the next 20 years.[19]

Supporting their projections, a study completed in January 2003 found that the "maximum achievable potential savings" for electrical loads was 30.8%, by 2012.[20] A more recent study conducted in 2007 by GDS Associates found that by implementing new energy efficiency measures the technical potential for electricity use reduction by 2015 would be 35% of projected sales, or 19%, if only cost effective technologies were implemented.[21] Improving electrical efficiency has been shown to create significant economic savings. GDS Associates determined the net present value of these costs and savings would be $348 and $964 million, respectively. Furthermore, the Vermont Energy Investment Corporation estimates that, between 2006-2008, their efforts led to a total of $66.5 million investment in energy efficiency measures statewide, with a projected lifetime cost savings of $184 million dollars.[22]

Based on the above findings, it is reasonable to assume that Vermont can cost-effectively achieve a goal of zero (or even negative) electrical load growth between now and 2025, given sufficient technical, political, and financial support for such efforts.[23]

Heating Fuel Efficiency: The combustion of fuel oil, propane, kerosene, and biomass for space and water heating and industrial processes was responsible for 27% of the state's total energy use in 2007.[24] In 2007, the Vermont Department of Public Service commissioned GDS Associates to determine the savings possible for thermal heating. GDS Associates projected that between 2005 and 2015, without the implementation of more aggressive energy efficiency measures, thermal energy use statewide would grow by 8.5%. However, the report also found significant opportunities for increased thermal efficiency in Vermont. In fact, cost- effective

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[19] 2009 Vermont Comprehensive Energy Plan. Public Review Draft. Published May 2008; Department of Public Service, p. II-28.
[20] Electric and Economic Impacts of Maximum Achievable Statewide Efficiency Savings, 2003 to 2012, Results and Analysis Summary." Prepared by Optimal Energy, Inc. 2004. Available online at: http://www.neep.org/files/Updated_Achievable_Potential_2005.pdf.
[21] GDS Associates, Inc. 2007. Vermont Electric Energy Efficiency Potential Study. Prepared for the Vermont Department of Public Service.
[22] The Vermont Energy Digest. An Inventory of Renewable Energy and Efficiency. Prepared by the Vermont Council on Rural Development. April 2007.
[23] See Appendix B for details on the methodology used to derive electrical load projections.
[24] 2009 Vermont Comprehensive Energy Plan. Public Review Draft. Published May 2008; Department of Public Service, p. II-18.

technologies have the potential to reduce the end-use of fuel oil by 14%, 8% for propane, 5.9% for kerosene, and 14.2% for wood.[25] When projected energy growth is factored in, implementing these cost-effective efforts, energy use in 2015 would be 4.7% less than that in 2005.[26] In economic terms, the net present value of the benefits, costs, and savings of implementing the maximum, cost effective energy efficiency measures would be $646, $160, and $486 million, respectively.

Assuming a similar energy reduction trajectory between 2015 and 2025, it is possible for Vermont to cost-effectively achieve a reduction in total thermal load between 2009 and 2025, given sufficient technical, political, and financial support.

Transportation Fuel Efficiency: Approximately 31% of energy used in Vermont was associated with transportation.[27] Historically, savings due to increases in average fuel efficiency measures in Vermont have been offset by longer commutes, increasing annual vehicle miles traveled (VMT), and higher numbers of vehicles per capita. However, a recent study published by the University of Vermont's Transportation Research Center suggests that travel behavior has been changing significantly in recent years.[28] The report finds that 2.7% less gasoline was purchased in Vermont in 2006 and 2007, when compared to 2005. In addition, annual VMT decreased an average of .81% annually between 2004 and 2007, and over 3% in 2008.[29] CCTA and GMTA bus ridership grew 18% and 37%, respectively, in the same period.

The 2009 comprehensive plan, and a previous Public Service Board report, present a suite of strategies, policy changes, technological innovations, and market forces that could reduce transportation energy use by as much as 30%.[30] These include:

- Improved emission standards (i.e. CAFE Standards, the California Low-Emissions Vehicle standard, or LEV)
- Land use planning that encourages mixed use growth within village centers and less dependency on personal vehicles for transportation
- 55 mile-per hour interstate speed limits and stricter highway speed enforcement
- Shifting vehicle registration and license fees to gas taxes
- Expansion of public transit, carpool, and van share programs
- Increased park and ride, pedestrian, and bicyclist facilities
- Increases in telecommuting
- Rising fuel costs
- The electrification of the vehicle fleet

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[25] GDS Associates, Inc. 2007. Vermont Energy Efficiency Potential Study for Oil, Propane, Kerosene and Wood Fuels Report. Prepared for the Vermont Department of Public Service.
[26] See Appendix B for methodology used to derive thermal load projections.
[27] 2009 Vermont Comprehensive Energy Plan. Public Review Draft. Published May 2008; Department of Public Service, p. II-18.
[28] The Vermont Transportation Energy Report. Vermont Clean Cities Coalition. Prepared by Karen Glitman, Lisa Aultman-Hal, Tristam Coffin, Richard Watts. August 2008.
[29] US Transportation Department (2008). "Decline In American Driving Reaches Year-Mark." Available online at http://www.fhwa.dot.gov/pressroom/fhwa0826.htm.
[30] Vermont Department of Public Service. Fueling Vermont's Future: Comprehensive Energy Plan and Greenhouse Gas Action Plan, Volume 2, July 1998.

Given the array of strategies, policy changes, and technological innovations available, it is reasonable to assume that a gradual reduction of transportation energy used between 2009 and 2025 is possible, assuming there is adequate local, state and federal support.[31]

[31] See Appendix B for methodology used to derive transportation energy usage projections.

APPENDIX D – Energy Calculation Notes

Present-Day Energy Calculations

Manure Digestion - Present-Day Calculation Note
2007 calculation: (Source: CVPS website, http://www.cvps.com/cowpower/Our%20Farms.html)
Blue Spruce Farm, estimated Cow Power production: 1,300,000 kWh/year
Green Mountain Dairy, estimated Cow Power production: 1,800,000 kWh/year
Montagne, estimated Cow Power production: 1,400,000 kWh/year
Berkshire Cow Power, estimated Cow Power production: 3,500,000 kWh/year
Other operational systems: 500,000 kWh/year (Dan Scruton, Vermont Agency of Agriculture)
Total: 8,500,000 kWh/year

2008 calculation:

- Maxwell Neighborhood Farm, estimated Cow Power production: 1,750,000 kWh/year (Source: CVPS website, http://www.cvps.com/cowpower/Our%20Farms.html)

- Conversion: kWh * 3413 = BTUs. 1,750,000 kWh * 3413 = 5.97 x 10e9 BTU/year

Total existing manure production capacity in 2008: 8,500,000 kWh/year + 1,750,000 kWh/year = 10,250,000 kWh/year

Conversion: kWh * 3413 = BTUs
10,250,000 kWh/year * 3413 = 3.50 x 10e10 BTU

Firewood - Present-Day Calculation Note
In 2006, an estimated 680,000 tons of green firewood was burned (Source: *Vermont Energy Digest*, p. 22).

Assume 12,040,000 BTUs per green ton (assuming a 30% moisture content) and an efficiency of .63 (Source: Paul Frederick, Vermont Division of Forestry).
680,000 green tons * 12,040,000 BTUs/green ton * .63 efficiency = 5.16 x 10e12 BTU

Wood Pellet - Present-Day Calculation Note
Assume 16,400,000 BTUs per ton of pellets (Source: Paul Frederick, Vermont Division of Forestry) and .83 pellet combustion efficiency.
24,000 tons of pellets burned currently (Source: *Vermont Energy Digest*, p.24)
24,000 * 16,400,000 BTU per ton of pellets * .83 = 3.27 x10e11 BTU

Wood Chips for Electric Only - Present-Day Calculation Note
700,000 tons used at McNeil and Ryegate currently (Source: *Vermont Energy Digest*, p.24)
[Note that much of the wood used at the McNeil and Ryegate plants is not harvested in Vermont. A large volume of the wood McNeil uses comes from New York, and the majority of Ryegate's wood comes from New Hampshire. (See footnote 2, *Vermont Energy Digest,* p. 24)]
Assume 8,600,000 BTUs per green ton and 20% system efficiency (Source: Paul Frederick – Forestry Spreadsheet)
700,000 tons * 8,600,000 BTUs per green ton * .20 = 1.20 x 10e12 BTU

Wood Chips for Heat - Present-Day Calculation Note

- 2007 calculation: 93,000 tons used in community-scale (schools, State of Vermont, businesses, etc.) and forest products industry currently (Source: *Vermont Energy Digest*, p.24) Assume 8,600,000 BTUs per green ton and 65% system efficiency (Source: Paul Frederick, Vermont Division of Forestry). 93,000 tons * 8,600,000 BTUs per green ton * .65 = 5.20 x 10e11 BTU

- 2008 calculation: 5,100 green tons/year of capacity came online in 2008 at Bennington College, Weathersfield, Harwood, Danville, and Whitingham (Source: Paul Frederick, Vermont Division of Forestry). Assume 8,600,000 BTUs per green ton and 65% system efficiency (Source: Paul Frederick, Vermont Division of Forestry). 5,100 tons* 8,600,000 BTUs per green ton * .65 = 2.85 x 10e10 BTU

Total existing wind production capacity in 2008: 5.20 x 10e11 BTU + 2.85 x 10e10 BTU = 5.49E+11 BTU

Wood Chips for CHP - Present-Day Calculation Note
In 2005 facilities with wood-fired CHP capacity used approximately 136,000 green tons (Source: Paul Frederick – Vermont Division of Forestry). This includes the co-generation facility at Dirigo Paper in Gilman, which is currently non-operational.

Assume 8,600,000 BTUs per green ton and 65% system efficiency. 136,000 green tons * 8,600,000 BTUs per green ton * .65 = 7.60 x10e11 BTU

Small-Medium Wind - Present-Day Calculation Note
2007 calculation: Assume 499 kW installed small wind (Source: *Vermont Energy Digest*, p. 42) and 20% annual capacity factor (Source: Author's assumption) = 874,248 kWh annually.

2008 calculation:
- 25 systems with total estimated production of 143,471 kWh/year production installed in 2008 (Source: Gabrielle Stebbins, Vermont Small-Scale Renewable Energy Incentive Program).
- Conversion: kWh * 3413 = BTUs. 143,471 kWh/year * 3413 = 4.89 x 10e8 BTU/year

Total existing wind production capacity in 2008: 874,248 kWh/year + 143,471 kWh/year = 1,017,719 kWh/year

Conversion: kWh * 3413 = BTUs
1,017,719 kWh/year * 3413 = 3.47 x 10e9 BTU

Commercial Wind - Present-Day Calculation Note
Assume 6MW installed capacity at Searsburg and 110,000 MWh production over 10 years (Source: *Business Wire*, Sep. 2006). Thus, annual production is 11,000 MWh.

6 MW * CF * 8760 hr/yr = 11,000 MWh = 11,000,000 kWh
Thus, annual capacity factor (CF) = 20.9%

Conversion: kWh * 3413 = BTUs
11,000,000 * 3413 = 3.75 x 10e10 BTU

Solar Hot Water - Present-Day Calculation Note

2007 calculation: Assume 500 installed systems at 101,000 BTU/day per system (Source: *Vermont Energy Digest*, pp.48-49):
500 systems * 101,000 BTU/day per system * 365 days = 1.84 x 10e10 BTU/year for all systems.

2008 calculation:

- 166 systems with total estimated production of 12,208,000 BTU/day of solar thermal installed in 2008 (Source: Gabrielle Stebbins, Vermont Small-Scale Renewable Energy Incentive Program).
- 12,208,000 BTU/day * 365 days = 4.46 x 10e9 BTU/year for all systems installed in 2008.

Total existing solar thermal production capacity in 2008: 1.84 x 10e10 BTU/year + 4.46 x 10e9 BTU/year = 2.29 x10e10 BTU/year.

Solar PV - Present-Day Calculation Note
2007 calculation: 923 kW of existing installed net-metered capacity (Source: Vermont Department of Public Service) and assuming a 15% (Source: author's assumption) solar PV capacity factor. 923 * .15 * 8760 = 1,212,822 kWh/year

2008 calculation:

- 459,897 kWh/year of estimated of net-metered small-scale (15 kW system capacity or less) PV annual installed in 2008 (Source: Gabrielle Stebbins, Vermont Small-Scale Renewable Energy Incentive Program). Conversion: kWh * 3413 = BTUs. 459,897 kWh/year * 3413 = 1.57 x 10e9 BTU/year
    - Large-scale (60.48 kW) solar PV system at Farm-Way. 76,941 kWh/year of estimated PV production (Source: Anne Margolis, Vermont Department of Public Service). Conversion: kWh * 3413 = BTUs. 76,941 kWh/year * 3413 = 2.63 x 10e8 BTU/year.
    - Large-scale (72 kW) solar PV system at National Life. 77,767 kWh/year of estimated PV production (Source: Anne Margolis, Vermont Department of Public Service). Conversion: kWh * 3413 = BTUs. 77,767 kWh/year * 3413 = 2.65 x 10e8 BTU/year.
- 154,617 kWh/year of estimated of net-metered large-scale (greater than 15 kW system capacity) PV production installed in 2008 (Source: Anne Margolis, Vermont Department of Public Service). Conversion: kWh * 3413 = BTUs. 154,617 kWh/year * 3413 = 5.28 x 10e8 BTU/year

- Total PV production capacity added in 2008: 459,897 kWh/year + 154,617 kWh/year = 614,508 kWh/year

Total existing PV production capacity in 2008: 1,212,822 kWh/year + 614,508 kWh/year = 1,827,330 kWh/year

Conversion: kWh * 3413 = BTUs
1,827,330 * 3413 = 6.24 x 10e9 BTU

Large Hydro - Present-Day Calculation Note

Total Vermont hydro production – large- and small-scale: 8% of Vermont's total 2005 electric load of 6,298 GWh came from Vermont utility-owned and privately owned Vermont plants (Source: *Vermont Energy Digest*, p. 52). This translates to 504 GWh. 504 GWh = 504,000,000 kWh total hydro production.

Conversion: kWh * 3413 = BTUs
5.04x10e8 * 3413 = 1.72 x 10e12 BTU total hydro production

There are about 450 MW of large-scale hydro (systems of 10MW or larger) in Vermont (Source: 2005 PSB Dam Inventory) and 138 MW of small-medium hydro (capacity of less than 10 MW) (Source: *Vermont Energy Digest*, p. 52), for a total of 588 MW. Thus, large-scale hydro is 77% of the total installed capacity and small-scale hydro is 23% of the total.

Thus, lareg hydro production is calculated as 1.72 x 10e12 BTU * 77% = 1.32 x 10e12 BTU.

Small Hydro - Present-Day Calculation Note
Total Vermont hydro production – big and small: 8% of Vermont's total 2005 electric load of 6,298 GWh came from Vermont utility-owned and privately owned Vermont plants (p. 52, VCRD). This translates to 504 GWh. 504 GWh = 504,000 MWh = 504,000,000 KWh.

Conversion: kWh * 3413 = BTUs
5.04x10e8 x 3413 = 1.72 x 10e12 BTU total hydro production

There are about 450 MW of large-scale hydro (systems of 10MW or larger) in Vermont (Source: 2005 PSB Dam Inventory) and 138 MW of small-medium hydro (capacity of less than 10 MW) (Source: *Vermont Energy Digest*, p. 52), for a total of 588 MW. Thus, large-scale hydro is 77% of the total installed capacity and small-scale hydro is 23% of the total.

So, small hydro production is calculated as 1.72 x 10e12 BTU * 23% = 3.96 x 10e11 BTU.

Geothermal - Present-Day Calculation Note
Approximately 200 residential GSHPs currently in Vermont (Source: *Vermont Energy Digest*, p. 55). GSHPs can reduce overall residential energy use by 50% in heating and cooling mode (Source: *Vermont Energy Digest*, p. 54).

A typical Quebec residential home of 1,500 ft^2 uses the following amount of energy annually:

Space heating: 60GJ
Water heating: 30 GJ
AC: 750 kWh
(Source: *Ground Source Heat Pump Systems in Canada*, May 2007, p. 5)

Convert GJ to BTUs
Joules * 9.49 x 10e-4 = BTUs

Space heating: 60GJ = 6 x 10e10 J * 9.49 x10e-4 = 5.69 x 10e7 BTU
Water heating: 30 GJ = 3 x 10e10 J * 9.49 x10e-4 = 2.85 x 10e7 BTU
AC: 750 kWh * 3413 = 2.56 x 10e6 BTU
Total energy use = 8.80 x 10e7 BTU

Assume GSHPs reduce overall energy use by 50% in heating and cooling mode (Source: *Vermont Energy Digest*, p. 54). 8.80 x 10e7 * .5 = 4.40 x 10e7 BTU saved per each home with GSHP.

Assuming 200 homes in Vermont: 200 * 4.40 x 10e7 = 8.80 x 10e9 BTUs produced currently with residential GSHPs.

2025 Energy Calculations

Crop-Based Algae - 2025 Calculation Note
(Source: Dan Scruton, Vermont Agency of Agriculture)
60,000,000 gallons produced in 2025 (calculated using 100 algae unit-acres in production and 600,000 gallons per unit oil yield).
Assume 130,000 BTUs/gallon of B100.
60,000,000 gallons * 130,000 BTU/gallon = 7.8 x 10e12 BTU

Crop-Based Biodiesel - 2025 Calculation Note
(Source: Dan Scruton, Vermont Agency of Agriculture)
4,000,000 gallons produced in 2025 (calculated using 40,000 acres in production and 100 gallons per acre oil yield).
Assume 130,000 BTUs/gallon of B100.
4,000,000 gallons * 130,000 BTU/gallon = 5.20 x 10e11 BTU

Grain Ethanol - 2025 Calculation Note
(Source: Dan Scruton, Vermont Agency of Agriculture)
600,000 gallons produced in 2025 (calculated using 2,000 acres in production and 300 gallons per acre ethanol yield).
Assume 76,000 BTUs/gallon of ethanol.
600,000 gallons * 76,000 BTU/gallon = 4.56 x 10e10 BTU

Cellulosic Ethanol from Crops - 2025 Calculation Note
(Source: Dan Scruton, Vermont Agency of Agriculture)
87,500,000 gallons produced in 2025 (calculated using 35,000 acres in production * 2,500 gallons of ethanol per acre yield).
Assume 76,000 BTUs/gallon of ethanol.
87,500,000 gallons * 76,000 BTU/gallon = 6.65 x 10e12 BTU

Crop/Substrate Digestion - 2025 Calculation Note
(Source: Dan Scruton, Vermont Agency of Agriculture)
Assume 1.2 kW per acre, 60 units in 2027, and average 500 acres used per unit: 1.2 * 60 * 500 = 36,000 kW installed capacity.
36,000 kW x 8760 hrs/yr * .9 CF (Author's assumption) = 283,824,000 kWh/yr in 2025.

Conversion: kWh * 3413 = BTUs
283,824,000 * 3413 = 9.69 x 10e11 total BTUs in 2025

Grass Pellets - 2025 Calculation Note
(Source: Dan Scruton, Vermont Agency of Agriculture)
225,000 tons produced in 2025 (calculated using 15,000 acres in production * 15 tons per acre pellet yield)
Assume 16,000,000 BTUs/ton of pellets.

225,000 tons * 16,000,000 BTU/ton * 90% conversion efficiency = 3.24 x 10e12 BTU

Manure Digestion - 2025 Calculation Note
(Source: Dan Scruton, Vermont Agency of Agriculture)
Assume .22 kW per cow, 150 units in 2025, and average 500 cows per unit): .22 * 500 * 150 = 16,500 kW installed capacity.
16,500 kW * 8760 hrs/yr * .9 capacity factor (Author's assumption) = 130,086,000 kWh/yr in 2025.

Conversion: kWh * 3413 = BTUs
130,086,000 * 3413 = 4.44 x 10e11 total BTUs in 2027

Manure Fuel Cell - 2025 Calculation Note
(Source: Dan Scruton, Vermont Agency of Agriculture)
Assume .10 kW per cow, 500 units in 2025, and average 100 cows per unit): .10 * 500 * 100 = 5,000 kW installed capacity.
5,000 kW * 8760 hrs/yr * .9 CF (assumed) = 39,420,000 kWh/yr in 2027

Conversion: kWh x 3413 = BTUs
39,420,000 x 3413 = 1.35 x 10e11 total BTUs in 2025

Wood Energy - 2025 Calculation Note
From 25x25 SC discussion on 12/11/07: In 2025, 1.5 million green tons in chunk wood, chips, and pellets will be available for energy and other uses – in addition to the amount of wood used in energy applications today. Assume a 50% moisture content in all cases except for firewood (Source: Paul Frederick, Vermont Division of Forestry). Assume 500,000 tons is dedicated to cellulosic ethanol and 1,000,000 tons goes to electric and thermal energy, with a preference for CHP technology.

Firewood - 2025 Calculation Note
In 2006, an estimated 680,000 green tons of firewood was burned (Source: *Vermont Energy Digest*, p. 22). Assume 84,000 green tons in addition to 680,000 green tons, for a total of 764,000 tons.

Assume 12,040,000 BTUs per green ton (assuming a 30% moisture content) and a conversion efficiency of .63 (Source: Paul Frederick, Vermont Division of Forestry).
764,000 green tons * 12,040,000 BTUs/green ton * .63 efficiency = 5.80 x 10e12 BTU total in 2025.

Wood Pellets - 2025 Calculation Note
(Source: Paul Frederick, Vermont Division of Forestry)
In 2025, there will be one Vermont pellet mill making pellets from 180,000 tons of green wood. At 50% moisture for green wood, this translates to approximately 90,000 tons of pellets.
This is in addition to the 24,000 tons of pellets that are currently used.

90,000 + 24,000 = 114,000 tons of pellets used in 2025

Assume 16,400,000 BTUs per ton of pellets and 83% pellet combustion efficiency.

114,000 tons of pellets * 16,400,000 BTUs per ton for pellets * .83 = 1.55 x 10e12 BTUs total in 2025.

Wood Chips for Electric Only - 2025 Calculation Note
(Source: Paul Frederick, Vermont Division of Forestry).
In 2025, there will be one conventional electric-only wood chip plant rated at 25MW and using 300,000 green tons of wood at 50% moisture.
Assume 8,600,000 BTUs per green ton at 50% moisture and a conversion efficiency of 20%.
300,000 green tons * 8,600,000 BTUs per green ton * .2 = 5.16 x 10e8 BTUs.
This is in addition to the 1.20 x 10e12 BTUs of electric-only BTUs currently produced.
5.16 x 10e8 BTUs + 1.20 x 10e12 BTUs = 1.72 x 10e12 BTUs total in 2025.

Wood Chips for Heat - 2025 Calculation Note
(Source: Paul Frederick, Vermont Division of Forestry)
In 2025, heat-only wood chips will include:
- Institutional Wood Chip Heating (medium: 50,000sq.ft.)
- Institutional Wood Chip Heating (large 200,000sq.ft.)
- Small District Heat Only (e.g., Johnson State College campus size)

For a total of 33,500 green tons used.
Assume 8,600,000 BTUs per green ton and 65% system efficiency.
33,500 green tons * 8,600,000 BTUs per green ton * .65 = 1.87 x10e11 BTU
This is in addition to the 5.20 x 10e11 BTU currently produced in heat-only applications.
1.87 x10e11 BTU + 5.20 x 10e11 BTU = 7.07 x 10e11 BTUs total in 2025.

Cellulosic Ethanol from Wood - 2025 Calculation Note
(Source: Paul Frederick, Vermont Division of Forestry)
Assume cellulosic yield of 76.7 gallons per dry ton.
Assume 50% moisture of green wood.
500,000 green tons * .5 = 250,000 dry tons
250,000 dry tons * 76.7 gallons/dry ton = 1.92 x 10e7 gallons of ethanol

Assume 83,333 BTUs/gallon of ethanol.
83,333 BTU/gallon * 1.92 x 10e7 gallons = 1.60 x 10e12 BTUs total in 2025

Wood Chips for CHP - 2025 Calculation Note
(Source: Paul Frederick, Vermont Division of Forestry)
In 2025, wood for CHP will include:
- Campus CHP (i.e., Middlebury College-size ~1.9 million ft sq)
- Small City Biomass District Heating (i.e., Montpelier-size)
- Large City Biomass District Energy (Burlington/BED-size)
- Industrial/ Commercial CHP (5 MW)

For a total of 411,000 green tons used in 2025.

This is in addition to the 136,000 green tons used in CHP applications currently.

411,000 + 136,000 = 547,000 green tons used in 2025
Assume 8,600,000 BTUs per green ton and 65% system efficiency. 547,000 green tons * 8,600,000 BTUs per green ton * .65 = 3.06 x10e12 BTUs in 2025

Small-Medium Wind - 2025 Calculation Note
Assume wind (of all scales) provides 10% of current electric use, including 12 MW of installed small-medium farm-based wind (Source: 25x25 SC discussion). Current state electric use (in 2005) is 6,298 GWh (Source: *Vermont Energy Digest*, p. 7).

Conversion: kWh x 3413 = BTUs
6,298,000,000 kWh *3413 = 2.15 x 10e13 BTU

10% * 2.15 x 10e13 = 2.15 x 10e12 BTU

12 MW of installed small-medium farm-based wind and .20 annual capacity factor (Author's assumption) = 12,000 kW * 8760 hr/yr * .20 CF = 21,024,000 kWh annually.

Conversion: kWh x 3413 = BTUs
21,024,000 x 3413 = 7.18 x 10e10 BTU from small-medium wind energy in 2025

Commercial Wind - 2025 Calculation Note
Assume wind (of all scales) provides 10% of current electric use, including 12 MW of installed small-medium farm-based wind (Source: 25x25 Steering Committee discussion). Current electric use (in 2005) is 6,298 GWh (Source: *Vermont Energy Digest*, p. 7).

Conversion: kWh x 3413 = BTUs
6,298,000,000 kWh *3413 = 2.15 x 10e13 BTU

10% * 2.15 x 10e13 = 2.15 x 10e12 BTU

2.15 x 10e12 BTU less the amount that small-medium generates is the amount that commercial wind will generate: 2.15e12 BTU - 7.18 x 10e10 BTU (as calculated in *Small-Medium Wind - 2025 Calculation Note*) = 2.08 x 10e12 BTU from commercial-scale wind energy in 2025.

How many commercial-scale turbines would this require?
2.08 x 10e12 BTU divided by 3413 = 6.09 x 10e8 kWh
kW * hrs/year * CF = kWh
Assume 30% annual capacity factor for commercial-scale wind (Source: Author's assumption).
6.09 x 10e8 kWh divided by (8760 hrs/yr * .3 CF) = 231,735 kW
231,735 kW = 232 MW
Assuming 2 MW turbines, 232 MW = 116 commercial-scale turbines.

Solar Hot Water - 2025 Calculation Note
Assume hot water heating accounts for 16% of residential, commercial, and industrial energy use. (Source: *Homepower Magazine*, 1998).
Sum energy use by sector (except transportation) from EIA data yields 1.16 x 10e14 BTU (see calculation below) and multiply by .16 to yield Vermont 2004 hot water load of 1.85e13 BTU.

25x25 SC solar hot water goal is stated as "10% of current thermal hot water use." 1.85 x 10e13 * .10 = 1.85 x10e12 BTU.

Vermont 2004 energy consumption by end-use sector (Source: http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=VT#overview)
Residential 51,433 billion Btu
Commercial 32,941 billion Btu
Industrial 31,499 billion Btu
Total = 115,873 billion BTU = 1.16 x10e14 BTU

How many solar hot water systems would this require?

Assume X installed systems at 101,000 BTU/day per system (Source: *Vermont Energy Digest*, pp.48-49).
X systems x 101,000 BTU/day/system x 365 days = 1.85e12 BTU
X = 50,183 systems in 2025

Solar PV - 2025 Calculation Note
25x25 SC solar PV goal is stated as "5% of current electric use." 2005 Vermont electric use is 6298 GWh (Source: p.7 of VDRC) or 2.15 x 10e13 BTUs. 2.15 x 10e13 BTU * .05 = 1.08 x10e12 BTU.

How many solar PV systems would this require?
Assume X installed kW at 18% average capacity factor (Source: Author's assumption).
X * .18 CF * 8760 hrs/year = 1.08 x10e12 BTU / 3413 BTU per kWh
X = 200,683 kW (or about 200 MW of installed PV capacity)

Large Hydro - 2025 Calculation Note
Assume 15 MW of additional hydro (all scales) by 2025 (Source: 25x25 SC discussion). Assume there will be no new big hydro since state is fully dammed. So large-scale hydro production in 2025 will be the same as current, which is 1.32 x 10e12 BTU, as the following calculation shows:

Total Vermont hydro production – big and small: 8% of Vermont's total 2005 electric load of 6,298 GWh came from Vermont utility-owned and privately owned Vermont plants (Source: *Vermont Energy Digest*, p. 52). This translates to 504 GWh. 504 GWh = 504,000,000 KWh.

Conversion: kWh x 3413 = BTUs
5.04x10e8 x 3413 = 1.72 x 10e12 BTU

There is about 450 MW of large-scale hydro (10MW or larger) in Vermont (Source: 2005 PSB Dam Inventory) and 138 MW of small-medium hydro (less than 10 MW) (Source: *Vermont Energy Digest*, p. 52), for a total of 588 MW. Large-scale hydro is 77% of the total installed capacity and small hydro is 23% of the total.

So, large-scale hydro production is calculated as 1.72 x 10e12 BTU * 77% = 1.32 x 10e12 BTU.

Small Hydro - 2025 Calculation Note
Assume 15 MW of additional hydro by 2025 (Source: *Vermont Energy Digest*, p. 53 & 25x25 SC discussion on 12/11/07). 138 MW of installed small, in-state hydro in 2005 (Source: *Vermont Energy Digest*, p. 52).

15 MW of additional installed small, in-state hydro in 2025 (Source: *Vermont Energy Digest* p. 52). Assume 50% annual capacity factor (Source: Author's assumption).
15,000 KW * .50 * 8760 = 65,700,000 kWh/yr

Conversion: kWh * 3413 = BTUs
65,700,000 * 3413 = 2 .24 x10e11 BTU new hydro – in addition to 3.96 x 10e11 BTU of current small hydro.
2 .24 x10e11 + 3.96 x 10e11 BTU = 6.20 x 10e11 BTU of small hydro in 2025

Geothermal - 2025 Calculation Note

25x'25 Steering Committee goal: Geothermal should reduce statewide fossil fuel used in space and hot water heating by 5%.

Vermont residential sector fossil energy consumption in 2004 = 26.7 trillion BTUs = 2.67 x 10e13 BTU (natural gas = 3.1 trillion BTUs, distillate fuel=15.7 trillion BTUs, kerosene=2.3 trillion BTUs, LPG=5.6 trillion BTUs) (Source: http://www.eia.doe.gov/emeu/states/sep_sum/html/sum_btu_res.html)

Vermont commercial sector fossil energy in 2004 = 9.9 trillion BTUs = 9.9 x 10e12 BTU (natural gas=2.7 trillion BTUs, distillate fuel=6.0 trillion BTUs, kerosene=0.2 trillion BTUs, LPG=1.0 trillion BTUs) (Source: http://www.eia.doe.gov/emeu/states/sep_sum/html/sum_btu_com.html)

Vermont industrial sector fossil energy in 2004 = 7.0 trillion BTUs = 7.0 x 10e12 BTU (natural gas=2.8 trillion BTUs, distillate fuel=3.4 trillion BTUs, kerosene= 0.3 trillion BTUs, LPG=0.5 trillion BTUs) (Source: http://www.eia.doe.gov/emeu/states/sep_sum/html/sum_btu_ind.html)

Total heating fuel usage for all sectors = 4.36 x 10e13 BTU

Reduce this by 5% through the use of GSHPs: 4.36 x 10e13 BTU * .05 = 2.18 x 10e12 BTUs offset by GSHPs.

How many residential GSHP units would this require?
Assume that GSHPs reduce energy use by 4.40 x 10e7 BTU per each home (Source: *Geothermal - Present-Day Calculation Note*).
2.18 x 10e12 BTU divided by 4.40 x 10e7 BTU = about 49,500 GSHP units.
In the year 2000, Vermont had about 170,000 owner-occupied housing units and about 71,000 renter-occupied housing units (Source: http://www.housingdata.org/profile/resultsMain.php

APPENDIX E – National 25x'25 Recommendations

In December of 2008, the National 25x'25 Steering Committee offered President-Elect Barack Obama and members of Congress the following twelve recommendations designed to bolster the U.S. economy, create new jobs and insure a clean energy future, and lead to a long-term, comprehensive energy strategy that will accelerate the production of all forms of renewable energy and create new renewable energy markets:

1. Increase funding for the Rural Energy for America Program (REAP).
The Rural Energy for America Program, authorized under Section 9007 of the Energy Title of the 2008 Farm Bill, provides grants or loan guarantees for renewable energy systems and energy efficiency improvements for agricultural producers and rural small businesses. The program is currently funded at $255 million over four years, with additional annual authorization of $25 million. The limit on the maximum amount of the combined loan and grant is 75 percent of the funded activity and the grant portion cannot exceed 25 percent of the cost of the activity. The program, in existence since 2002, is continuously oversubscribed and many valid projects are rejected because of limitations on USDA funding. Increasing funding for REAP will generate temporary construction jobs in rural America along with permanent jobs operating and maintaining renewable energy facilities. As an example, a 104 megawatt wind power project in Oregon, financed through REAP, generated over 30 permanent jobs in Gilliam County, Oregon.
Proposed funding for REAP: $250 million annually, $500 million over two years.

2. Increase funding for the Repowering Assistance Program.
The Repowering Assistance Program, authorized under Section 9004 of the Energy Title of the 2008 Farm Bill provides loans and loan guarantees to help biofuel plants convert their heating and power fuel supply to biomass and reduce their dependence on fossil fuel-powered boilers. Payments would be made for installation of new systems that use renewable biomass or for new production of energy from renewable biomass. The program is currently funded at $300 million over four years, with additional $25 million in annual authorization. According to the Renewable Fuels Association 172 biorefineries are in operation today. Installation of renewable biomass boilers will generate construction and maintenance jobs and contribute to cleaner air and environment.
Proposed funding for Repowering Assistance: $150 million annually, over two years.

3. Broaden the authority and increase funding for the Biorefinery Assistance Program.
The Biorefinery Assistance Program authorized under Section 9003 of the Energy Title of the 2008 Farm Bill provides loans and loan guarantees to construct commercial-scale advanced biofuel facilities. Loans may be up to 80 percent of the cost of the project not to exceed $250 million. It also provides grants for demonstration-scale advanced biofuels plants. Despite existing federal grants and loan guarantees, the collapse of the credit markets has stalled construction of the nation's first commercial-scale cellulosic biorefineries. Of six projects selected by the U.S. Department of Energy in 2007 to receive up to $385 million in federal support, only one has begun construction. It also has slowed the conversion of existing grain-based ethanol plants to dual feedstock biofuels production facilities. The economic recession may therefore delay progress toward meeting cellulosic and advanced biofuels targets in the Renewable Fuels Standard and slow progress toward curtailing greenhouse gas emissions. Additional funding for the

Biorefinery Assistance Program will reduce investor risk and provide construction and operations jobs in rural communities. consideration should be given to broadening the authority to utilize direct federal grants to expedite the construction of first generation advanced biorefineries and to modify or retrofit existing grain-based ethanol plants to convert cellulosic biomass to biofuels. Knowledge gained and experience with these operations would rapidly drive down costs associated with second-generation cellulosic biofuel plants and result in private-sector investment in their construction.
Proposal for Biorefinery Assistance Program: increase and fully fund mandatory and discretionary levels, at $500 million in year one and $1 billion in year two, and consider expanding the use of the grants to facilitate the construction of first generation cellulosic biofuel plants.

4. Fund the Bioenergy Crop Assistance (BCAP).
The Bioenergy Crop Assistance Program was authorized under the 2008 Farm Bill to support the establishment and production of eligible crops for conversion to bioenergy, and to assist agricultural and forest landowners with collection, harvest, storage, and transportation of these crops to conversion facilities. The rules for the program have not been developed, and no mandatory funding is provided in the authorizing legislation. Twenty-one cellulosic biorefineries are in the planning stage of construction, to begin operations by 2010, but without full and immediate funding of BCAP to provide incentives to farmers to grow dedicated energy crops, feedstocks may not be available, jeopardizing investments and threatening the commercial scale production of advanced biofuels.
Proposed for Bioenergy Crop Assistance Program: Implement BCAP in 2009; fund at $250 million annually, $500 million over two years.

5. Invest in Biofuel Infrastructure Projects.
A comprehensive federal initiative should be developed and funded to address biofuel infrastructure, distribution and delivery issues. A coordinated plan should be developed and significant federal funding provided for biofuel distribution infrastructure projects. Biofuel pipeline feasibility studies need to be completed. The federal government should help finance the construction of new pipelines, as well as address rail capacity for biofuels. Funding for E-85 Corridor programs should be expanded and funding should be made available to facilitate the manufacturing and deployment of blender pumps. The federal government should promote the use of flex-fuel vehicles, by creating a federal FFV fleet and increase funding for battery technology development. In addition, advanced biorefineries, most of which are in planning stages, often await permitting for long periods of time. The processing of these permit applications must be expedited.
Proposal: Increase federal investments in biofuel distribution infrastructure, including financing to expand rail capacity, pipeline construction, and strong incentives for E85 and blender pumps, the number of which should grow as more flex-fuel vehicles are registered in a region. Provide strong incentives to speed up commercial use of flex fuel vehicles and their use by federal entities. Expedite permitting for advanced biorefineries.

6. Fund the Community Wood Energy Program.
The Community Wood Energy Program authorized under the Food, Conservation, and Security Act of 2008, provides grants to state and local governments and communities to develop wood energy plans and to acquire and upgrade community wood energy

systems in communal facilities, such as schools, town halls, libraries. The program would use woody biomass as a primary fuel for such projects.
Proposed funding for the Community Wood Energy Program: $20 million annually, for two years.

7. Increase funding for and extend Clean Renewable Energy Bonds (CREBs).
The Energy Policy Act of 2005 provides electric cooperatives and public power systems with the ability to issue Clean Renewable Energy Bonds (CREBs). The CREB is a renewable incentive for not-for-profit utilities, comparable to the Production Tax Credit (PTC) that is available to investor-owned utilities. Not-for-profit utilities that serve 25% of the nation can not access the PTC. CREBs support a wide variety of projects, including wind, biomass, geothermal, solar, municipal solid waste, small irrigation power, and hydropower. CREB funds would support both large- and small-scale projects, and would generate jobs both in installation of renewable energy technologies and in manufacturing of the required component parts. The program is already over-subscribed, at $800 million in current mandatory spending.
Proposal for CREBs: extend the program through 2010 and provide additional bonding authority of $2.5 billion.

8. Restructure the Production Tax Credit and Investment Tax Credit for renewable energy electricity sources.
Currently, a PTC or an ITC is given in a form of a tax credit to be claimed against income for developers of and investors in renewable electricity projects utilizing biomass, solar, wind, hydro, marine, landfill gas, geothermal and other clean sources of energy. The credit is currently non-transferable. Furthermore, in many cases other incentives reduce the amount of the Production Tax Credit or an Investment Tax Credit. For example, a biomass Production Tax Credit is reduced by half when a Combined Heat and Power (CHP) Investment Tax Credit is also used for the same project. State and government financing also reduces the PTC amount a renewable energy project can receive. According to recent analysis by the American Wind Energy Association, the failure to restructure the PTC and provide a rapid long-term extension could result in the loss of 89,000 jobs and $16 billion in investment in the wind energy industry alone. Renewable energy development relies upon transactions with major financial industry players, because renewable electricity is a capital intensive industry. The current economic crisis has removed many major financial investors from tax equity markets, dramatically reducing the ability of many renewable power developers to realize the intended benefits of available tax incentives. Thousands of megawatts of new renewable energy power capacity for 2009 could be cancelled or delayed as a result, unless the tax credit system is restructured, and PTCs are extended over five years. In addition, equity strapped industries may not be able to increase investments in geothermal, biomass, solar and hydropower projects. According to the National Renewable Energy Laboratory, if the PTC were transferable to lending institutions, or if it were applicable as prepayment on any loans, the wind, solar, biomass, geothermal, hydro and other renewable energy industries could fully utilize the PTC and the ITC. In a time of economic downturn, full use of the ITC and the PTC is essential for the renewable energy sector to continue attracting investment and prevent job loss.
Proposal: Restructure the federal Production Tax Credit and Investment Tax Credit for all sources of renewable electricity to allow for accelerated depreciation, refundable credits and transfers between persons/entities, and enable projects to utilize other financial incentives without a reduction in the amount of ITC and PTC that an entity can claim.

9. Extend the Production Tax Credit and Investment Tax Credit for five years.
Production and investment tax credits serve as primary incentives for investors to develop wind, solar, geothermal, hydro, marine and other forms of electricity from renewable sources. Wind industry developers, for example, are eligible for a production tax credit of 2.1cents per kilowatt hour generated in the first 10 years of operation. Manufacturing of both wind turbines and solar panels is growing in the United States, bringing jobs to rural areas. More than 50 new or expanded wind industry manufacturing facilities have been announced or opened since January of 2007, creating tens of thousand of high paying jobs while providing clean and reliable energy. However, an unstable PTC/ITC policy serves as a disincentive to investors, particularly in this time of economic distress. The solar industry, for example, estimates that if PTC were not extended in 2008, the solar PV sector alone would have lost $8.1 billion in investment and a net 39,800 jobs in 2009.
Proposal: Extend the Production Tax Credit and Investment Tax Credit for renewable electricity sources for five years.

10. Increase the Production Tax Credit for renewable electricity produced from biomass, hydro, green gas and other renewable sources of energy.
Currently producers of renewable electricity from wind and geothermal sources of energy receive a Production Tax Credit of 2.1cents per kilowatt hour. Other producers of renewable electricity receive half this amount. Additional renewable electricity could be generated in the United States if developers who produce renewable electricity from biomass, hydro, renewable gases and other sources of energy received the same credit as is currently allowed for wind and geothermal electricity developers.
Proposed funding: Create a level playing field for producers of renewable electricity by increasing the Production Tax Credit for biomass, marine, hydro, marine, green gas, waste and other renewable energy sources of electricity to a level equivalent to that received by wind and geothermal energy producers.

11. Improve tax incentives for Community Wind.
Community wind is a type of wind development that focuses on investment from local communities, rather from an outside investor. The National Renewable Energy Laboratory (NREL) estimates that smaller community wind projects contribute twice as many jobs and income to a local community than a larger wind plant financed by outsider investment. An average community wind plant of 20 MW can provide up to 41 jobs and $4 million in local income, as opposed to an outside-investment 40 MW plant's 18 jobs and $1.3 million in income for the community. However, community wind investors' income off the plant is often passive. Under current regulations passive income has to be quite large to fully use the credit. Regulations should be changed to allow for local wind investment projects to count against active income of the local investors. Such a change will generate more interest in, and investment by communities in local clean electricity sources.
Proposed: Allow community wind developers to count tax incentives against active income.

12. Fund Smart Grid and improve electricity transmission.
The Federal government should appropriate funds for the Smart Grid Investment Matching Grant Program created under Energy Independence and Security Act of 2007. The program provides reimbursement for 20 percent of qualifying Smart Grid Investments. Within two years, the stimulus effect of this provision will become apparent, through significant new job creation in renewable energy

electricity sector, as more electricity sources will be able to capitalize on a better grid system. 300GW of wind power are awaiting grid connection. In order for the wind industry to expand, 12,000 miles of new transmission lines are needed, as well as a smart grid management system. The Department of Energy reports that transmission is the number one barrier preventing rapid long-term expansion of wind energy use. Without adequate transmission capacity, the nation risks losing existing jobs in wind turbine manufacturing and installation. A more efficient, reliable transmission grid will also reduce electricity costs to consumers in states with high peak rates.

Proposed funding for Smart Grid: $1.3 billion for smart grid investment.