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Energy Efficiency, Conservation, & Renewable Energy

A

Overview

Towns in Vermont of all sizes, from Burlington to Thetford, are successfully reducing their energy use through lowered demand and increased efficiency. These reductions can have crucial economic, environmental and social benefits, and carry the promise of changing the way our communities function and grow.

According to the most recent reports from Vermont's Department of Public Service (2005 and 1998), 85% of the money Vermonters spent on energy flowed away from the state. Vermont, like the rest of the nation, is heavily dependent on foreign sources of supply that are increasingly insecure and unpredictable. Energy costs will continue to escalate, and demand continues to increase at unparalleled rates. Efficiency and conservation measures can save money and make funds available, that municipalities would otherwise have spent for energy, to support other needed programs and services. The development of renewable energy sources such as biomass, solar, wind, geothermal or hydroelectric – and the conversion of residences, commercial, and community facilities to their use – also open new opportunities for economic development. According to Deb Sachs of Alliance for Climate Action, Sacramento, California's investment of $50 million in energy projects increased regional income by $124 million, and created 880 jobs.

The environmental impacts are clear. Vermont has committed to reducing greenhouse gases by 25% by 2012 as part of an agreement of the Governors' Commission on Climate Change. The Governor joined in signing the New England Governors/ Eastern Canadian Premiers (NEG/ECP) global warming agreement, and joined seven other Northeastern states in agreeing upon targeted reductions that are part of the Regional Greenhouse Gas Initiative (RGGI). The costs of global warming have been measured in changes to Vermont's winter, with impacts on ecosystems, the maple industry, agriculture, foliage and ski tourism. Vermont's forecast could change from climate zone 4 to zone 6, which will mean a different growing season and a different crop balance. By reducing energy use and burning less fossil fuel, less carbon dioxide, methane, nitrous oxide and other greenhouse gases are produced, slowing and reducing these impacts. Burlington is among those leading the way with 67% of Burlington Electric's power produced from renewables, and a target of reducing greenhouse gases by 10% from 1990 levels by the year 2010. [Source: P. Keane and S. Ranganathan, Energy Smart Growth: A Case Study, Environmental and Energy Study Institute.

Building design is key. South-facing orientation provides much of this home's heat while the roof overhang, insulated curtains, careful placement of windows for x-ventilation and semi-earth-sheltered features keep it comfortable year-round.

Energy Definitions

Energy efficiency refers to the more efficient use of energy in order to reduce economic costs and environmental impacts, using less energy to perform the same function.

Energy conservation means the reduction or elimination of unnecessary energy use and waste.

Source conversion means using a cleaner or more renewable source of energy to perform the same function. In the case of automotive fuel, for example, efficiency would be driving the same number of miles in a vehicle with better gas mileage; conservation would be reducing the number of miles driven; and source conversion would be using biodiesel fuel rather than standard petroleum diesel.

Application

Energy Coordinators and Committees

The Vermont Planning & DevelopmentAct (24 V.S.A. Chapter 117) requires that municipal plans include "…an energy plan, including an analysis of energy resources, needs, scarcities, costs and problems within the municipality, a statement of policy on the conservation of energy, including programs… to implement that policy, a statement of policy on the development of renewable energy resources, a statement of policy on patterns and densities of land use likely to result in conservation of energy." The statute allows municipalities to appoint energy experts to help in their planning processes. Towns may appoint an energy coordinator as a non-voting ex-officio member of a planning commission (§ 4322). The energy coordinator serves a one-year term and is charged with implementing energy policies under the review of the planning commission and/or selectboard. A growing number of Vermont towns have created Energy Committees (§§4433 & 4464), who are sparking a wide variety of volunteer initiatives to get their communities to address the issue. Energy committees can be a very useful way for towns to implement the energy efficiency and conservation projects best suited for individual towns' specific needs.

Energy Audits

Whether conducted by an energy coordinator, a town energy committee, a conservation commission, the planning commission or select board, municipal energy plan implementation can begin with an energy audit, which is a systematic examination of the community's energy demands and use habits. An energy audit may examine only municipal assets and practices, or it may also take into account the energy use of residences and businesses.

Energy audits could examine the following:

- Sources of energy demand: heating and lighting municipal buildings, town offices, schools, firehouses etc.; lighting in public exterior spaces and along roads; powering municipal pumping, filtering, and waste-management systems; fuel for fleet, school and maintenance vehicles; and any other local power demands.
- Patterns of use associated with each source: vehicle miles driven, hours of building and equipment operation, and typical levels of service (lighting levels, maintained temperatures, vehicle occupancy or load, etc.)
- Energy consumption of each source in energy units: gallons for gasoline, propane, fuel oil; kilowatthours for electricity; therms for natural gas; cords or tons for wood and biomass; etc.
- Energy consumption of each source in dollars.

The results provide an accurate, detailed portrait of local energy use, as well as suggest key areas in which improvements will make the greatest difference. Improvements may take the form of increased efficiency, demand reduction, and/or conversion of energy sources.

Source Conversion and the Shift to Renewables

The concepts of increased efficiency and demand reduction are familiar but, in recent years, the idea of source conversion – the practice of replacing fossil fuel consumption with other, more renewable (and often more local), forms of energy – has taken hold. Alternative energy sources are especially important now as contracts with Yankee Nuclear and HydroQuebec for two-thirds of Vermont's energy supply are coming to an end. Biomass, which uses agricultural waste or wood chips for heat, offers a new approach to forestry, as waste wood from processing lumber is used to produce wood chips for use in school or commercial furnaces. Burlington's McNeil Generating Station uses a mix of wood and natural gas as the source of its 50 megawatts of power. Recovered methane from cow manure and agricultural waste is being used by Vermont utilities to replace fossil fuel and nuclear electric generation. Even private users, who generate less than 15 kw of wind or solar energy, can be net-metered into the grid, such that their electric meters turn backward when they generate more power than they use.

By utilizing local resources such as wind, sun, and river flow, Vermont cities and towns can shift the balance away from imported fossil fuels to renewables that can keep energy dollars local. Residents of Grafton, Greensboro, Hardwick, Middlebury and Ripton are working on proposals for micro and small scale hydro power. Like wind generation, these are subject to a regulatory process, and getting all the necessary approvals can be difficult.

Energy Audits

Owners of commercial, residential, and municipal buildings can request a building-scale energy audit through Efficiency Vermont as well as from other private energy service companies and voluntary energy auditing groups. Audits identify possible reductions in electric usage, and may also pinpoint other energy-saving opportunities, such as how to control thermal losses or the energy savings potential in equipment or fuel changes. Audits have led towns to eliminate incandescent lighting in favor of compact fluorescents in town offices, schools and fire houses; to improve insulation and weather-stripping of windows and doors; and in some cases to exchange oil-burning space heaters for wood chips.

Regulatory Options

Many energy strategies are voluntary, and pursued for individual economic self-reliance or environmental benefit. But while these are effective both individually and in their collective outcomes, there is also an array of community planning and development review strategies to help reduce Vermont's energy use.

Combined Heat and Power (CHP) Systems

Example: ***North Country Hospital, Newport***

Combined Heat and Power systems (CHP, also known as cogeneration or "co-gen") can be an efficient, clean and reliable approach to generating both electric power and thermal energy. The North Country Hospital in Newport has received national attention as an example of a successful CHP system. North Country Hospital uses a gasifier system that burns wood chips to generate both heat and electricity. The wood chips cost the hospital about $18/ton, with one ton of chips equivalent to 117 gallons of oil at over $2.50 per gallon. The CHP technology has resulted in huge cost savings for the hospital, anticipated to be as high as $328,000 annually.

Growth Center Planning

Growth center planning (see topic paper, Growth Centers) is key to reducing energy costs and consumption. Growth centers also offer other social, environmental and economic benefits. The preservation of Vermont's historic settlement patterns, built around town greens with integrated residential and small scale commercial uses provides an immediate and long-term reduction in energy demand, given that the majority of Vermont's energy demand is for transportation. Sprawling commercial zones and residential growth into surrounding farm and forest land, as well as inefficient extensions of power, water and sewage infrastructure also present financial burdens on taxpayers and local officials. Increased distances between residential areas, town centers and business services translates to increased use of personal and commercial transportation, with associated costs in fuel use and emissions. Compact development also provides more opportunities for cogeneration.

Nationally, total vehicle miles traveled has increased by about 70% since 1980, while population has grown by only about 20%. The U.S. Department of Transportation estimates that the majority of this increase is due to land use patterns that encourage car trips and discourage walking or public transportation. Thus, one of the most powerful strategies to reduce energy demand is "smart growth" in its various forms which include growth center planning, transit-oriented development and other means of encouraging dense and/or mixed-use development. (See topic paper on Planned Unit Development). This reduces vehicle miles by minimizing travel distances. It can eliminate some vehicle trips altogether by encouraging bicycle, pedestrian and transit use. Where car-pool, ride-share or public transit options are provided, fuel use, emissions, and traffic congestion are reduced.

Smart-Growth Ordinances

Local planning ordinances can encourage new development in areas close to existing development and services as well as in-fill development in existing centers. They can discourage growth in areas not well serviced by public infrastructure or which have important natural or scenic resources. Combining affordable housing designs with energy efficient construction will not only meet the needs of working families, but are less costly to live in over time. While energy considerations have not been a deliberate focus of Planned Unit Developments (PUD's), such smart-growth strategies have been shown to result in significant energy reductions.

Growth Centers

24 V.S.A. §§2790-2794

The growth center program, created in 2006, supports community planning that reflects the state's historic settlement pattern of compact villages surrounded by a working landscape of farms and forest. This program is intended to help communities accommodate future business and housing development without compromising the state's essential character.

Some elements of smart-growth ordinances include:

- Density targets and parking caps for housing development;
- Promoting mixes of single-family and multi-family housing, as well as mixes of market rate and affordable housing;
- Allowing certain types of home-based businesses;
- Including moderate-scale commerce and schools in new residential development.

Towns may create specific tax or infrastructure fee incentives to reward a blend of these features. Hinesburg is considering a system of points for good design that meets energy efficiency guidelines which will be rewarded with dimensional waivers or density bonuses. Conversely, impact fees could be assessed on developments which require significant infrastructure creation, or to compensate for added traffic, and that income applied to public transit or sidewalk/bike path costs in town centers.

Subdivision Regulations

Along with higher density and mixed-use development, subdivision regulations can be used to help preserve extensive vegetation belts and open spaces within or around new development through setback and

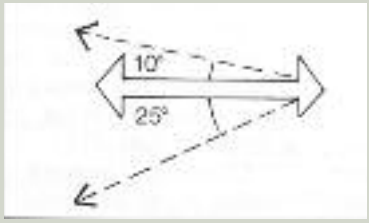
clustering requirements. Areas of existing woodlands can offer shade and windbreaks, reduce stormwater runoff and associated soil erosion, and remove some of the pollutant load from stormwater drained from impervious surfaces. The regulations can provide incentives that each building be provided with southerly, southwesterly or southeasterly solar access, providing for passive solar orientation that can lower heating demands. Other factors include waivers of setback limits to maximize solar access without shading neighboring homes, and waivers of height restriction or permits for solar tracking devices or individual renewable energy structures such as wind turbines. (See topic paper, Subdivison Regulations.)

Site Plan Review Ordinances

The site plan review process offers the opportunity to review individual site design aimed to be safe and attractive for pedestrians, carpooling, bus users and bicyclists. Landscaping should be designed to reduce buildings' heating and cooling costs, and to conserve water. Standards for energy efficient lighting design and technology are also critical. Municipalities can incorporate indoor and outdoor lighting standards into their site plan review processes. Outdoor lighting standards, in particular, can reduce energy consumption, provide better lighting design, and preserve the night landscape. (See topic papers on Land Use & Development Regulations, Zoning Regulations, Design Review, Public Transportation, and Bicycle and Pedestrian Facilities.)

Street Layout Sets the Framework for Building Orientation

In Vermont, this is the optimum range of east-west orientation of streets to maximize solar access of lots and buildings. Municipalities can lead the way by laying out a grid of streets designed for optimal solar orientation and adopting that street layout into an official map. (See topic paper, Official Map.)



Building Standards and/or Codes

If the municipal plan provides the background rationale, municipal bylaws can require or encourage energy-efficient buildings, components or equipment. The Federal Energy Star program and the independent Leadership in Energy and Environmental Design (LEED) program both offer standards for design and certification of successfully created energy-efficient buildings. The main components of achieving LEED or Energy Star certification include:

- Highly efficient heating, cooling, and domestic hot water equipment;
- Building envelope insulation and infiltration control;
- High-performance windows;
- Use of local and recycled building materials; and
- Passive construction strategies that consider design for natural light and shade, attention to thermal mass materials like stone and brick that absorb great amounts of solar heat and then release that stored heat gradually, and the selection of surface colors for roofs and other areas that absorb or reflect sunlight as appropriate.

Burlington and Williston have adopted the 2000 International Energy Conservation Code (IECC) as a model energy code for commercial buildings, and all residential buildings must comply with the Vermont Residential Building Energy Standard (RBES). Burlington's 2008 zoning regulations include a Green Building Initiative which would offer density bonuses to developers who agree to seek LEED certification. The Thetford Planning Commission, at the suggestion of the town energy committee, is also considering ensuring that a certificate of occupancy is contingent on meeting minimum standards. (See topic paper, Housing Regulations.)

Building efficiency guidelines can also be developed for existing construction. For example, Burlington has an ordinance requiring that certain energy efficiency improvements must be made when a building changes ownership. These "time-of-sale" requirements represent an important (and affordably gradual) investment in the energy-use profile of the entire community. These changes also make

Projects under Public Utility Regulation

Before building any electric generating facility, there are certain laws that municipalities and individuals must comply with.

- No person, municipality, or company may construct any electric generation facility without first getting a certificate of public good from the Public Service Board, unless the energy is solely for on-site consumption by the owner of the facility. (30 V.S.A. Section 248)
- To get a certificate, a person must submit an application to the Public Service Board. Application materials are available from the Board's website at http://www.state.vt.us/psb.
- Even if a proposed structure is for the owner's on-site consumption, it is also necessary to check with municipal bylaws before beginning construction. Even if the proposed structure is small and attached to an existing structure, municipalities may have zoning bylaws that regulate height and placement of alternative generating facilities.

important contributions to long-term housing affordability. Reducing individual building energy consumption, combined with reduction of driving miles due to increased development density, leads to immense reductions in a community's overall energy use and carbon emissions.

Offering a place that keeps bikes dry encourages their use.

Non-Regulatory Efforts

Transportation

Gasoline and diesel fuel accounts for about half of Vermont's overall energy usage, and while one estimate puts fuel use for farm equipment at 11% of the total, the great majority is used in commercial and private vehicles. Even small incremental reductions in driving habits can amount to large overall reductions in fuel use. One way of increasing a vehicle's efficiency is to increase the number of its occupants. More people riding in fewer cars burns less fuel and reduces traffic. Several Vermont communities have developed or are investigating car-pooling strategies, ride-share options and park-and-ride systems.

Municipalities can also plan for more efficient public vehicles: police, fire/emergency, school buses, and maintenance equipment. Governor Douglas has offered a greenhouse gas reduction plan that would transition the state's fleet to fuel efficient vehicles and require state employees to use government cars rather than their own higher emission vehicles. Municipalities could take similar action. Fuel efficiency targets for new vehicle purchases and increased maintenance schedules (especially for tune-ups and tire pressure) can improve miles per gallon. The design of routes for transit and snow removal can reduce overall miles traveled. Converting public vehicles to liquid natural gas or biodiesel can improve efficiency and reduce emissions. Communities like Brattleboro are implementing no idling campaigns. Reducing vehicular idling cuts polluting greenhouse gas emissions, energy use, and maintenance costs.

Stormwater

Another area for energy reduction is stormwater management, which may become more critical with predicted climate change. Reducing a community's impervious surface ratio (that is, the proportion of land area covered by pavement or buildings) reduces runoff by allowing rain and snow melt to be absorbed by the soil. Requiring hard surfaces, such as parking pads and bike paths, to use brick or block pavers, allowing water to seep into the soil between joints, can help decrease the energy costs associated with pumping and treating runoff. Building methods incorporating gutters and cisterns can reduce runoff and provide freshwater for landscaping and other non-potable water needs.

Green Roofs also offer an exciting opportunity to reduce stormwater runoff while beautifying a city's landscape. Green roofs retain 70 – 90% of precipitation, reducing energy expended on municipal wastewater systems. They last longer because no water ever touches the underlying roof; provide better insulation, reducing heating and cooling costs and the need for HVAC equipment generally. They also offer recreation sites for employees and in-house day cares.

Power generation

Municipalities may benefit from creating and controlling some of their own electric power. In preserving Vermont's historic settlement patterns, there is an opportunity to resurrect mill ponds and dams. There's estimated to be as much as 174 megawatts of undeveloped hydroelectric potential, using existing dams owned by the state or municipalities, which is more than 20 percent of the state's current electric demand. Most of the sites supporting this additional capacity are classified as "mini-hydro" – under 1000 kilowatts, and the development of this hydroelectric capacity in Vermont would offset the burning of more than a million barrels of oil. Each kilowatt of hydroelectric capacity can, on average, produce 4,000 kilowatt-hours of electricity per year. So even a 100-kilowatt hydro project would generate 400,000 kilowatthours annually – enough energy to fully power the lighting and computing needs of several hundred office workers. However, there are regulatory hurdles to be addressed at even the smallest and most local level. Communities like Greensboro have been working with regulatory agencies to negotiate "run of river" hydroelectric power. Other communities including Middlebury, Barre, Plainfield and Lincoln are working to explore the opportunities for waivers from full scale statutory review of small power projects.

Demand Management

Many communities are replacing incandescent bulbs in schools and town offices with compact fluorescent lighting. Several communities are negotiating with their utility companies to take on ownership of street lighting with the goal of reducing the number of needed lights, placing them on timers or motion sensors, and changing over to light emitting diodes (LED) which are less energy intensive and longer lasting. Burlington's LED traffic signals use 80% to 90% less energy than traditional incandescent traffic signals, and they last twelve times longer, significantly reducing maintenance costs.

Biofuels

Various forms of biofuels (corn ethanol, soy diesel, dairy methane, wood chips, grass pellets, etc.) are replacing gasoline and diesel fuel for vehicle operation, and replacing heating oil for building and equipment operation. Biofuels not only burn cleaner and may require less refinery energy, they could offer regional farmers and foresters the opportunity to augment their incomes with an "energy crop" that is complementary to their regular operation. This has important implications for the health of local and regional economies. Williston is among the Vermont municipalities exploring the potential of cogeneration (combined heat and electricity generation) and methane recovery from landfills and dairy wastes.

Wind

Small, individual wind turbines can power individual homes or groups of homes, and commercial facilities. Some communities like Hinesburg are exploring waivers of height restrictions to make individual and commercial scale turbines possible, and to support energy technology businesses.

Incentives and Funding Sources

Investigating opportunities for incentives and rebates can help municipalities manage the cost of investing in energy efficiency. The following are a few examples of funding and incentive programs.

- Efficiency Vermont manages a fund contributed to by the state's utilities to finance or offset green building and green planning projects, and also maintains a clearinghouse of connections to other governmental and private financial initiatives.
- Some lending agencies offer reduced interest rates or loan origination fees for the design and purchase of certified energy-efficient buildings and equipment.
- Revolving loan funds are available to support energy efficient programs like the program proposed by Burlington Electric, devoted to improving municipal buildings' efficiency and operations.
- The Vermont Energy Investment Corporation awards grants under the EPA Climate Wise Program.
- The Vermont Clean Energy Development Fund promotes the development and deployment of cost-effective and environmentally sustainable electric power resources, focusing on renewable energy resources and combined heat and power technologies.
- Sales tax exemptions for renewable energy equipment including solar hot water systems and off-grid photovoltaic and wind systems.
- Some programs allow businesses to partner with public transportation providers to reduce vehicle miles traveled per capita and green house gas emissions. (Vermont's Public Transportation Policy Plan, Feb. 2007)
- Country Home Products, the Alliance for Climate Action and the State of Vermont are sponsoring the Lawn Mower Exchange Program, which allows households to exchange their old gas mower for a cordless electric one at a significant discount.

Every municipality in Vermont will have different approaches to energy use. Energy audits will reveal opportunities for action, and a community's options for addressing them. While there may be significant up-front costs to some strategies, the constant pay-back over time – in reducing fossil fuel use and emissions as well as supporting the local economy through money saved, new jobs, business opportunities and a "greener" community – makes energy efficiency and conservation, as well as the use of renewables a win-win option.

Life-Cycle Cost and Payback Period

Energy improvements entail an initial investment, from the smallest level of replacing an incandescent light bulb with a compact fluorescent to the large scale of converting a school boiler from fuel oil to biomass. When choosing among possible energy improvements, it is important to understand which investments will have the greatest impacts. Two measurements help planners make those decisions. (Note: the following calculations are for illustration purposes only – actual costs will vary, and must be determined locally.)

Life-Cycle Cost (LCC) is the measurement of initial plus ongoing costs to accomplish some function, spread across a fixed period of time. An example might be space lighting for a town office that operates for 2500 hours per year and is expected to operate for another 15 years. The current system – standard T-12 tubes with electrical ballasts – has no first cost (since it's already installed), but will incur roughly $1,000 of maintenance and upkeep costs and consume $15,000 in electricity, for a total LCC of $16,000. Upgrading to a modern T-8 system with electronic ballasts will cost $4,000 for installation, incur $500 in maintenance and upkeep, and consume $9,000 in electricity, for a total LCC of $13,500.

Payback Period (PP) is an estimate of the length of time that reduced energy costs will recover the initial investment. For example, the additional cost of purchasing a townpickup truck fueled by liquid natural gas (after Federal and state incentives) instead of gasoline might be $1,500. However, the annual cost of fuel for gasoline operation would be $3400, and the annual cost of fuel for LNG operation would be $2600. The increased initial investment of $1500 divided by the annual savings of $800 indicates a payback period of 1.9 years.

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