First Biennial Report

of the

Climate Neutral

Working Group

~ Presented to ~

Gov. James H. Douglas

April 2005

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Commonly Used Acronyms and Abbreviations

BGS	Vermont Department of Buildings and General Services
BTU	British Thermal Unit
CERMP	Comprehensive Environmental & Resource Management Program
CH_4	Methane
CNWG	Climate Neutral Working Group
CO_2	Carbon Dioxide
CRT	Cathode Ray Tube
CTR	Commute Trip Reduction
DDC	Direct Digital Control
DEC	Vermont Department of Environmental Conservation
DOE / EIA	United States Department of Energy / Energy Information Administration
DPS	Vermont Department of Public Service
EDM	Electronic Document Management
EPA	United States Environmental Protection Agency
GHG	Greenhouse Gas
HOV	High Occupancy Vehicle (i.e., multiple persons traveling in one vehicle)
HRMS	Human Resource Management System
HVAC	Heating, Ventilation and Air Conditioning
IT	Information Technology
kWh	Kilowatt-hour
LCD	Liquid Crystal Display
mpg	Miles Per Gallon

NEG-ECP	Conference of the New England Governors and Eastern Canadian Premiers
NEPOOL	New England Power Pool
NESCAUM	Northeast States for Coordinated Air Use Management
N_2O	Nitrous Oxide
PAYD	Pay-as-you-drive automobile insurance
RGGI	Regional Greenhouse Gas Initiative
RGGR	Regional Greenhouse Gas Registry
RMRF	Resource Management Revolving Fund
SAEP	State Agency Energy Plan
SOV	Single Occupancy Vehicle (i.e., one person traveling in one vehicle)
TDM	Transportation Demand Management
VMT	Vehicle Miles Traveled
VTrans	Vermont Agency of Transportation

Executive Summary

This first biennial report of the Climate Neutral Working Group (CNWG) is being issued as required by Executive Order #14-03, signed by Governor James Douglas in September 2003. It is intended to give a brief introduction to the environmental, economic, and social risks that climate change poses to Vermont. It aims to provide a clear summary of the ongoing energy consumption and greenhouse gas (GHG) emissions inventory of Vermont State Government operations. In addition, the report includes potential emission reduction strategies, energy consumption case studies, and other relevant work conducted by the CNWG since the signing of the Executive Order regarding Climate Change.

Recommended actions for reducing GHG emissions are presented herein for consideration and implementation during 2005-2006 by the executive branch of the Vermont State Government. Each recommendation is presented in more detail in Chapter V. The major recommendations of this report include:

- Initiate widespread "Benchmarking" of buildings owned and operated by the State of Vermont, so that those with sub-optimal performance can be identified and given priority for performance upgrades

- Identify and implement resource conservation measures that are compatible with the goals of the newly created Resource Management Revolving Fund (RMRF).

- Purchase and install Vending Misers on all conventional vending machines, or specify mandatory use of ENERGY STAR Refrigerated Beverage Vending Machines in state vending contracts.

- Work with information technology (IT) personnel to install "SLEEP is GOOD" (available free from Efficiency Vermont) or comparable automatic power management software on each computer or set up so that control is at the network level.

- Promote a statewide policy encouraging IT staff, and administrative staff to activate good power management features on all computer printers, copy machines, and other similar equipment.

- Utilize Building Energy Performance Contracts wherever deemed appropriate.

- Monitor electronic document management (EDM) implementation in state government and study ways to take advantage of possible facilities space savings.

- All vehicles purchased for inclusion in the Vermont State Fleet shall be appropriately sized according to intended primary use, and shall be among the most fuel efficient and lowest emission vehicle models in each class.

- Increase the use of video and online conferencing to reduce vehicle trips and vehicle miles traveled.

- Expand education and tracking of vehicle engine anti-idling campaigns pertaining to state fleet vehicles, as well as private sector vehicles operating on state-owned property.

- Convene a CNWG sub-workgroup to formulate innovative strategies that will reduce GHG emissions from the extensive non-passenger portion of the state fleet.

- Convene a Transportation Demand Management (TDM) Committee to evaluate feasibility and effectiveness of various TDM strategies, and implement those deemed suitable to reduce GHG emissions generated by state employees commuting to and from the workplace.

- Conduct a survey of all state employees to determine more accurately the present level of employee participation in carpooling, vanpooling, or other mass transit as a means of commuting to and from the workplace.

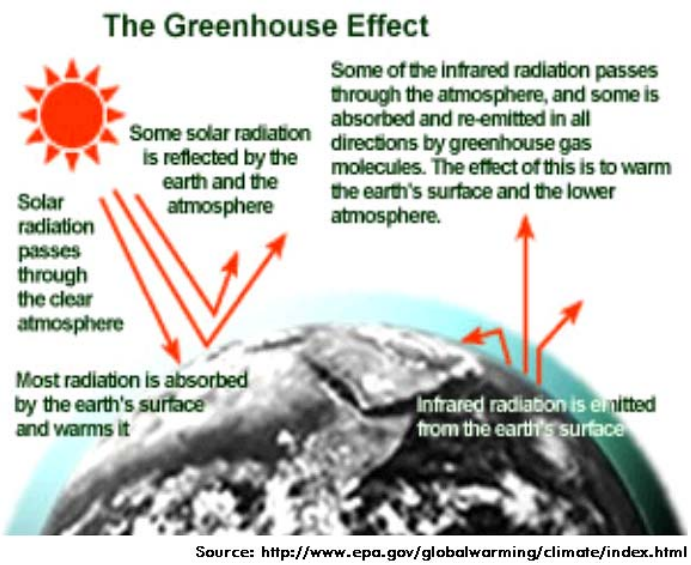
- Establish an official numeric "code" in the Department of Personnel Human Resource Management System (HRMS) that can be used to indicate "telecommuting" as a recognized work activity.

The information contained in this report will be evaluated by the CNWG continually throughout the next two years, and will result in the production of a second biennial report (autumn / winter 2006) that will update the emissions inventory to carefully document progress toward meeting the GHG reduction goals, as well as provide further recommendations for reducing GHG emissions. Lessons learned from this state government effort to "lead by example" will allow the State of Vermont to gain practical experience in implementing an effective GHG emissions reduction program, that will serve as an important first step in the development of a comprehensive statewide climate change action plan.

Chapter I – Introduction

I-a. Environmental and Economic Impacts

Climate change is a phenomenon that is happening all the time. In geological time-scales the Earth is always either getting warmer or cooler, and "normal temperatures" become difficult to define. Ice ages come and go, the climate gets warmer, the climate gets colder, and these changes are all part of natural cycles. The Earth is not static, but rather quite dynamic, and the climate would change with or without the presence of people. It is important to realize that climate change involves changes in the climate as a whole, not just one single element of the weather.



Source: http://www.epa.gov/globalwarming/climate/index.html

If climate is always changing, what are scientists concerned about? It is not the change, but the rate of change (and possible amount of change) that is unsettling to scientists today. The rate at which it is happening now is not normal or natural relative to historical patterns. In fact the Earth is warming faster than scientists can ever find a record for in the past. Scientists generally deduce that this increased rate of climate change is due to human behaviors that amplify the greenhouse effect. The greenhouse effect is the natural rise in Earth's temperature promoted by gases in the atmosphere including water vapor, carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4). Energy from the sun enters the atmosphere and warms the Earth, but without these gases, heat would escape back into space resulting in a *much* colder temperature here on Earth. For the purposes of this report, global warming is defined as warming caused exclusively by anthropogenic, or human-produced, influences upon the atmosphere. Specifically, this includes the release of CO_2, N_2O, CH_4 and other greenhouse gases (GHGs) from activities like fuel combustion for vehicular travel, space heating, electricity generation, as well as various non-combustion industrial processes, etc. Global warming is far more than just an issue about weather and climate. It has the potential to affect every portion of our lives: the economy, the environment, public health, and society in general.

Vermont is as susceptible to climate change as any other part of the country. Our way of life, our culture, what it means to live in Vermont and be a Vermonter may all be threatened and certainly changed for us, our children, and grandchildren. The well-known New England adage states: "If you don't like the weather now, just wait a minute." If we consider changes happening within the Earth's atmosphere, a corollary adage might state - "If you don't like the climate now, just wait a decade or two." Still, climate change does offer opportunities in addition to challenges for Vermont. Vermonters have always prided themselves as being independent, resourceful, and proactive. Today, the state government and citizens of Vermont have the opportunity to join our neighboring

states and Canadian provinces in adopting "climate wise" practices, and setting an important precedent for many others to follow.

Undesirable environmental and economic consequences will likely result if we do not make a genuine effort to reduce our contribution to global warming. Rivers and streams may become too warm for cold-water species such as brook, brown and rainbow trout. The skiing season may become much shorter in duration and perhaps too costly for many resorts to continue to make (and then lose) snow during warm melting spells. At lower elevations, snowshoeing, cross-country skiing, and snowmobiling may experience drastically shorter seasons.

A comment from the next generation...

Hilary Byrne, 9th Grader
Harwood Union High School

"... Climate change threatens the health of both Vermont and Vermonters - and within my lifetime. In fact, in many ways it likely will be my generation that will have to face many difficult social and personal lifestyle decisions if we don't come to grapple with the problem now.

... We must examine our own lifestyles and make sensible choices rather than take things, such as the gas-hungry cars, as the norm. We are creating the problem and we must take responsibility for actions. If we remain complacent, we lose."

The maple syrup industry production center has shifted from Maryland (in the 1920's) to New England (in the mid-1950's), and now is shifting even further north into Quebec, Canada. The migration of the maple syrup industry from the U.S to Canada is due to many factors including government subsidies in Canada, demographics, and changes in the climate. Scientists estimate that approximately 30% of the current sap production decline in New England may be attributed to the effects of climate change.[1,2] Changes in the climate will also likely lead to attenuation of the vibrant autumn foliage displayed by the sugar maple, and a gradual northward migration of wildlife associated with a northern hardwood forest.

Average annual snowfall (as a percent of total annual precipitation) has also declined at many sites in northern New England by roughly 15 percent since 1950.[3,4] These and other data suggest that the current warming trend has had its effect on the region, in terms of a decrease in annual snowfall, a reduction in length of snow cover duration on the ground, and earlier ice-out dates for many regional lakes and ponds. Perhaps the greatest impact of the warming trend has been during

[1] *US National Assessment of the Potential Consequences of Climate Variability and Change Educational Resources Regional Paper: The Northeast*.
http://www.usgcrp.gov/usgcrp/nacc/education/northeast/

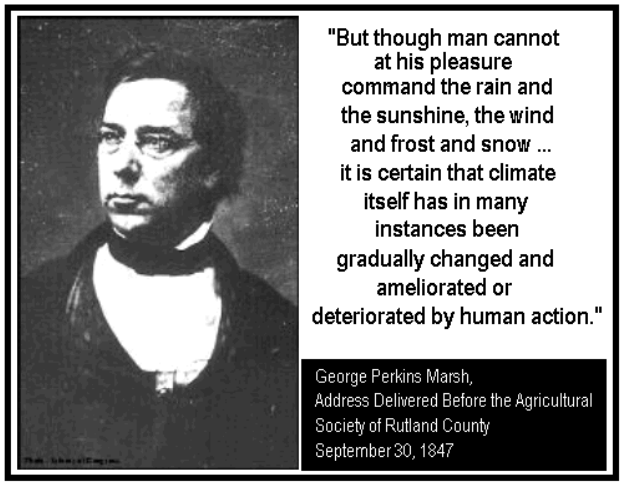
[2] Gary Lauten, Barrett Rock, Shannon Spencer, Tim Perkins and Lloyd Irland. 2002: *The New England Regional Assessment. (NERA). Chapter 5 - The Impact of Climate on Regional Forests*
http://www.necci.sr.unh.edu/necci-report/NERAch5.pdf

[3] Thomas G Huntington, Glenn A. Hodgkins, Barry D. Keim, and Robert W. Dudley. 2004: Changes in the Proportion of Precipitation Occurring as Snow in New England (1949–2000). *Journal of Climate*: Vol. 17, No. 13, pp. 2626–2636.
http://www.ametsoc.org/amsnews/newarming-726.pdf

the winter months. In Vermont, the average mean wintertime temperature has increased 3.0 degrees F since 1895.[4]

Even with this mounting evidence for climate change and global warming, there remain many uncertainties as to the consequences. Climate change can be a volatile issue, and there are plenty of skeptics. Unfortunately, variations in *weather*, rather than *climate*, often are used to discredit global warming. A streak of unusually cold weather, such as in July of 2001, is not a basis for refuting changes in climate. In fact, the entire year of 2001 was the second warmest in recorded history (and 2004 goes on record as the fourth warmest, with the top 10 warmest years all occurring since 1990). Climate is a *"motion picture"* and involves averaging many *"still-frame weather snapshots"*.

The story here isn't that the Earth's climate is changing; the story is that humankind is rapidly forcing the Earth into a period of instability that we, and possibly no other species, have ever experienced. How that story ends depends on our foresight and planning, or lack thereof, and how we choose to conduct ourselves from this point forward. George Perkins Marsh's words of long ago may be more pertinent today than they were in his own time.



Global warming will affect everything and everybody to some degree. It is up to each one of us to do what he or she can to try and mitigate the worst of its possible effects, and to plan carefully so that we may begin to adapt to the inevitable changes it will bring to our lives and the natural environment.

I-b. Importance of Adaptation to Climate Change

> *"While we must lower our emissions to minimize the change, we must realize that because these gases last a long time in the atmosphere, it is not possible to reverse within our lifetime the current trend of changes. Therefore we must consider how we can adjust or adapt to the changes."*
>
> *~Dr. Mathias Ruth (Associate Professor at Boston University)*

Even small climatological changes are likely to perturb our weather patterns in Vermont and contribute to more severe and more frequent extreme weather events ranging from floods, to

[4] Barry Keim and Barrett Rock. 2002: *The New England Regional Assessment (NERA). Chapter 2 – The New England Region's Changing Climate*
http://www.necci.sr.unh.edu/necci-report/NERAch2.pdf

droughts, ice storms, and heat waves. It may be impossible to make a clear "cause and effect" relationship between an individual weather event and climate change, and just as difficult to predict when and where such severe events will strike… but it is important that the State of Vermont carefully consider the potential consequences that severe weather events pose to the "built environment", including roads, culverts, bridges, water supply sources, wastewater treatment plants, etc.

An effective adaptation strategy should include proper siting of new infrastructure away from flood plains, erosion-prone areas, etc. In addition, construction standards should be evaluated and modified appropriately so that infrastructure is designed properly to withstand exposure to more extreme weather events. As an example, road designs must incorporate proper drainage of the road surface; and any associated culverts must be sized appropriately to function under more extreme and more frequent flood conditions than we have experienced in the past. The State will better protect the well-being of Vermonters by utilizing prudent engineering practices in all new construction projects, as well as renovations / upgrades to existing infrastructure,

In Appendix 3 of the document entitled "*The Local Emergency Management Director's Guide*", the Vermont Department of Public Safety already acknowledges that global warming is poised to become an emergency management issue. The report correctly states: *"The severity of its effects are difficult to anticipate, as it has not happened to us before."* Fortunately, we may look to the work of others to begin to improve our understanding of what actions we can implement. The Conference of New England Governors and Eastern Canadian Premiers (NEG-ECP) recently conducted a symposium in March 2004 that will result in the creation of a report to summarize expected regional climate change impacts, and provide recommended adaptation strategies. In addition, the CLIMB project (Climate's Long Term Impacts on Metro Boston) has conducted substantial research recently in order to address adaptation to the effects of climate change. The project has been a collaborative effort between Tufts University, Boston University, and the Metropolitan Area Planning Council, with a goal to study the potential impacts of climate change on infrastructure systems in metropolitan Boston, and to recommend strategies to prevent or mitigate the risk. Certainly, some of the risks that are anticipated for Boston may not be particularly relevant to Vermont. Still, this research offers a wealth of information that may assist the State of Vermont in identifying, anticipating, and adapting to the potential risks associated with climate change.

I-c. Regional Best Practices

In August 2001, the NEG-ECP came to agreement that climate change / global warming presented a credible threat to the Northeastern U.S. and Eastern Canada. The collective endorsement of the NEG-ECP Climate Change Action Plan, ongoing planning efforts, and GHG reduction actions by state and provincial governments is an ambitious and important step toward mitigating this global problem. This pioneering regional initiative serves to fill the void created by a lack of similar, potentially further-reaching federal government initiatives.

The goals established by the NEG-ECP Climate Change Action Plan are as follows:

Short-term Goal: Reduce regional GHG emissions to 1990 emissions by 2010.

Mid-term Goal: Reduce regional GHG emissions by at least 10% below 1990 emissions by 2020, and establish an interactive five-year process, commencing in 2005, to adjust the goals if necessary and set future emissions reduction goals.

Long-term Goal: Reduce regional GHG emissions sufficiently to eliminate any dangerous threat to the climate; current science suggests this will require reductions of 75-85% below current levels.

In signing the NEG-ECP regional Climate Change Action Plan, Vermont (and all other participating states and provinces) voluntarily agreed to make genuine efforts to reduce its own emissions so that GHG emission reductions within the entire region meet the aforementioned goals by 2010. Within the Action Plan is a menu of nine recommended Action Items which participating governments may use to facilitate GHG emission reductions (For a detailed description of each Action Item, refer to the NEG-ECP Action Plan at http://www.negc.org/documents/NEG-ECP CCAP.PDF). It is important to make clear that each state or province will likely focus its initial efforts on a subset of these Action Items that best fit its own specific emissions, social, political, and economic profiles, thereby attempting to provide the greatest GHG emissions reductions at the least total cost. Such varying approaches among the participating jurisdictions are an acceptable outcome within the framework of the NEG-ECP plan so long as the region (as a whole) progresses toward attainment of the established goals.

The State of Vermont absolutely is committed to enacting additional measures to reduce in-state GHG emissions. It is worth noting several initiatives where Vermont has already made relatively good progress. The list below is not exhaustive, but highlights a few of the more important undertakings and approaches already in existence:

- Vermont has adopted programs that foster fuel efficiency and reduced emissions, such as the California low emission vehicle (LEV) program that will steer the market toward increased use of hybrid drive systems and other advanced technologies. Other programs such as the "Onboard Diagnostics" (OBD) vehicle inspection requirement help ensure that vehicle engines are maintained so that they operate as efficiently as possible.

- Vermont's existing electricity generation is already comparatively low in GHG emissions (and has been for some time because of goals and policies established in the late 1980s and early 1990s). This makes it difficult to achieve substantial reductions in this sector, and makes ongoing evaluation and planning crucial to *maintaining* an electrical generation mix characterized by low emissions.

- Vermont was the first state in the nation to have an "Energy Efficiency Utility" that provides technical guidance and financial incentives to Vermonters to help reduce energy costs through energy efficiency improvements in their homes and businesses. Efficiency Vermont was established by the Vermont Public Service Board and the Vermont Legislature in response to a request from the Vermont Department of Public Service, all of the state's twenty-two electric utilities, and a dozen consumer and environmental groups.

Chapter II – Vermont's Initial Goals

In order to most effectively address GHG emissions from sources throughout the state (including both the public and private sectors), the Vermont State Government must "lead by example" by reducing its own GHG emissions. Lessons learned from this undertaking will greatly improve the ability and credibility of state government to play a meaningful role in helping to promote statewide GHG emissions reductions.

In September 2003, Gov. James Douglas signed Executive Order #14-03 aimed at addressing NEG-ECP Climate Change Action Plan - Action Item #4: "State and Provincial Governments to Lead by Example". This Executive Order calls for creation of the Climate Neutral Working Group (CNWG) and directs state government agencies and departments to reduce greenhouse gas emissions from state government buildings and operations by an amount consistent with the recommendations of The Conference of the New England Governors and Eastern Canadian Premiers Climate Change Action Plan. The goals are to reduce region-wide GHG emissions (within the public sector) from the 1990 baseline by: twenty-five percent by 2012; fifty percent by 2028; and, if practicable using reasonable efforts, seventy-five percent by 2050. The complete text of Executive Order #14-03 can be found in Appendix A of this report.

The first goal of this first biennial report is to provide a clear summary of the ongoing work of the CNWG since the signing of the Executive Order regarding climate change. Secondly, it aims to provide strategies and recommended actions to be considered by the administration and implemented over the course of the next two years to help us begin to move closer to the 2012 GHG reduction goal. The recommendations of this first biennial report should not be interpreted as sufficient on their own to allow us to reach the 2012 goal. Greenhouse gas emission reductions resulting from the implementation of any (or all) of the actions recommended by this first CNWG biennial report will be evaluated in the second biennial report (autumn / winter 2006). In short, the work of the CNWG does not end with this report. With this report, the CNWG puts forth initial recommendations for action to begin reducing our GHG emissions. Over the course of the next 2 years, the work of the CNWG must focus on:

(1) Assisting with implementation of the recommended actions,

(2) Quantifying resulting emissions reductions and documenting progress toward the GHG emissions reduction goal, and

(3) Using this information as a guide to selecting new strategies and recommendations for action to be included in the 2006 biennial report.

In addition, the efforts of the CNWG will both supplement and draw upon parallel efforts such as the Department of Buildings and General Service's (BGS) Comprehensive Environmental & Resource Management Program (CERMP) and impending updates to the State Agency Energy Plan (SAEP) required by Vermont Statute 3 V.S.A § 2291.

Chapter III – Inventory of Vermont State Government Energy Consumption and Greenhouse Gas Emissions

The logical first step toward meeting the goals established by the executive order was to determine energy consumption and GHG emissions (1990 base year and current year) from all measurable energy consuming and GHG-emitting activities of state government. This report divides the activities into two major categories, namely *"infrastructure"* and *"transportation".* Infrastructure includes indirect emissions from electricity consumed within buildings owned and / or occupied by Vermont State Government. It also includes direct, or onsite, emissions from energy or fuel consumed for space heating within these buildings. Transportation encompasses direct GHG emissions from vehicle fuel consumption (either state fleet or personal vehicles) traveling on official state business, as well as emissions from vehicles that employees use for commuting to and from work each day.

It is important to note that this first biennial report only addresses emissions of carbon dioxide (CO_2) from state government operations, rather than total greenhouse gases (GHGs). This is in part due to the relative difficulty with which emissions of other major GHGs, such as methane (CH_4), nitrous oxide (N_2O), etc. can be quantified accurately from the available data. For combustion sources, which comprise the overwhelming majority of GHG emissions in state government, carbon dioxide emissions have a direct relationship to the quantity of fuel burned. In other words, we can estimate CO_2 emissions by simply knowing the amount and type of fuel combusted, the portion of fuel oxidized during combustion, and the carbon content of that fuel. To estimate emissions of the other GHGs accurately, more detailed data regarding the specific technology used to combust the fuel, pollution control devices in place, ambient environmental conditions, and maintenance and operational practices is required.[5] More robust data collection would enable the CNWG to account for additional GHGs (including emissions of other combustion as well as non-combustion GHGs) in future reports. In order to get the most complete picture of GHG emissions and emissions reductions, the CNWG should work with appropriate state agencies to improve data collection in upcoming years, and update the emissions inventory to include additional GHGs if feasible. For purposes of this first biennial report; however, the CNWG focuses on CO_2 emissions as a reasonable proxy for GHG emissions, since CO_2 emissions vastly exceed emissions of the other GHGs from fuel combustion.

III-a. Infrastructure: Electricity Consumption

Electricity consuming devices used in daily state government activities include lighting, and office equipment such as computers, copy machines, fax machines, printers, etc. In addition there are microwaves, refrigerators, coffee machines, vending machines, fans, air conditioners and a variety of electrical motors and other devices that keep things operating behind the scenes. With assistance from the Department of Buildings and General Service's (BGS) *Comprehensive Environmental & Resource Management Program* (CERMP), the CNWG obtained available electricity bills to determine usage in kilowatt-hours (kWh) for 2003. Similar records were largely

[5] U.S. EPA. April 2004: INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2002. http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2004.html

unavailable for the 1990 base-year. As a result the 1990 electricity usage was estimated as follows: 1990 Electricity = 2003 electricity x (ratio of 1990 heating emissions total / 2003 heating emissions total). This estimate may be improved upon through upcoming data collection efforts to be undertaken as part of the SAEP.

Determining CO_2 emissions from electricity consumption required that we know not only the kWh consumed by state government activities, but also know the emissions characteristics of the electrical generation mix. For this purpose, the CNWG used the regional average CO_2 emissions rate (in pounds per kWh) for the New England Power Pool (NEPOOL) region during both 1990 and 2003. The regional rates for 1990 and 2003 were 1.08 lbs CO_2 / kWh and 0.99 lbs CO_2 / kWh respectively, which take into account emissions attributable to electrical transmission and distribution losses. The basic assumption of this approach is that Vermont receives its electricity from the regional electrical grid (NEPOOL). The regional grid is a reservoir of electricity created by the electrical generation activities throughout the region. Inputs to the reservoir include a range of generation types ranging from high CO_2 emitters (fossil-fueled plants) to low CO_2 emitters (hydro, nuclear, wind facilities, etc.). Whenever electricity is consumed anywhere in the region, it is assumed to come from this homogenized pool.

As we move toward meeting the 2012 GHG reduction goal, we will need to carefully evaluate and do our best to forecast any dramatic changes to the electricity mix. For example, a reduction in nuclear or hydroelectric power (which have low CO_2 emission rates) would likely mean an increased consumption of fossil fuel generated electricity from the NEPOOL grid. As such a scenario would make it more difficult to attain our 2012 goal, the CNWG must work with experts from the Vermont Department of Public Service (DPS) to anticipate changes to our future electrical consumption mix, and encourage the use of cleaner electricity generation technologies that are less GHG intensive. This GHG emissions inventory shall be adjusted as needed, enabling us to evaluate the impacts of such changes.

III-b. Infrastructure: Space Heating

Infrastructure space heating refers to CO_2 emissions from both fossil fuel-fired and wood-fired boilers / furnaces that provide heat to buildings owned and/or operated by the State of Vermont. During 2003, approximately 73% of space heating needs (on a BTU basis) was met through combustion of fossil fuels. The remaining 27% was generated by the combustion of woody biomass (wood). Combustion of wood is generally thought of as being “carbon neutral”, since trees sequester CO_2 (but not other GHGs) during their growth as part of the natural carbon cycle of the biosphere. Using this rationale, CO_2 emissions from woody biomass combustion are commonly not counted in an emissions inventory. Throughout this report, space heating data obtained from the CERMP rely on the carbon neutrality assumption. This assumption is valid so long as trees that are combusted for space heating are efficiently grown, efficiently harvested and transported, and efficiently burned.

III-c. Transportation: Official State Business

This category includes emissions from fleet vehicles owned by the State of Vermont as well as emissions from state employee use of personal vehicles for official state business. The methodology used for this portion of the inventory was adapted from the CERMP and the BGS *Fleet Management Proposal for Passenger Vehicles*. Using data obtained from BGS, we estimate 2003 CO_2 emissions from total state fleet vehicles at roughly 41,000 tons. As of November 2003, the State of Vermont owns and operates 561 passenger vehicles. This number excludes law enforcement, highway maintenance, and other special purpose vehicles. The 561 passenger vehicles represent approximately 13% of the total fleet emissions, or 5,300 tons of CO_2 emissions.

III-d. Transportation: Employee Commuting

Partly due to Vermont's rural landscape, and partly to personal choice, Vermont state employees travel substantial distances on their daily commute to work. The average commute is approximately 33 miles round trip. On any given workday, state employees currently travel an estimated 266,000 vehicle miles round trip from their homes to work and back again. That translates to roughly 59 million vehicle miles traveled (VMT) annually. While as many as 25 percent of state employees work in the same zip code in which they live, the daily VMT for these local travelers is estimated at only 8,000, which is less than 6 percent of the total.

Determining CO_2 emissions required making an assumption about the overall average fuel economy of the personal vehicles used by state employees. Vehicle fuel economy varies widely from lower than 15 miles per gallon (mpg) for some large sport utility vehicles (SUVs) and full-size pickup trucks to roughly 50 mpg for gasoline-electric hybrid passenger vehicles. Refinement of this number would be possible by conducting a widespread survey of state employees regarding the make and model of their personal vehicles, and then applying the appropriate average adjusted city / highway EPA fuel economy estimate for each vehicle make / model / year combination. At this time, the CNWG plans to conduct such a survey; however it is not yet complete. For purposes of this report, we used the U.S. EPA adjusted average fuel economy of 20.8 mpg (for all light duty vehicles), and further adjusted (for average Vermont monthly temperatures and vehicle idling) to obtain an average estimate of 18.3 mpg for all state employee personal vehicles. Based on this assumption, state employee commuting consumed approximately 3.2 million gallons of gasoline in 2003 (roughly 1% of total gasoline sales in Vermont), thereby emitting approximately 31,500 tons of CO_2.

III-e. Energy Consumption and CO_2 Emission summary

Simultaneously looking at all the emissions data allows us to compare the relative contribution from each category listed in this chapter, and provides a first step in determining where reduction efforts may be most needed. Figure 1 shows the relative emissions contributions from each category for both 2003 and the 1990 "base year." Total estimated CO_2 emissions from all four categories were approximately 131,000 tons during 1990 and about 138,000 tons during 2003. Despite annual differences in the composition of the state vehicle fleet, fuel mix used for space heating, number of state employees, and electricity consumption, the overall relative contribution from the four categories was similar for both years (see Figure 1).

Figure 1. Comparative (1990 vs. present) Carbon dioxide (CO_2) emissions from Vermont State Government activities

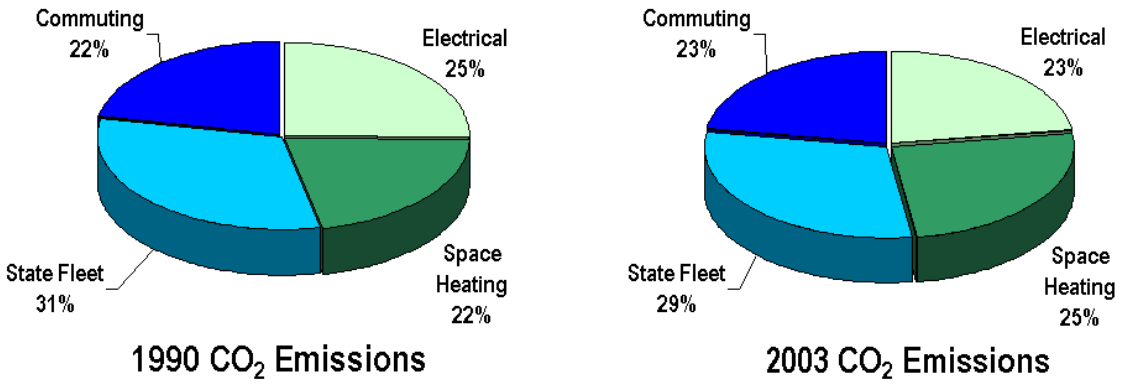


Figure 2 represents a projection of these data out to 2012 taking into account the Executive Order goal of reducing emissions by 25% below 1990 levels by 2012. The 2012 emission reduction goal (total emissions of roughly 98,277 tons) can be reached either by trying to reduce emissions from each category by the same amount over the next 8 years (approximately 1,248 tons CO_2 in each category per year, for a total annual CO_2 reduction of approximately 4,990 tons), or by weighting the reductions based on the current relative contribution of each category to the total emissions. Estimated annual CO_2 reductions based on the "weighted" approach" can be seen in Table 1 below.

Figure 2. Summary of Vermont State Government CO_2 emissions

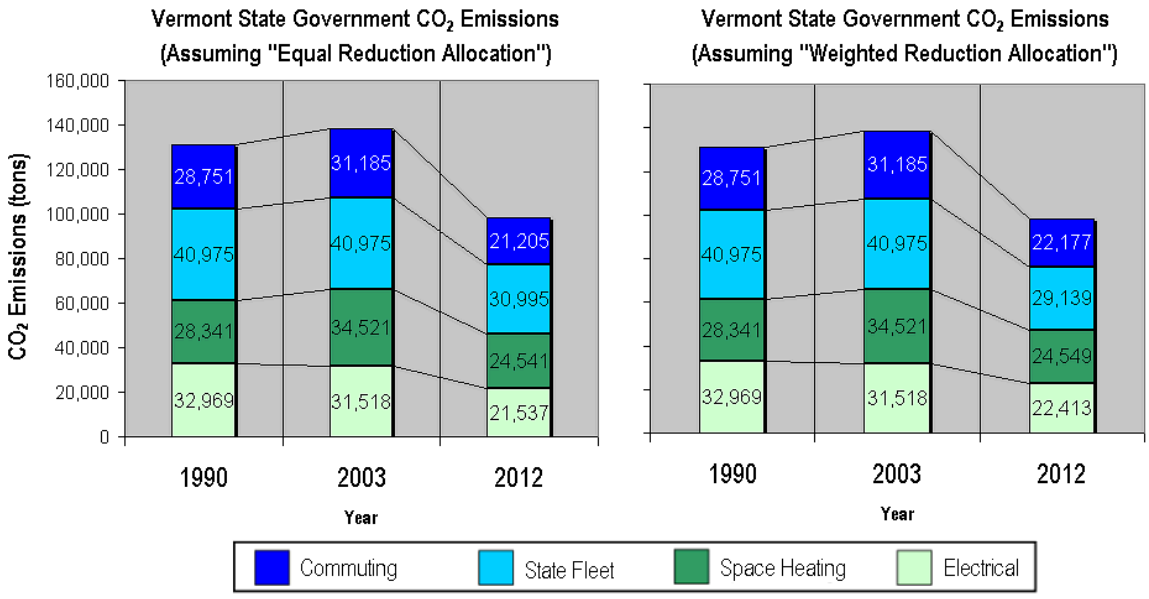


Table 1. Estimated "weighted" annual CO_2 reductions required to meet 2012 goal

Category	Annual CO_2 reduction (tons)
Electricity Consumption	1,138
Space Heating	1,247
Total State Fleet	1,480
Employee Commuting	1,126
TOTAL Annual CO_2 reduction required	~4,990

It is possible that during the course of efforts undertaken by state government to reduce CO_2 emissions, it may find that there is relatively little that can be done reasonably to reduce emissions from a particular category. As a result, it may become necessary to adopt an alternate approach, which strives for disproportionately high emissions reductions from one or more of the remaining categories in order to meet the 2012 goal. It will be crucial throughout this entire process to maintain careful documentation of actual emissions reductions in each category, and adjust our efforts accordingly.

Chapter IV – Potential Strategies to Reduce GHG Emissions Within Vermont State Government

The inventory presented in the previous chapter provides us with a measure of our historical and current CO_2 emissions, as well as a metric by which we may document progress toward our goals. Now that both the start and finish lines have been established, we begin to examine and recommend energy and CO_2-reduction strategies that will keep us on the path to meeting our goals. This chapter outlines a menu of potential strategies that the State of Vermont may employ during the ongoing effort to reduce CO_2 emissions from state government infrastructure and transportation. The strategy list should not be viewed as exhaustive or complete, but rather as a set of measures or "toolbox" that the CNWG may draw upon and augment as appropriate.

Most of the strategies in this "toolbox" are adapted from existing literature and research, the climate change efforts of other states, and policy / program development already underway within the State of Vermont. They range from changing employee behavior to implementing new programs and policies. Some provide clear, immediate gains and are easily implemented. Others likely will take several years, require careful policy decisions, and require shifting or increasing available resources. The CNWG has placed each strategy into one of the following categories: "Current", "Short-range", "Mid-range", or "Long-range". These categories signify an anticipated general timeframe during which each strategy might be implemented as a recommended action.

At this time, a number of these strategies present us with uncertainties for accurately quantifying GHG reduction benefits, thereby requiring further research and study by the CNWG. In Chapter V of this first biennial report, the CNWG has selected a subset of the strategies outlined here in Chapter IV to put forth as recommended actions that the State of Vermont should institute over the next 2 years in its efforts to reduce GHG emissions from state government activities. The list of recommended actions put forth in Chapter V is deliberately brief so that state resources and efforts will allow thorough and successful completion of each recommended action and provide quantifiable reductions toward the 2012 goal. Over the next two years, the CNWG will continue to refine and improve upon the "strategy toolbox" in order that a number of these strategies (and additional ones) may be put forth as recommended actions in the second biennial report due autumn / winter 2006. In addition, to ensure effective use of resources and avoid redundancy, the efforts of the CNWG, CERMP, and SAEP must be well coordinated during 2005-2006.

Potential Infrastructure Strategies:

Current

1. The State shall update the State Agency Energy Plan (SAEP) (3 V.S.A. Section 2291) to include the strategies and actions called for in this biennial report, and require each agency "to engage in a continuing planning process, coordinated by BGS, to assure that programs and actions are consistent with the goals established in the State Agency Energy Plan" and that "by January 1st, 2006 each state agency shall adopt an implementation plan" to be readopted every five years.

2. The State has available the newly created Resource Management Revolving Fund (RMRF) that provides an initial source of revenue for implementation of resource conservation measures anticipated to generate a life cycle cost benefit to the State. The RMRF will be reimbursed through realized life cycle cost benefits.

3. Alternative fuels continue to be a viable option to the use of fossil fuels for the State. Wood biomass (wood chunk, chips, biodiesel) accounts for about 10% of the fuel expenditures of BGS-tracked facilities (providing about 27% of the heating energy requirements on an equivalent BTU basis) and 55% of VTrans garage square footage is heated with wood. A wind generator is being constructed at a welcome center and one is being planned for a fish hatchery. Geothermal heating systems are being constructed at a rest area and a state office building. The State also utilizes alternative energy delivery systems, such as the cogeneration system installed recently at a major correctional facility, to improve the overall energy profile of the State's infrastructure

4. Some state agencies have purchased electronic document management (EDM) software and are currently scanning paper documents to make them available either through their intranet or the internet. This is driven primarily for customer service reasons (to improve permit/license application turnaround time and access to public information) but has potential for reducing GHG emissions through space reductions for paper storage and through increased telecommuting possibilities. The CNWG should monitor the implementation of EDM and ensure that GHG reductions are maximized and carefully documented.

<u>Short-range</u>

1. The State of Vermont could consider providing educational materials and training to state building managers and all state employees regarding wise energy use, energy efficiency, behavioral changes that will result in energy conservation, etc. In order that training efforts are maximized, the state could consider incentives to reward employees who put the training to actual use. An existing program example:
    - VTrans has a program called Best Overall Maintenance Site (BOMS) in which garage crews compete for significant awards (each employee from the site deemed the "overall state winner" gets $300, 2nd prize $100/employee, district winners $50/employee). Currently the areas judged are safety and hazmat-related, but energy management practices could be documented and included as well. VTrans also has an "on-the-road" training program that brings training on various topics to the districts at the garages. Again, these are mostly safety and hazmat-related, but energy management practices could also be taught.

2. The State could consider implementing an "Energy-Use Reduction Program" to reduce GHG emissions from government activities.
    - As outlined in the CERMP, "the State could work with private energy contractors and utility companies to analyze the State government's energy needs, improve purchasing procedures for efficient acquisition of new technology, and propose an audit method to identify best-practices for new energy-saving technologies."

3. The State could investigate and put into practice innovative energy efficiency and conservation policies / actions including:
   3.1. Work with information technology (IT) personnel to install "SLEEP is GOOD" software (available from Efficiency Vermont) or comparable automatic power management software on each computer or set up so that control is at the network level.

   3.2. Promote a policy ensuring that IT staff, and administrative staff activate proper power management features on all computer printers and copy machines.

   3.3. Purchase and install appropriate energy saving devices such as Vending Misers on all vending machines (except in rare locations where consumer traffic flow would prevent Vending Miser from properly turning off vending machine lighting and compressor to realize energy and cost savings)

   3.4. Improved Heating, Ventilation and Air Conditioning (HVAC) operation.
      3.4.1. Install computerized direct digital control (DDC) technology to optimize building indoor environmental control. DDC technology makes it possible to monitor multiple indoor environmental parameters, and adjust HVAC with greater efficiency
      3.4.2. Install indoor carbon dioxide measuring devices to match HVAC output to actual occupancy load
      3.4.3. Refurbish / tune-up existing HVAC systems on a regular basis

   3.5. Install indoor occupancy sensors and light sensors to utilize artificial lighting only when necessary.
   3.6. Continue to purchase only equipment / devices that meet or exceed the Energy Star standards established by the U.S. Government.
   3.7. Require the establishment and use of technology such as "benchmarking" in order to measure resource consumption to assist in determining measures to modify our infrastructure. BGS recently received a $126,000 grant from DPS and DOE to use Energy Star Portfolio Manager software to benchmark state building energy use. Use of benchmarking technique will identify buildings with substandard performance, and focus on improving existing state building envelopes (windows, vestibules, thermal barriers, etc.) using the United States Green Building Council's "Leadership in Energy and Environmental Design" (LEED) guidelines or comparable guidelines suggested by the SAEP.
      - Utilize efficiency guidelines in construction of all new Vermont State Government buildings so that they perform at levels 30% better than that required by existing energy code.
      - Periodically evaluate available lighting / lamp technology and initiate new replacement programs. This should apply to indoor office lighting, outdoor lighting, illuminated signage (including exit signs), etc.
      - Investigate district-heating options that provide combined heat and power (CHP) opportunities and efficient, clean use of renewable fuels wherever feasible.

4. The State could investigate the changes EDM can make on central file-storage facility needs. Plans to expand the file-storage facility in the next three years should be re-examined to determine

if expansion is necessary given increased, decentralized electronic document storage state-wide. If physical storage is necessary, must it be heated or will cold storage suffice?

Mid-range

1. The State could consider buying/leasing/building small, regional, general office space in locations where state employees live rather than buying/leasing/building large, centralized, agency-centric office space in Montpelier as planned (National Life or expansion of 133 State Street). Increased use of EDM means that fewer office employees need to be physically located where the work is; work can be brought electronically to the employee. General office space would be designed to use the "hoteling" concept to reduce space needs for home office, vacationing, or on-the-road workers.

Potential State Fleet / Transportation Strategies:

Current

1. The State of Vermont is investigating and working to establish a centralized fleet that will result in the following:
    - Consistent collection and monitoring of fuel use and emissions data
    - Rightsizing (using the right size and type of vehicle for the job)
    - Timely and consistent maintenance schedules
    - Replacing the use of state employee personal cars (for official state business) with use of more fuel efficient and lower emission state fleet vehicles, without increasing the total vehicle miles traveled by employees during pick up and drop off of fleet vehicles and traveling to and from home

2. State contracts are being written to require the purchase or rental of the most fuel-efficient and lowest emission vehicles in each vehicle class for the state fleet.

3. The State is investigating the environmental and economic impacts of replacing the use of conventional diesel fuel with appropriate biodiesel blends, and will begin replacement wherever appropriate.

Short-range

1. The State could investigate and promote ways to increase the use of telephone, video, and online conferencing to reduce trips. Videoconferencing may take the form of web-cast trainings or using interactive television to replace some face-to-face meetings. Using technology where available, state employees may participate in trainings or meetings without leaving their workstation.

2. The State could consider utilizing a single (or compatible) maintenance, parts and equipment contract(s) for state motor vehicles and motorized equipment that require state of the art emissions, fuel efficiency, and overall environmental beneficial technologies and practices.

3. The State could consider requiring maintenance procedures for heavy-duty vehicles that promote state of the art emissions control, fuel efficiency, and other environmentally beneficial technologies and practices.

4. The State could market and promote the use of public transit and vanpools (when available), ridesharing, and non-motorized options such as walking and biking while on the job.

5. The State could consider establishing and actively promoting shuttle bus/van routes and schedules between key state facility destinations (e.g., Montpelier / Waterbury / Burlington).

6. The State could consider expanding existing vehicle anti-idling education campaigns on state-owned property.

Mid to long-range

1. When feasible, new state facilities and services (such as copy centers, daycare, etc.) could be located within close proximity and within mixed-use growth centers.

Potential State Employee Commuter Management Strategies:

Short to mid-range

1. The State could convene a Transportation Demand Management (TDM) Committee to evaluate feasibility and effectiveness of various TDM strategies, and implement those deemed suitable to reduce GHG emissions generated by state employees commuting to and from the workplace.

2. The State could conduct a survey of all state employees to determine more accurately the present level of employee participation in carpooling, vanpooling, or other mass transit as a means of commuting to and from the workplace.

3. The State could establish an official numeric "code" in the Department of Personnel Human Resource Management System (HRMS) that can be used to indicate "telecommuting" as a recognized work activity. This code will enable the CNWG to measure the level of employee participation, associated GHG emissions reductions, and effectiveness of potential future telecommuting initiatives put forth by the TDM Committee.

4. The State could consider setting aside desirable and convenient reserved parking spaces in every state employee parking lot to reward employees driving vehicles that utilize hybrid (or other fuel economy enhancing) technology, or meet strict emissions standards such as AT PZEV (Advanced Technology Partial Zero Emission Vehicles). Able-bodied drivers of less efficient, more polluting vehicles would park in less convenient spaces.

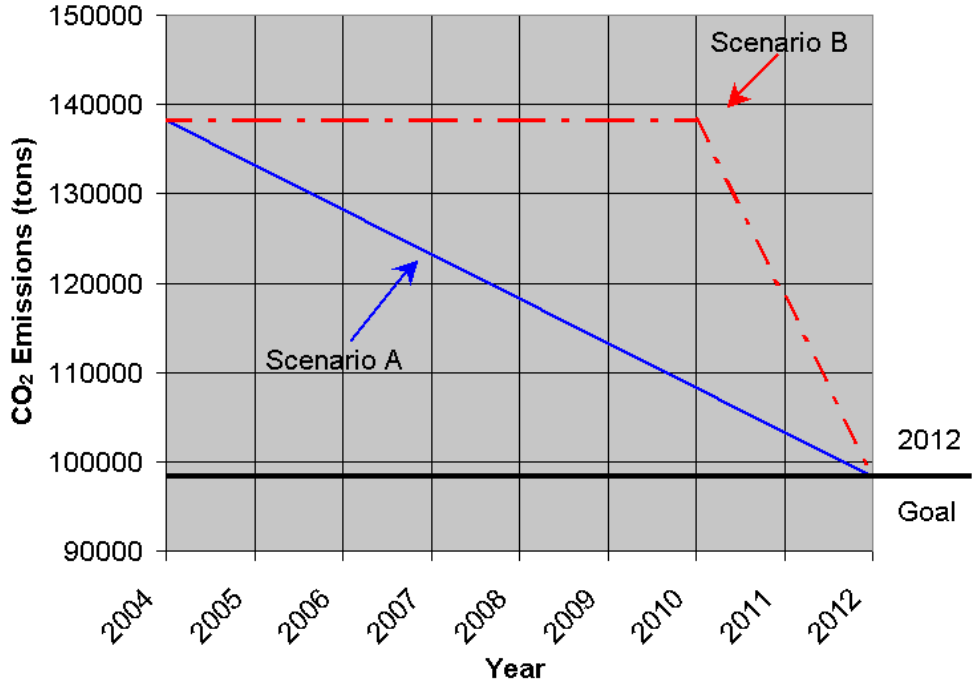
Chapter V – Recommended Actions to Begin Reducing Carbon dioxide (CO_2) Emissions From Vermont State Government Activities.

This chapter contains the short-list of strategies that the CNWG presents as recommended actions for Vermont State Government to initiate during the 2005-2006 timeframe. The general criteria used to identify these recommended actions as "low-hanging fruit" (i.e., relatively straightforward to implement compared to other strategies) include the following:

1. The CO_2 reduction benefit is clear
2. Complementary work is already underway by BGS or others to implement policy changes
3. There is minimal new cost associated with the recommendation
4. The recommendation can be easily (in a relative sense) and consistently adopted and enforced throughout state government.
5. It is possible to initiate a pilot project(s) to assess potential CO_2 reduction benefits.

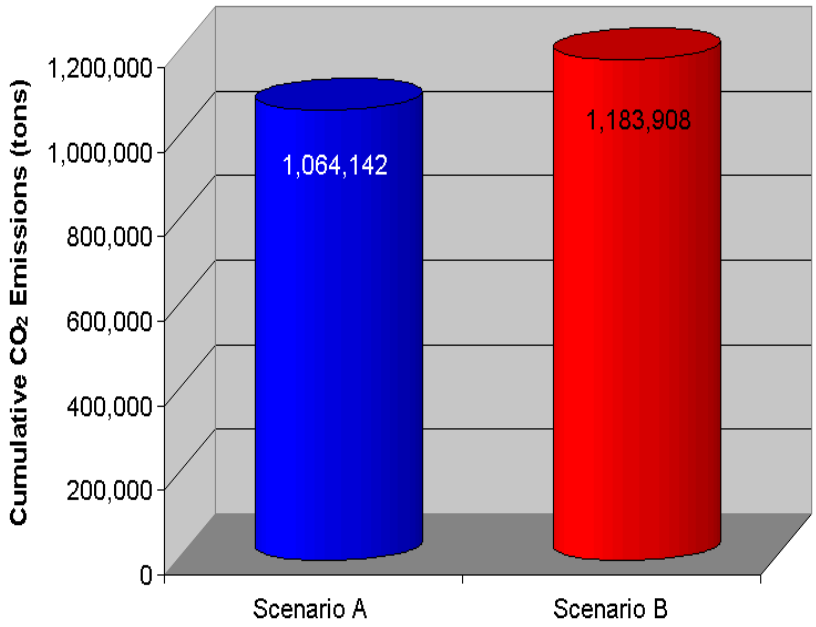
It is worth reiterating that the list of recommended actions is intentionally short, in order that each action receives maximum available state resources for successful implementation over the next two years. Also, as we act to reduce CO_2 emissions within state government, it is important to remember that the greatest total GHG emissions reductions can be achieved through efficient and timely actions. For example, Figure 3 illustrates that we can meet the 2012 GHG emissions goal through systematic, well-implemented incremental actions (Scenario A) of approximately 4,990 tons per year (as outlined in Chapter III). The same goal theoretically can be met by postponing actions for several years, followed by actions that produce a sudden more dramatic decrease in emissions (Scenario B).

Figure 3. Two potential emissions reduction implementation schedules to meet the 2012 CO_2 reduction goal



However, timely and efficient actions (Scenario A) provide an important cumulative GHG emissions reduction benefit that is not provided by the more sudden and dramatic approach (Scenario B) (see Figure 4). In this hypothetical example, following Scenario A would prevent the emissions of 119,766 tons of CO_2 relative to following Scenario B. This savings is approximately equivalent to an avoided extra year of emissions from Vermont State Government operations.

Figure 4. Comparing cumulative (8 year) CO_2 emissions from two potential emissions reduction implementation schedules



As in the previous chapters, this chapter divides the recommended actions between the major emissions categories (Infrastructure, Transportation). Whenever possible, the CNWG has provided a best estimate of potential CO_2 emissions savings so that a metric exists by which we can gauge the level of effort needed to make genuine progress toward the 2012 goal. In a few cases, the CNWG also provides an estimate of financial savings. This cost information should provide valuable information for a program like the Resource Management Revolving Fund (RMRF), discussed in Chapter IV and in this chapter.

Infrastructure:

Recommended Action #1: Initiate widespread "Benchmarking" of buildings owned and operated by the State of Vermont, so that those with sub-optimal performance can be identified and given priority for performance upgrades such as comprehensive HVAC upgrades, building envelope improvements, window replacements, etc. At this time the actual GHG emissions reduction benefits from benchmarking are not readily quantifiable. However, as

the benchmarking process is applied to each building using the Energy Star Portfolio Manager,[6] the CNWG will be able to collaborate with BGS engineers on a case-by-case basis to determine feasible building improvements and associated GHG emissions reductions. Energy and GHG emissions reductions are expected to be substantial.

Recommended Action #2: Identify and implement resource conservation measures that are compatible with the goals of the newly created Resource Management Revolving Fund (RMRF). The RMRF[7] provides initial funding for implementation of measures that reduce energy consumption and GHG emissions, while simultaneously providing an anticipated financial savings to the State over the useful "life" of the measure (life cycle cost benefit). The RMRF will be reimbursed through realized life cycle cost benefits. Actual CO_2 emissions savings will be quantifiable on a case-by-case basis.

Recommended Action #3: Purchase and install Vending Misers on all conventional vending machines, or specify mandatory use of ENERGY STAR Refrigerated Beverage Vending Machines in state vending contracts. A CNWG case study (Appendix B) indicates that the State of Vermont could avoid approximately 1,000 lbs of annual indirect CO_2 emissions from electricity consumption for each Vending Miser installed. This represents an approximate 32% energy savings and $100.00 cost savings annually per machine. Similar savings would be expected from use of Energy Star refrigerated beverage vending machines, which are approximately 35% more energy-efficient than standard new machine models. Energy Star vending machines directly incorporate more efficient compressors, fan motors, and/or lighting systems and are equipped with a low power mode option that allows the machine to be placed in low-energy lighting and refrigeration states during times of inactivity.

Recommended Action #4: Work with information technology (IT) personnel to install "SLEEP is GOOD" (available free from Efficiency Vermont) or comparable automatic power management software on each computer or set up so that control is at the network level. Based on a case study performed by the CNWG (see Appendix B), we estimate that the State of Vermont could avoid between 170 and 450 lbs of annual indirect CO_2 emissions from electricity consumption per computer monitor that has proper power management when not in use vs. one that is constantly left on. This represents a financial savings of between $17.00 and $46.00 per machine per year. Going one step further, the State of Vermont could achieve an estimated additional CO_2 emissions savings as much as 300 lbs (and financial savings of approximately $30.00) per computer / monitor combination per year if employees simply turn both computer and monitor off during non-work hours and weekends.

Recommended Action #5: Promote a statewide policy encouraging IT staff, and administrative staff to activate good power management features on all computer printers and copy machines. Purchasing office equipment displaying the Energy Star logo does not necessarily mean that it will automatically provide the assumed energy savings benefits. Equipment power management settings can often be adjusted so that greater energy savings can be realized. Additionally, the policy should provide a mechanism to educate employees about the

[6] http://www.energystar.gov

[7] See http://www.bgs.state.vt.us/policies/p0033.htm for a detailed description of the RMRF.

potential energy and financial savings that can be realized by simply turning off computers, monitors, copy machines, and printers at the end of each workday. Through education / policy, request that each employee turn off his or her own computer and monitor at the end of each workday. Encourage several employees to volunteer to take responsibility for making sure the copy machine(s) and computer printer(s) near their workstation are turned off at the end of each workday. If necessary, provide an incentive system.

Using a typical copy machines as an example: (See Appendix B)

- Utilizing proper power management settings so that copy machines go into standby mode when not being used can reduce CO_2 emissions by roughly 240 lbs per machine per year, and save about $26.00 in annual electricity costs per machine.
- The simple additional step of turning this machine off before leaving at night could save an additional 600 to 1,040 lbs of CO_2 emissions per machine per year, and save an extra $60.00 to $105.00 in annual electricity costs per machine.

Recommended Action #6: Utilize Building Energy Performance Contracts wherever deemed appropriate. According to the CERMP, *"the State could work with private energy contractors and utility companies to analyze the State government's energy needs, improve purchasing procedures for efficient acquisition of new technology, and propose an audit method to identify best-practices for new energy-saving technologies."* (For an example of an existing performance contract at the Mahady Courthouse, see Appendix B).

Recommended Action #7: Monitor electronic document management (EDM) implementation in state government and study ways to take advantage of possible facilities space savings. Convene a CNWG work group to:

- Review space needs at the Central Files facility in Middlesex to determine if EDM implementation affects planned expansion of that facility.
- Consider procuring small regional office facilities where employees live instead of the large centralized facility planned for Montpelier in the next few years.

Transportation - State Fleet:

Recommended Action #1: All vehicles purchased for inclusion in the Vermont State Fleet shall be appropriately sized according to intended primary use, and shall be among the most fuel efficient and lowest emission vehicle models in each class. This includes a purchasing preference for appropriate advanced technology vehicles including hybrid gasoline-electric vehicles. In addition, the Department of Buildings and General Services (BGS) shall utilize survey and auditing procedures to ensure that purchased vehicles are "right sized" for their intended primary use.

Data from the *BGS Fleet Management Proposal for Passenger Vehicles* compares vehicle costs and CO_2 emissions reductions (over a 6 year estimated lifetime) from a conventionally fueled Chevrolet Cavalier (28 mpg) and a Honda Civic Hybrid vehicle (up to 50 mpg). The data indicate that when looking at vehicle purchase price, fuel costs, maintenance and repair expenses, insurance, administrative fees, and resale value, the Honda Civic Hybrid would cost approximately

$363.00 per year more than the Chevy Cavalier while reducing CO_2 emissions by 5,500 lbs per year. This effectively means that for the hybrid vehicle is reducing 5,500 lbs of CO_2 emissions annually at the low cost of about $0.07 per pound.

Best available information suggests that the overall state passenger fleet has an average fuel economy of approximately 18.3 mpg. Carbon dioxide emissions reductions would be even greater if a vehicle having this average fuel economy was replaced with a hybrid vehicle that achieves up to 50 mpg. In this comparison, each hybrid vehicle would reduce CO_2 emissions by 12,200 lbs, roughly 6 tons per year! Since other passenger vehicles are generally more expensive and get poorer fuel economy than the Chevy Cavalier, it is also likely that the CO_2 reduction achieved by the hybrid vehicle would come with a financial *savings* rather than with a small associated cost as in the scenario above. As appropriate, these guidelines also shall apply to contracts executed for state employee vehicle rental for business travel.

Recommended Action #2: Increase the use of video and online conferencing to reduce vehicle trips and vehicle miles traveled. Actual CO_2 reductions from this category can only be calculated on a case-by-case basis where detailed information is available about vehicle fuel economy, and distance traveled by each meeting participant. However CO_2 emissions savings can be substantial. Example scenarios and their associated potential CO_2 savings are illustrated in the table below.

Table 2. Estimated CO_2 savings from use of various interactive video or online conferencing scenarios.

			Using video or online conferencing instead of face-to-face meeting	
Meeting Scenario	Face-to-Face Meeting Location	Participants	Single Meeting CO_2 savings *	CO_2 savings over 100 such meetings *
A	Waterbury	2 cars from Montpelier	56 lbs	3 tons
B	St. Albans	1 car each from Barre, White River Junction, St. Johnsbury, Montpelier	680 lbs	34 tons
C	Montpelier	1 car each from Burlington, St. Johnsbury, White River Junction	279 lbs	14 tons

** Assuming average vehicle fuel economy is 18.3 mpg.*

Recommended Action #3: Expand education and tracking of vehicle engine anti-idling campaigns pertaining to state fleet vehicles, as well as private sector vehicles operating on state-owned property. According to the U.S. Environmental Protection Agency and U.S. Department of Transportation, heavy duty diesel trucks "…*consume an estimated one gallon of*

diesel fuel for each hour at idle, using as much as 2,000 gallons (per truck) of fuel every year… On average, each truck idling produces about 22 tons of carbon dioxide … Studies indicate that idling can cost approximately $2,000 (per truck) annually from maintenance costs alone." Passenger gasoline vehicles also produce CO_2 emissions while at idle. For each hour at idle, an average gasoline passenger vehicle may consume almost ½ gallon of gasoline and emit approximately 10 lbs CO_2.

Recommended Action #4: Convene a CNWG sub-workgroup to formulate innovative strategies that will reduce GHG emissions from the extensive non-passenger portion of the state fleet. The "Reduce Non-passenger Vehicle Emissions Workgroup" (RNVEW) shall convene by June 2005, and shall consist of relevant experts (including non-passenger vehicle operators) from VTrans, BGS, Department of Public Safety, ANR, and other interested agencies. The workgroup will be charged with investigating potential GHG emissions reduction strategies (beyond anti-idling) for non-passenger vehicles, and compiling a report of recommended actions to be submitted to the CNWG for consideration by December 1, 2005. Recommendations from the RNVEW report will be used over the next two years to step up efforts to effectively reduce GHG emissions from the state non-passenger vehicle fleet.

The majority of existing fleet strategies focus on passenger vehicles, as it is relatively much easier to control passenger vehicle (as opposed to law enforcement, emergency, and highway maintenance vehicles, etc.) trips and achieve emissions reductions. However, passenger vehicles are responsible for only about 13% of CO_2 emissions from the entire Vermont State Fleet. Although strategy development may be difficult, it is extremely important that we begin to address the remaining 87% of the fleet if we are to meet our emissions reduction goals effectively.

Transportation – Employee Commuting:

Recommended Action #1: Convene a Transportation Demand Management (TDM) Committee to evaluate feasibility and effectiveness of various TDM strategies, and implement those deemed suitable to reduce GHG emissions generated by state employees commuting to and from the workplace. Localized pilot projects and case studies coupled with meticulous data collection may be helpful in developing program elements, as well as determining actual GHG reductions and overall cost / benefit of widespread implementation of specific strategies. The TDM Committee shall be a cooperative effort, and include appropriate representatives from the CNWG, the Vermont State Employees Association (VSEA), and management-level personnel from Vermont State Government. Some examples of strategies that might be explored in more detail by the TDM Committee include:

A. Investigate a parking space buyout program that will pay eligible state employees to find ways to get to and from work by means other than SOV driving.[8] Such a program provides incentives for HOV commuting, thereby cutting GHG emissions and reducing the need for construction of additional parking spaces. In Montpelier the estimated cost for a surface

[8] Details of an existing program may be found at: www.dartmouth.edu/~parking/incentives/tdm.html.

parking space is $55 per month. This figure represents amortization of land cost, construction, maintenance and forgone property taxes. Estimated annual CO_2 emissions savings per participant would be roughly 4 tons, assuming that the average state employee commutes 33 miles round trip daily in a vehicle that gets approximately 18.3 mpg.

B. Facilitate, coordinate and promote (through education and incentives) carpooling and vanpooling. The State of Vermont could offer assistance to employees in identifying and joining existing carpools and vanpools, as well as in starting new ones. Efforts could be coordinated by using employee home and workstation zip code data to notify employees of existing carpools and vanpools that are likely to follow the same commuting route as they do. A vanpooling case study in Appendix B demonstrates a sizeable annual CO_2 emissions savings of 38 tons from one large vanpool versus each rider commuting via SOV. Since CO_2 emissions savings are potentially large, the State of Vermont should investigate one or more of the following (or similar innovative) incentives for carpooling and vanpooling:

1. Commuter Pre-tax Benefit: The Commuter Choice Program is a federally approved pretax benefit that mimics the state's existing medical savings benefit and childcare pretax benefit. Vanpools, carpools and transit pass holders are eligible to receive a portion of their commuting costs pretax.
   - Benefit to the employee based on a monthly average of $75 saved pretax
     - Avoided Social Security Tax (7.6%) $5.70
     - Federal Taxes (28% marginal rate) 21.00
   - Benefit to the State based on a monthly average $75 saved pretax per employee
     - Avoided Social Security Tax (7.6%) $5.70
   - Administrative Costs to the Employer:
     - Startup costs were estimated at $56,000 (January 2002).
     - Ongoing administrative cost of $6.25 per employee per month (The State ongoing administrative cost of $6.25 minus savings of $5.70, yields an estimated net cost to the State of about $0.55 per participating employee per month).

2. The State could investigate the feasibility of partnering with an insurance company, with assistance from the U.S. Environmental Protection Agency (EPA), to offer "Pay As You Drive" (PAYD) insurance to state employees. EPA is working to overcome barriers to PAYD insurance, and is working with state and local governments, industry groups, regulators, and other interested organizations to help establish pilot programs with the insurance industry. PAYD insurance provides scaled insurance discounts to clients for reducing the number of miles they drive. Market survey research done by the Washington State Department of Transportation concluded that offering vehicle insurance discounts based on reduced driving mileage is one of the most attractive incentives to encourage commuters to shift to ridesharing (such as carpooling and vanpooling), and transit.

3. The state could assist employees in joining existing and / or starting new carpools & vanpools (use employee commuting data analysis assembled by VTrans). Carpools (3-5 riders) and Vanpools (6-15 riders) would each register with the state, submit at the end of each pay period, a standardized "ridership log" signed by all riders and listing names of all riders and documenting the number of days each rider was present. As an incentive, each quarter-year, the state would award 1 day of Personal Leave Time (similar to what is done for any employee if sick leave is not used for a particular "quarter") to all riders of 1 carpool and 1 vanpool having the highest ridership for that quarter.

4. The State could consider becoming a partner in the "Best Workplaces for Commuters Program" sponsored by the U.S. Environmental Protection Agency and U.S. Department of Transportation. The principal goals of this program are to simultaneously provide financial savings to the employer while improving the quality of life for commuting employees. Additionally, it would provide the State with credible, third party public recognition for its efforts to improve employee benefits and environmental responsibility. To qualify for this voluntary program, the State of Vermont would have to offer one primary benefit, such as telecommuting, parking space buyout, vanpool passes, etc. Additionally, the State would likely have to offer three secondary benefits including such options as: shuttles to and from transit stations, ridesharing or carpool matching, preferred parking for carpools and vanpools, compressed work schedules, etc. Additional information is available at www.bestworkplacesforcommuters.gov.

C. Establish a comprehensive telecommuting policy and actively promote employee incentives for telecommuting. Telecommuters (teleworkers) typically work 1 to 2 days per week at home, although many studies include those who work at least 1 day per month at home. Telecommuting saves employees time and money while decreasing GHG emissions. Telecommuting also offers the potential for sharing of office space and infrastructure. Georgia state government began a telecommuting program with 39 employees and now has 1500. In June 2004, Georgia estimated telecommuters saved 12,800 hours and $202,000 in travel costs. The Georgia Department of Education recently hired 48 full-time teleworkers, saving $27,000 a year in office space and related costs, according to Michael Halicki, communications director for the Clean Air Campaign. Some additional opportunities to enhance the success of this potential strategy include:

1. Consider promotion of a pilot program(s) at the Division or Department Level.

2. Ensure that telecommuters will be able to work seamlessly whether in the office or the home environment. By increasing the percentage of state documents and data stored in a well-organized digital (& / or online) format, the State will improve worker efficiency tremendously both in the office and at home.

3. Develop clear policies to be followed by state employees that address concerns related to acceptable data access and storage procedures, confidentiality, electronic signatures, security, etc.

4. Educate managers and potential telecommuters about the benefits of allowing and utilizing telecommuting, as well as expectations required of them to maximize efficiency of the program.

5. Improve computer network connections so that telecommuters are able to log on and work within the state's network quickly, easily and securely.

D. Establish new commuter shuttle routes. Green Mountain Transportation Authority (GMTA) has bus routes servicing the Central Vermont and Burlington corridors. Most recently GMTA has added a shuttle bus service to the Route 100 corridor between Morrisville and Waterbury. This supplements service between Burlington, Waterbury and Montpelier with connections on to Barre state offices. In addition the Route 2 vanpool from St. Johnsbury to Montpelier and then onto Waterbury, the new Essex service and the Burlington-Waterbury-Burlington vanpool are available for state employee commuting. Utilizing payroll inserts, email, and employee newsletters the state will promote these available services.

Recommended Action #2: Conduct a survey of all state employees to determine more accurately the present level of employee participation in carpooling, vanpooling, or other mass transit as a means of commuting to and from the workplace. It is important that the State of Vermont conduct this survey as soon as possible during 2005, and that all state employees are strongly encouraged to participate. The data obtained from the survey will provide a "baseline" against which the CNWG can gauge effectiveness of potential future TDM strategies. The survey must be clear and concise, and must be conducted at periodic intervals (biennially), which will enable the CNWG to determine actual GHG emissions reductions in the "employee commuting" category.

Recommended Action #3: Establish an official numeric "code" in the Department of Personnel Human Resource Management System (HRMS) that can be used to indicate "telecommuting" as a recognized work activity. This code will enable the CNWG to measure the level of employee participation, associated GHG emissions reductions, and effectiveness of potential future telecommuting initiatives put forth by the TDM Committee.

Chapter VI – Greenhouse Gas Registry and CO_2 cap and trade system

In addition to requiring reduction of GHG emissions from Vermont State Government activities, Executive Order #14-03 calls for the preparation of a report "describing opportunities to initiate a statewide voluntary GHG emissions registry, and investigate the feasibility of a carbon emissions cap and trading program for the state as a strategy for further reducing region-wide GHG emissions". Chapter VI of this first biennial report is intended to address this requirement. The programs described below are still in their early developmental stages, and it is certain that the CNWG will be able to provide a more detailed and substantial update as part of the second biennial report in autumn 2006, or sooner if feasible.

Staff of the Department of Environmental Conservation (DEC) Air Pollution Control Division have been actively engaged as members of a working group of environmental and energy officials from neighboring states in the effort to develop a regional greenhouse gas registry, as recommended in the Climate Change Action Plan of the Conference of New England Governors and Eastern Canadian Premiers. The Northeast States for Coordinated Air Use Management (NESCAUM)[9] initiated this effort in October 2003, and ten states (the NESCAUM states, Delaware and Pennsylvania) are currently participating in the effort. Several other states are observing the process. The Regional Greenhouse Gas Registry (RGGR) is being designed as a system for organized reporting and recording of GHG emissions data, and is intended to address several important activities including:

- Support voluntary reporting: The registry supports the voluntary registration of emissions from companies, and will document credible, reproducible, and transparent base year emissions, which might be protected under any future federal regulatory program. The registry will also provide technical support to first-time reporters, identify emissions trends and track progress, and provide stakeholders with relevant information.

- Supplement ongoing and future climate change work and support mandatory reporting by:
  - Providing detailed data on major GHG emission sources, thus allowing states to refine top-down emission inventories.
  - Furnishing information for regulators, participating entities, and the public about companies' emissions and emission reductions

- Support the Regional Greenhouse Gas Initiative (RGGI): The registry will serve as the emissions and allowance tracking system for participating RGGI states. It will require participating companies to supply verifiable GHG-emissions data that have been generated using transparent, standardized, and appropriate methodologies. Such data will be used to track emissions and reductions over time.

By following the World Resources Institute / World Business Council for Sustainable Development's (WRI / WBCSD) *GHG Protocol*, the registry is being designed to promote consistency and compatibility with other GHG registries such as the California Climate Action Registry, encourage participation by states outside of the region, and endeavor to develop an

[9] NESCAUM member states include the six New England states, New York and New Jersey.

interface with Canadian registry efforts. Emphasis on broad geographical inclusiveness, uniformity, and transparency will help to streamline the reporting process, facilitate reciprocity between registries, and reduce administrative burden associated with operating and managing the registry. Although some details are still being discussed among the regional participants, the goal is to have an operational registry for use by participating jurisdictions by late 2005.

In addition to the RGGR effort, a parallel effort called the Regional Greenhouse Gas Initiative (RGGI) is underway to design a regional GHG cap-and-trade program. RGGI was launched in April 2003, when New York Governor Pataki invited eleven governors in the Northeast and Mid-Atlantic states to discuss the prospect of creating a cap-and-trade program for CO_2 emissions from the power generation sector. To date, nine states (Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont) have signed on as full participants. In addition, several other jurisdictions are participating as observers (Maryland, Pennsylvania, the District of Columbia, and the Eastern Canadian Provinces. Although many specific design issues are still under deliberation, it is likely that there will be linkage between the RGGI and RGGR efforts through the emissions and allowance tracking system.

Initially RGGI will focus on developing a program to reduce CO_2 emissions from fossil fuel-fired power plants (>25 Megawatts) within the region of participation, while preserving energy reliability and affordability, and striving to accommodate the differences in individual state policies and programs. Interaction between RGGI representatives from participating jurisdictions and stakeholders will allow the program's design to benefit from a diversity of experience, and will be instrumental in its overall success. The goal is to reach agreement on program design by April 2005. Future design of the cap-and-trade process may be extended to encompass additional GHGs as well as non-power plant emission sectors and sources. In this later phase of the program, states and stakeholders will cooperate to establish creditable reductions / offsets beyond the electric power plant sector that may be used to comply with the cap. As the number of emission sectors and cap-compliance options increase, greater emissions reductions as well as reduced compliance costs are likely to be achieved.

Vermont's direct participation in the *initial* round of the RGGI cap-and-trade program will be somewhat limited, given that the in-state power generation sources are relatively small and generally are not substantial CO_2 emission sources in comparison to others in the region. However, we will continue to provide support and guidance for the effort in anticipation that it may evolve into a cap-and-trade program that encompasses additional GHG emission sources more relevant to helping Vermont meet its emission reduction goals as described by the New England Governors' and Eastern Canadian Premiers' Climate Change Action Plan.

Current and ongoing activities, as well as progress made within the framework of the RGGR and RGGI efforts may be viewed at the following internet links:

http://www.rggr.us/
http://www.rggi.org/

Chapter VII – Next steps

- Adapt the working structure of the existing CNWG to include two main branches: a "*Technical Workgroup*" and an "*Executive Workgroup*."
    - The *Technical Workgroup* will consist of staff experts from all relevant agencies named by the Executive Order. It will perform the general work of the CNWG, as directed by the *Executive Workgroup,* and provide technical information and recommendations to the *Executive Workgroup*. This workgroup will meet formally six times per year (or more often if necessary) to coordinate and facilitate CNWG efforts.
    - The *Executive Workgroup* will consist of the CNWG co-chairs, and will utilize the supplied technical information to assist them in making policy decisions and ultimately setting the course for future CNWG activities.
- Coordinate with parallel state efforts such as the CERMP and SAEP to maximize available resources as we work to promote and initiate as many of the "Recommended Actions" listed in Chapter V as possible.
- Improve data collection and periodically monitor energy consumption in order to effectively gauge progress toward meeting the Executive Order goals.
- Conduct additional research as appropriate on strategies that are currently listed in Chapter IV.
- Work to develop new, innovative strategies, to be included in the 2006 biennial report that may provide the Vermont State Government with an improved capacity to meet the stated GHG reduction goals.
- Monitor progress of pilot projects and encourage expansion of those that are successful.
- Share lessons learned to date, and initiate cooperative and constructive input from representatives of the business, environmental, forestry and transportation sectors regarding opportunities to reduce emissions and conserve energy.

References and Supporting Documents:

- Biomass and Carbon Neutrality – Issues and Concerns for Stakeholder Discussion. Maine GHG Initiative. (Memo from Maine DEP Commissioner to Agriculture and Forestry GHG Working Group). July 22, 2004. http://maineghg.raabassociates.org/Articles/Biomass%20Neutrality%20Memo%207-22-04.doc

- CLIMB: Climate's Long-term Impacts on Metro Boston. A Collaborative Project of Tufts University, Boston University, and the Metropolitan Area Planning Council (MAPC). http://www.tufts.edu/tie/climb/ExSum.html

- Comprehensive Environmental & Resource Management Program. Department of Buildings & General Services. Revised April 28, 2004. http://www.bgs.state.vt.us/pdf/CERMP.pdf.

- Fleet Management Proposal For Passenger Vehicles. Department of Buildings & General Services. December 5, 2003.

- Fueling Vermont's Future: Vermont Comprehensive Energy Plan and Vermont Greenhouse Gas Action Plan (Pursuant to 30 VSA Para 202b). Vermont Department of Public Service. July 1998. http://www.state.vt.us/psd/Menu/DPS_Doc_Lib/cepGuide.htm#whatis

- NEG-ECP Climate Change Action Plan. The Committee on the Environment and the Northeast International Committee on Energy of the Conference of New England Governors and Eastern Canadian Premiers. August 2001. http://www.negc.org/documents/NEG-ECP%20CCAP.PDF

- The Local Emergency Management Director's Guide. Vermont Department of Public Safety. August 6, 2003. http://www.dps.state.vt.us/vem/emd/director_menu.html

- The New England Regional Assessment. (NERA). March 2002. http://www.necci.sr.unh.edu

- U.S. Greenhouse Gas Emissions and Sinks: 1990-2002. United States Environmental Protection Agency. April 2004. http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2004.html

- US National Assessment of the Potential Consequences of Climate Variability and Change Educational Resources Regional Paper: The Northeast. Updated October 12, 2003. http://www.usgcrp.gov/usgcrp/nacc/education/northeast/

APPENDICES

STATE OF VERMONT

Executive Department

EXECUTIVE ORDER

[Climate Change Action Plan for State Government Buildings and Operations]

WHEREAS, the scientific evidence, reviewed by the U.S. National Academy of Sciences, the Intergovernmental Panel on Climate Change, and an overwhelming majority of the world's climate scientists, indicates greenhouse gases are accumulating in the Earth's atmosphere as a result of human activities; and

WHEREAS, these scientists also contend that the increases in greenhouse gases are causing the global climate to change at a greater rate and magnitude than would otherwise be expected, projecting an increase in globally-averaged surface temperatures of 2.5 to 10.4 degrees Fahrenheit by the end of the century; and

WHEREAS, even small changes in surface temperatures are projected to cause significant changes in our regional climate and Vermont's environment; and

WHEREAS, the United States, with only 5 percent of the world's population produces 20 to 25 percent of all greenhouse gas emissions from human activities and is, therefore, a significant factor affecting the global climate; and

WHEREAS, Vermont, although it plays a small role, contributes to greenhouse gas emissions via car and truck traffic, with Vermonters driving more miles per person than the national average, and the burning of fossil fuels for home heating and power generation; and

WHEREAS, the federal government and numerous private sector businesses in the United States and abroad are discovering that it is a sound business decision, both financially and environmentally, to decrease their greenhouse gas emissions - simultaneously increasing productivity and employment; and

WHEREAS, ambitious energy efficiency and conservation efforts will not only reduce greenhouse gas emissions, but will also reduce a host of other pollutant emissions (including toxic chemicals) associated with fossil fuel combustion for electricity generation and transportation.

NOW, THEREFORE, BE IT RESOLVED THAT I, James H. Douglas, by virtue of the power vested in me as Governor of the State of Vermont, do hereby direct state government agencies and departments to reduce greenhouse gas emissions from state government buildings and operations. Vermont's goal is to reduce emissions by an amount consistent with the recommendations of The Conference of the New England Governors and Eastern Canadian Premiers Climate Change Action Plan. The goals established by the Conference are to reduce region-wide greenhouse gas

emissions from the 1990 baseline by: twenty-five percent by 2012; fifty percent by 2028; and, if practicable using reasonable efforts, seventy-five percent by 2050.

To promote these goals I hereby order as follows:

(1) A Climate Neutral Working Group is established to be jointly chaired by the Commissioners of the Department of Environmental Conservation, the Department of Buildings and General Services, and the Department of Public Service, and to include Secretaries, Commissioners, and technical representatives from the Agency of Natural Resources, Department of Public Service, Agency of Administration, Agency of Commerce and Community Development, Agency of Transportation, Department of Buildings and General Services, Vermont Energy Investment Corporation, and other agencies as interested. The working group is tasked with coordinating, documenting, and encouraging efforts to meet Vermont's greenhouse gas emission reduction goals. It will prepare a biennial report documenting efforts to meet the goals, identifying future planned steps and their anticipated impacts, and highlighting any challenges for meeting those goals, as well as opportunities for expediting greenhouse gas emission reductions.

(2) The report shall include the state of the science for responding to climate change, including the status of methods and measures available to meet the goals. In addition, the working group will identify opportunities to share lessons learned with Vermont businesses, other state and provincial governments, and the federal government.

(3) All state government agencies, offices, and departments are hereby directed to:

(i) Purchase only energy-consuming devices that meet or exceed the Energy Star® or comparable standards established by the U.S. federal government, and to operate these devices in a manner that maximizes their energy efficiency features.

(ii) Purchase vehicles that have the highest available fuel efficiency in each respective vehicle class (e.g., passenger cars, light duty trucks, etc.), pursuant to performance specifications approved by the Climate Neutral Working Group. In setting these performance specifications, the Working Group shall consider vehicles that not only meet high fuel economy standards but that also provide lower total overall emissions of greenhouse gases, criteria pollutants, and hazardous air contaminants.

(iii) Develop programs to encourage state employees, through the use of incentives, to use transportation alternatives to a single person in a single motor vehicle for commuting and business travel, including incentives as may be bargained with the collective bargaining units.

(4) The Department of Buildings and General Services shall work with the Climate Neutral Working Group and all state facilities to ensure that every state building reduces its energy consumption to meet the outlined greenhouse gas reductions.

(5) The Department of Buildings and General Services shall investigate cost-effective opportunities to purchase renewable energy to reduce the State of Vermont's reliance on fossil fuels. Renewable energy includes electricity derived from sources such as solar, wind, geothermal, landfill methane gas, or small scale (less than 30 megawatts) hydroelectric projects.

(6) The Climate Neutral Working Group shall prepare a report to the Governor and the General Assembly describing opportunities to initiate a statewide voluntary greenhouse gas emissions registry, and investigate the feasibility of a carbon emissions cap and trading program for the state as a strategy for further reducing region-wide greenhouse gas emissions. The Agency shall identify the effort required to establish sector-specific baselines, develop an emissions tracking protocol, and institute an emissions trading mechanism. It should also recommend greenhouse gas reduction targets and identify activities to help meet those targets.

(7) The Climate Neutral Working Group shall request input from representatives of the business, environmental, forestry and transportation sectors regarding opportunities for the private sector to reduce emissions and conserve energy.

(8) The chairs of the Climate Neutral Working Group shall consult with representatives from the other New England states to establish a broad-based approach to these environmental issues.

Administrative support shall be provided by the Agency of Natural Resources.

This Executive Order shall take effect upon signing and supersedes and replaces Executive Order #11-02 (renumbered Executive Order #10-28) dated August 22, 2002.

This Executive Order shall sunset on July 1, 2020.

Witness my name hereunto subscribed and the Great Seal of the State of Vermont hereunto affixed at Montpelier this 16th day of September, 2003.

James H. Douglas

Governor

By the Governor:

Neale F. Lunderville

Secretary of Civil and Military Affairs Executive Order No. 14-03

Appendix B - Energy Consumption Case Studies:

This Appendix is intended to serve as a repository for case studies and pilot projects that the CNWG has deemed valuable in helping to determine the magnitude and feasibility of various GHG emissions reduction actions within state government. It is certain that case studies such as these will increase both in number and in scope as the State of Vermont moves forward in its charge to reduce emissions. Case studies will be a useful way to share lessons learned with other public sector participants in the NEG-ECP effort, as well as with schools, private citizens, businesses, and other interested groups in Vermont.

In this first biennial report, the majority of the case studies have focused on ways to reduce GHG emissions from electricity use. Consumption of electricity accounts for approximately 23% of the CO_2 emissions generated by state government buildings and operations, including transportation. While this number may seem relatively modest, efficient use of electricity will provide substantial financial savings for state government, and also is an important step toward meeting the GHG emissions reduction goals of the executive order. In order to estimate potential projects that would yield savings and reductions, the CNWG monitored electricity consumption by several devices commonly found in state government buildings. These devices include: computer monitors, copy machines, printers, chilled beverage vending machines, and unchilled snack vending machines. Each device was monitored for an extended period to determine how much electricity it uses during normal operation. Further measurements were made on each device with any enhanced energy saving features enabled or installed. The data loggers (see photo at right) were capable of measuring and recording both cumulative kilowatt-hours (kWh) and amperes at designated intervals to create time-series data.

Energy data logger

Additional case studies showing CO_2 emissions and financial savings are included in this Appendix. They include case studies outlining the benefits of vanpooling, and an ongoing building energy performance contract at a building operated by the State of Vermont.

Case Study: Computer monitors

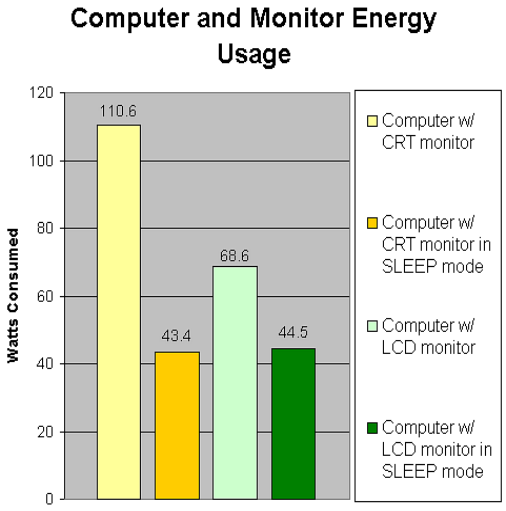
Computer monitors are one of the most prevalent electricity consuming devices found in state government offices. Currently two types of computer monitors, Cathode Ray Tube (CRT) and "flat screen" or Liquid Crystal Display (LCD), are being used. With the data loggers, we compared the electricity consumption of these two monitor types and found that a typical CRT monitor consumes approximately 73 watts under normal operating conditions. A typical LCD monitor consumes roughly 29 watts under the same conditions, about 60% less electricity than required by the CRT monitor.

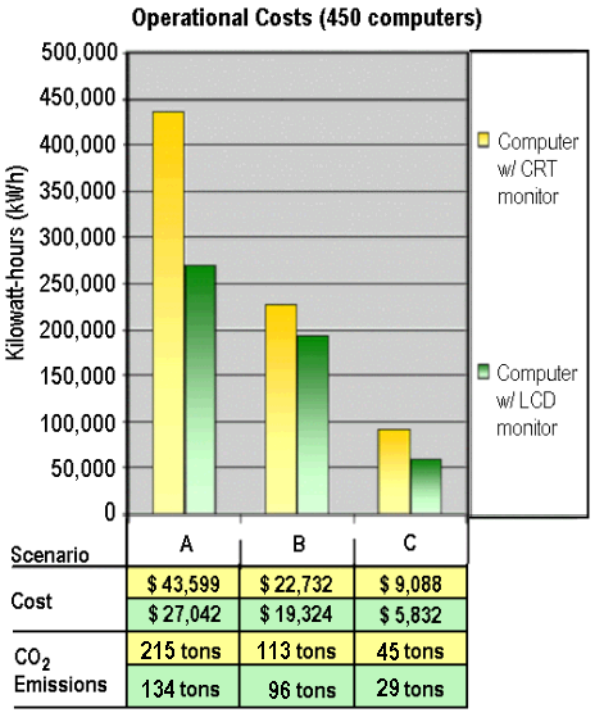

CRT Monitor


LCD Monitor

While switching to LCD monitors is good energy saving strategy, important energy savings can be realized regardless of monitor type. Electricity usage by either monitor type is reduced to less than 5 watts when proper "Power Management" settings are utilized to allow the monitor to "sleep" or "standby" after a preset period of computer inactivity. It is interesting and important to note that screen savers DO NOT reduce electricity consumption.

Another easy way to save electricity is to simply turn off your monitor whenever you will be away from your desk for more than 15 minutes. This reduces the electricity consumption to zero. Turn off both your monitor and computer any time you will not be using them for several hours, including each night when you leave work. Savings would be substantial considering the number of computers and monitors found in all state offices.





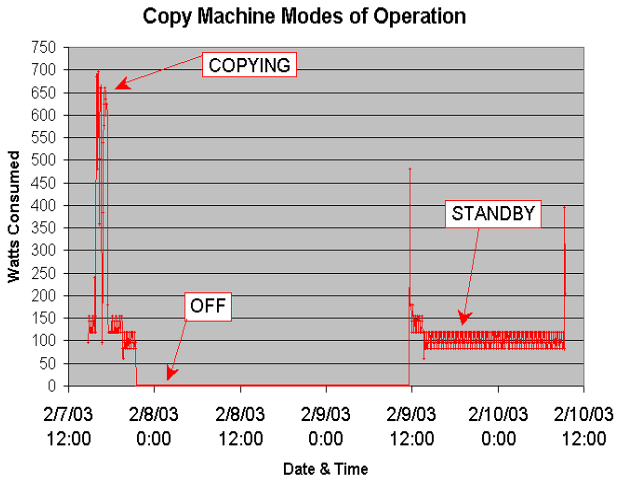
Scenario	A	B	C
Cost	$ 43,599	$ 22,732	$ 9,088
	$ 27,042	$ 19,324	$ 5,832
CO_2 Emissions	215 tons	113 tons	45 tons
	134 tons	96 tons	29 tons

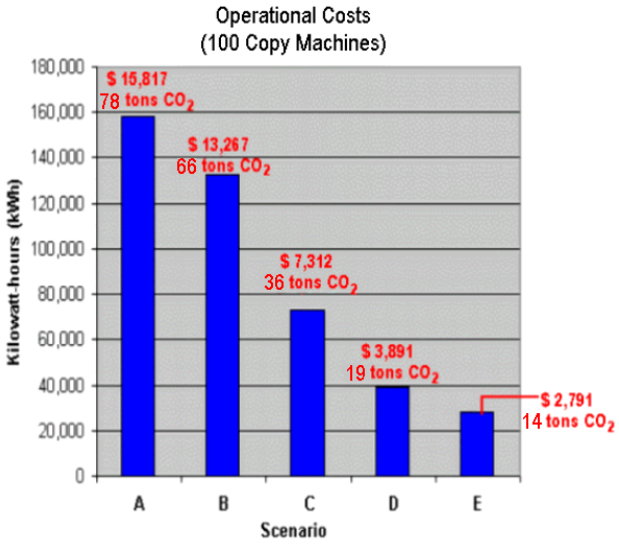
We estimate that the Department of Environmental Conservation alone operates approximately 450 computers with monitors. The graph at left represents total kWh consumed, and total cost of operating plus associated CO_2 emissions for these 450 computers annually assuming electricity costs $0.10 per kWh, all computers and monitors are operated as indicated in the scenarios outlined below.

- Scenario A: Both computer and monitor remain ON at all times.
- Scenario B: Computer remains ON at all times, but monitor is programmed to STANDBY or SLEEP during non-work hours and weekends.
- Scenario C: Both computer and monitor remain ON during regular work hours, but OFF during non-work hours and weekends.

Case Study: Copy machines

Copy machines are relatively high wattage office machines that continue to consume considerable electricity even when sitting idly for long periods of time. In general, we were able to discern 2 distinct operating modes, in addition to the machine simply being turned off. During normal copy production, the machine we studied used as much as 700 watts, with 180 watts being the average. If the power management features of this Energy Star machine were activated, the average wattage used during "standby" mode was 102 watts. It is important to note, that if the power saving features are not activated or set correctly, the copy machine will not enter standby mode, and electricity will be wasted.





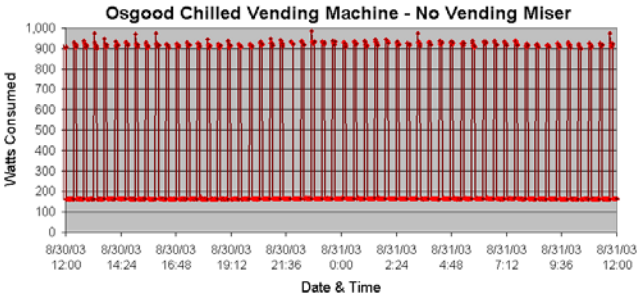
Using the data collected, we considered 5 operating scenarios (A through E in the graph at left) in order to determine potential electricity savings from proper setting of the power management features, as well as employee behavior changes. Each scenario assumes that 100 copy machines are operated as outlined in each scenario for a period of one year. On the y-axis of the graph is the total kWh required to operate the 100 machines. In red text above each bar is the total annual cost of electricity (assuming $0.10 per kWh) and associated CO_2 emissions for operating all 100 machines. The scenario details are as follows:

- Scenario A: Copy machines are left ON at all times and power management features are not active.
- Scenario B: Copy machines are left ON during regular work hours, but power management features are activated so that the machines are in STANDBY mode during non-work hours and on weekends.
- Scenario C: Copy machines are left ON during regular work hours, but power management features are activated so that the machines are in STANDBY mode during non-work weekday hours. Machines are turned OFF during the weekend.
- Scenario D: Copy machines are left ON during regular work hours, but machines are turned OFF during all non-work hours (including weekends).
- Scenario E: Same as Scenario C, except that we assume that copiers are only actively making copies for about 3 hours during each work day, while in STANDBY for the remainder of the work day.

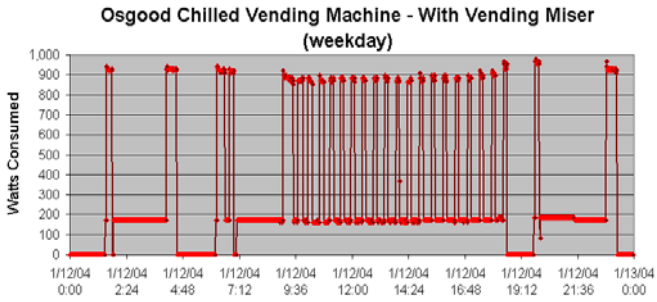
Using proper power management settings, and turning the machine off during non-working hours has the potential to reduce electrical consumption per machine by up to 82%!

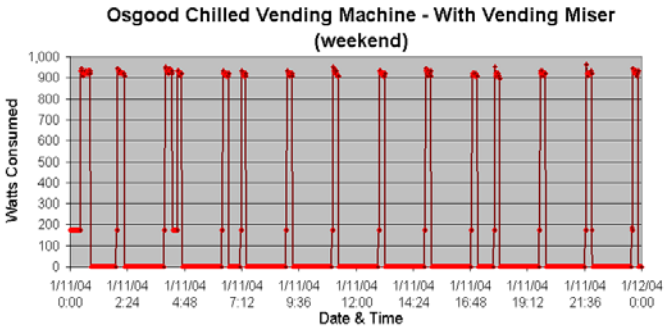
Case Study: Chilled beverage vending machines

We collected data from a cold beverage vending machine located in the Osgood Building of the Waterbury Office Complex over several weeks. Results showed that when the refrigeration compressor is off, the machine consumes about 160 watts continuously for lighting purposes. Every 20 minutes, the compressor cycles on and operates for about 7 to 8 minutes. During this short period, the machine consumes roughly 850-900 watts. The machine cycles on and off in this fashion constantly regardless of whether it is during prime vending / work hours or during a weekend. On average, the machine uses 8.64 kWh per day. Assuming electricity costs $0.10 per kWh, it would cost $0.86 per day, or $315.36 per year (3154 kWh) for electricity to operate this machine.



After BGS installed a Vending Miser unit, we repeated the data collection to see how much electricity would be saved with the help of the Vending Miser unit. We monitored the same machine with the Vending Miser installed over several weeks and found that the electrical consumption pattern was quite different from the original results. During regular weekday working hours, the machine operated much as it did without the Vending Miser installed, cycling on and off and consuming between 160 and 900 watts. However, during non-work weekday hours and weekends, the Vending Miser permitted the vending machine to shut down both lighting and compressor and reduce electricity consumption to nearly zero. The vending machine's display lighting reactivates when the Vending Miser's electronic eye detects movement of a customer near the vending machine. The Vending Miser only reactivates the compressor when necessary to keep the beverages chilled to the proper temperature. As a result, the vending machine now uses only about 6.76 kWh per weekday and 3.95 kWh per weekend, or approximately 2146 kWh per year. Assuming that electricity costs $0.10 per kWh, it would cost $214.60 annually to operate the machine with Vending Miser installed. This represents a savings of 32% or $100.76 per year per machine. At this rate, the Vending Miser would pay for itself in approximately 21 months of operation (assuming a cost of $175.00 per unit) and would save 1764 kWh of electricity and approximately 1 ton of CO_2 emitted to produce the electricity during that same time. A similar study was also performed on a chilled beverage vending machine in the Montpelier Capital Complex Pavilion, which yielded similar results. Extrapolating these savings to the 61 chilled beverage vending machines managed by the Division for the Blind and Visually Impaired (DBVI), the state could save $ 6146.00, 61460 kWh, and 30 tons of CO_2 per year.



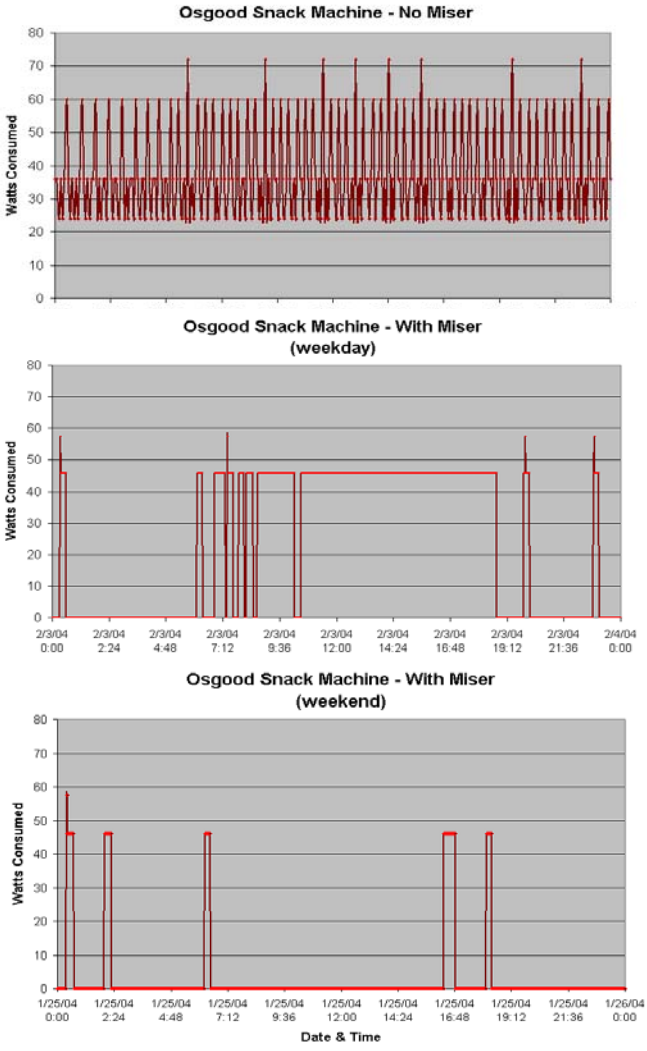


Case Study: Unchilled snack vending machines

Snack machines also consume less electricity with the installation of a Snack Miser. With no miser installed, the snack machine continually consumed an average of approximately 40 watts. During the course of a day, the machine would use about 0.88 kWh. Over the course of a year, the machine would use 321 kWh, which at $0.10 per kWh for electricity, would cost $32.10.

Installation of the Snack Miser, allowed the snack machine to power down it's lighting and other electronic components, yielding similar weekday / weekend electricity consumption patterns as in the chilled beverage vending machine case study described previously. On an average weekday, the snack machine now only uses 0.15 kWh. On an average weekend, the same machine uses 0.66 kWh, which is substantially less than the 0.88 kWh used daily prior to installation of the miser. With the Snack Miser installed, the machine will use an estimated 167 kWh annually, which at $0.10 per kWh, would cost $16.70... a 48% savings per machine.

Extrapolating these savings to the 45 snack vending machines managed by the Division for the Blind and Visually Impaired (DBVI), the state could save $ 693.00, 6930 kWh, and approximately 4 tons of CO_2 per year.



Case study: CO_2 reduction from vanpooling

(Adapted from ANR Environment 1998 publication)[10]

Car and vanpools have the potential to counter some of the growth in vehicle miles traveled and, therefore, to reduce air pollutant emissions and the subsequent harmful effects on the environment and our health. A clear example of the benefits of such vanpools may be shown from the Route 2 Commuters, Inc. vanpool experience. This vanpool has operated successfully between St. Johnsbury, Montpelier, and Waterbury for 26 years and is still going strong in 2004. It serves state employees most directly, but could be a model for others throughout Vermont. Fifteen subscribers ride the van regularly on the St. Johnsbury to Montpelier/Waterbury sector, with four other regular subscribers riding the Montpelier to Waterbury sector.

Using the one-year period from April 3, 1995 to March 29, 1996 for a calculation based on the actual ridership during this time period, the vanpool resulted in an estimated reduction of 3,875 gallons of gasoline for commuting purposes. This equates to a reduction of 38 tons of CO_2, for this one-year period. More than 130,000 miles of vehicle travel were eliminated during this year by the use of the vanpool by these 19 riders.

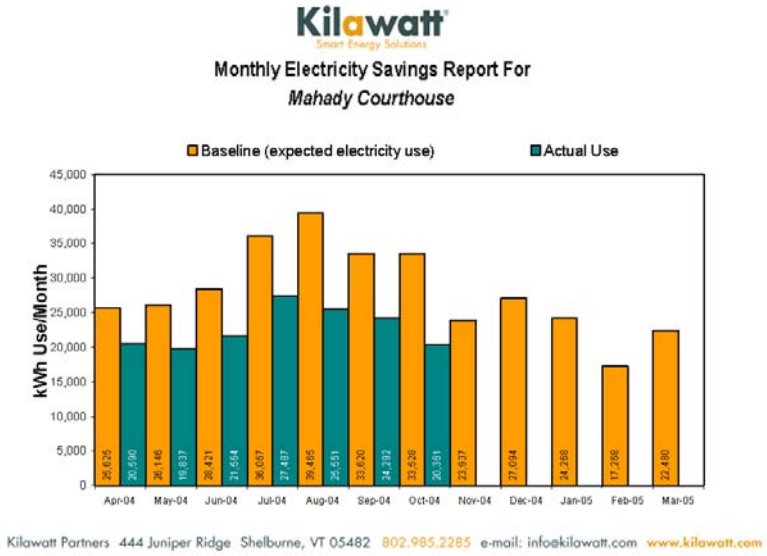
In addition to being easier on the environment, this vanpool provides financial benefits as well. The overall average cost per mile was found to be 6.7 cents per mile for each rider, compared to more than 30 cents per mile for a commuter driving alone in a typical sedan.

[10] http://www.anr.state.vt.us/Env98/DOCS/webpgs/airqual.htm#slr2

Case Study: Infrastructure electricity consumption reduction and cost savings

The Department of Buildings and General Services (BGS) is analyzing energy use at all BGS buildings with the purpose of reducing electricity and fuel use. This particular project focuses on reducing electricity use at the Mahady Courthouse in Middlebury Vermont. BGS does not have capital funds to invest in this building, and thus solicited proposals from firms wherein the firm's fees are paid from electricity savings. Although capital funds for improvements are not available, limited State personnel resources were provided for this project. The Mahady Courthouse is occupied by the Court Administration and BGS Maintenance. The building was built in 1994 and consists of two stories of approximately 20,000 square feet per floor. The building was designed according to the 1991 Energy Standards and also has multiple fuel capabilities.

The chosen contractor, Kilawatt Partners, is analyzing the electrical use at the Mahady Courthouse and determining what changes can be made in the way that the building is used so that the state will see reduced energy bills. Kilawatt Partners is looking at individual electricity use of each employee, looking at how groups of employees use energy, such as during coffee breaks, and looking at how BGS Maintenance operates the building including night setbacks, temperature settings, air handling operations, exterior and interior lighting and any other areas of electricity use. This project began in January of 2004 and will continue through January 2006.



Average monthly electricity consumption (kWh) savings since initiation of this project have been roughly 28% from the expected baseline. Assuming that this will be representative of annual electricity savings, the carbon dioxide (CO_2) emissions reduction at Mahady Courthouse will be approximately 50 tons annually.

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