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CHAPTER 5 - CHARTING VERMONT'S ENERGY FUTURE: THE COMPOSITE POLICY CASE

This chapter identifies a set of policies selected from the inventory of policies that were modeled individually in Chapter 4. These selected policies are only an "illustrative sampling," related to energy sources and supply, transportation, and buildings and equipment, that enable Vermont to make progress toward the state's energy goals as presented in Chapter 2. The selected policies are modeled together in this chapter to illustrate their combined impacts. Throughout the chapter the impacts of this composite policy case are compared to the base case; the business as usual scenario that shows what is likely to happen without bold initiatives that will change energy use and associated environmental degradation. (See Chapter 3 for more on the base case.) Implemented as a group, the policies in the composite case represent a transition in energy supply choices and patterns of end use, enabling Vermont to take a leading role in moving the Northeast and the nation toward a sustainable and environmentally sound energy future with economic benefits.

Both the composite policy case and base case are forecast through 2020, and most policies in the composite case were modeled to begin implementation in 1997. Typically, policies in the composite policy case were modeled in the same way they were modeled in Chapter 4, with a few exceptions.[i] (The policy Moving to Greater Retail Competition While Maintaining Societal Benefits is one of the policies that cannot be modeled due to insufficient data; nevertheless, it is of critical importance in this Plan. See Volume 1, Chapter 4.)

Many policies discussed in Chapter 4 were not modeled, and computer generated information about their impacts over the forecast period has not been developed. (The policy Moving to Greater Retail Competition While Maintaining Societal Benefits is one of the policies that cannot be modeled due to insufficient data; nevertheless, it is of critical importance in this Plan. See Volume 1, Chapter 4.)
These policies are not part of the composite policy case, but this does not mean they are unworthy of serious consideration or irrelevant in achieving Vermont's energy goals. In some cases, computer modeling was not feasible without further research and data. In other cases, policies were not modeled because their benefits would have been quantitatively small; nonetheless, these policies may require little or no cost outlays, offering highly cost-effective options. Many of the non-modeled policies discussed in Chapter 4 of this Plan are worth pursuing in Vermont.

Similarly, some policies that were modeled in Chapter 4 but not chosen for the composite policy case achieve lesser progress toward a similar goal than policies chosen for the composite policy case. Combining these similar policies in the composite policy case would not result in larger benefits. For example, the policy "Replace Vermont Yankee with Wood Gasification and Wind Power," which is in the composite policy case, achieves benefits which are greater but similar to "Renewable Portfolio Standard with Wood Gasification and Wind Power," which is not included in the composite policy case.

The composite policy case presented in this chapter represents one combination of cost-effective policies, but not the only possible good combination. Any policy that works toward Vermont's energy and environmental goals and is cost-effective deserves attention.

The following policies were chosen for the composite policy case. See Chapter 4 for a description of each policy and its impacts when modeled as a stand-alone option.

Strategy A. Promote Sustainable Use of Wood Energy
Policy 1. Promote Clean, Efficient Wood Burning with New Stoves
Policy 4. Replace Vt. Yankee Power with Wood Gasification and Wind Power

Strategy D. Support Appropriate Uses of Hydro Power and Methane Sources
Policy 2. Increase Appropriate Use of Landfill Methane Energy
Policy 3. Increase Appropriate Use of Farm Methane Energy

Strategy H. Use Energy Taxation to Meet Vermont's Energy Goals
Policy 1. Review Current Energy Goals and Energy Taxes and Assess their Consistency
Combined results for:
Carbon Tax at $100/Ton with Revenue Returned to Taxpayers
Remove Sales Tax Exempt. on Motor Fuels with Rev. to Taxpayers
Gross Fuel Receipts Tax with Revenue to Weatherization

II. TRANSPORTATION
Strategy B. Increase the Efficiency of Vehicles
Policy 1. Increase Federal CAFE Standards
Policy 2. Consider Adopting a 55 MPH Interstate Speed Limit
Policy 3. Consider Stricter Enforcement of Highway Speed Limits

Strategy C. Reduce Vehicle Miles Traveled
Policy 2. Shift VMT to More Efficient Modes - Bus, Vanpool, and Train
Policy 3. Encourage Non-Motorized Transportation
Policy 4. Encourage Telecommuting
Policy 5. Encourage High-Density, Mixed-Use Land Use Planning and Curtail Sprawl
Policy 6. Pay-at-the-Pump Auto Liability Insurance

Strategy D. Reduce Transportation Related Emissions
Policy 2. Continue Phased-In Implementation of Vapor Recovery at Gas Stations
Policy 3. Adopt Low Emissions Vehicle Standards

Strategy E. Internalize Costs of Transportation More Fully through Transportation Energy Taxation
Policy 1. Review and Revise State Tax Policy to More Fully Internalize the Cost of Transportation
Combined Results for:
Shift Roadway Const/Maint Funding from Prop. Tax/Motor Fuels Tax
Shift Police/Fire Trans. Funding from Property Tax/Motor Fuels Tax
Remove Sales Tax Exempt. on Motor Fuels (see H above)
Policy 3. Shift Registration and License Fees to Motor Fuels Taxes
Policy 4. Support Commuter Buses with Motor Fuels Tax (same as C2 above)

III. BUILDINGS AND EQUIPMENT
Strategy A. Improve Efficiency and Indoor Air Quality in New Homes
Combined Results of Residential New Construction Policies
Strategy C. Increase Efficiency in Commercial New Construction
Combined Results of Commercial New Construction and Retrofit Policies

I. OVERVIEW: COMPOSITE CASE POLICIES AND THEIR IMPACTS

Vermont's statutory energy goals mandate that the state work toward adequate, reliable, and secure energy sources

- with less risk, and greater safety;
- with improved environmental impacts, especially reduced air pollution;
- with greater assurance that our usage of every resource is sustainable, which includes greater reliance on renewable energy sources;
- with greater efficiency;
- with the affordability of energy preserved, especially for low income Vermonters; and
- with positive economic impacts.

Modeling the set of policies designated as the composite policy case gives information about the impacts of these policies on a number of indicators over the life of the forecast. These key indicators are summarized in the tables and figures below and are italicized in the text that follows. See Figure 5.I.1 for a comparative view of the cumulative impacts of key indicators under the base case and the composite policy case over the life of the forecast. Figure 5.I.2 shows the status of the key indicators in 1990 and in 2005 under the base case and composite policy case. Additional information about *Total energy use*, and a break down into *Residential, Commercial, Industrial*, and *Transportation energy use* is shown under the figure, and a group of key indicators is reported in Table 5.I.1. For purposes of comparison, each of the policies modeled individually in Chapter 4 has a figure comparable to Figure 5.I.2, reporting the policy's impacts on key indicators in 2005, supporting information on *Energy use*, and a data table like Table 5.I.1. Appendix 5 contains information about how to obtain detailed Policy Run Output Report with modeling impacts of each individual policy and the composite policy case.

Some of the major cumulative impacts of the composite policy case are summarized in Figure 5.I.1 and discussed in the remaining sections of this chapter. Over the life of the forecast, the following cumulative savings can be achieved under the composite policy case as compared to the base case.

- Vermont's *Total energy use* is reduced by 552 TBTU or 16.2%.
- Vermont's *Oil use* is reduced by 483 TBTU or 22.9%.
- Vermont's *Non-renewable energy use* is reduced by 750 TBTU or 25.9%.
- Vermont's *Energy costs (net of policy taxes)* are reduced by $6.2 billion or 14.8%.
- The costs imposed on the environment by air emissions from Vermont energy use (*Air emission costs*) are reduced by about $5.0 billion or 25.6%.
- Vermont's *Total costs* (including energy costs, related costs, and the environmental costs of air emissions) are reduced by $12.2 billion or 20.1%.
- Vermont's *Per capita disposable income* increases by an average of $130 per year or 0.6%.
- Vermont's *Per household residential energy expenditure as a percent of poverty level income* decreases from an average of 26.7% under the base case to 26.3% under the composite case.
- Vermont's *Greenhouse gas emissions* decrease by 53.3 million CO_2 equivalent tons or 21.4%.

Figure 5.I.1 Cumulative Impacts of Base Case and Composite Policy Case

1997-2020

Figure 5.I.2 Impacts of Composite Policy Case

Selected Impacts in 2005

Energy Impacts, TBTU

Sector	1990	2000		2005		2015		Cumulative to 2020	
		Base Case	Policy Case	Base Case	Policy Case	Base Case	Policy Case	Base Case	Policy Case
Residential	31.53	35.37	34.64	35.96	34.78	38.21	36.53	884.60	853.16
Commercial	11.99	17.81	16.92	19.33	17.69	22.11	20.06	485.86	446.36
Industrial	12.42	16.80	16.17	18.41	17.41	19.90	19.09	446.67	440.48
Transportation	42.10	60.52	47.10	64.66	45.78	70.71	46.90	1591.51	1117.14

Total	98.04	130.50	114.83	138.36	115.65	150.93	122.58	3408.63	2857.14

Table 5.I.1 Indicators of Composite Policy Case
Selected Indicators of Vermont Energy Goals, 1997-2020

SUSTAINABILITY

Total non-renewable energy used[a] (TBTU)	Non-renewable energy saved rel. to base case[a] (TBTU)	Non-renewable energy per capita (MMBTU)					% of energy from renewable sources				
		1990	2005 Base	2005 Policy	2015 Base	2015 Policy	1990	2005 Base	2005 Policy	2015 Base	2015 Policy
2146.9	749.6	146.1	184.1	145.2	187.9	113.8	16.0%	15.5%	18.5%	15.5%	35.7%

ENERGY EFFICIENCY

Total Energy used[a] (TBTU)	Energy saved rel. to base case[a] (TBTU)	Energy saved as a % of base case use[a]	2015 sector energy use as a % of 1990 sector energy use[b]	Total energy use per capita (MMBTU)				
				1990	2005 Base	2005 Pol.	2015 Base	2015 Pol.
2857.1	551.5	16.18%	125.0%	173.8	217.9	178.2	222.3	176.9

SECURITY

Energy from oil[a] (TBTU)	% of energy from oil[a]	Total energy expenditures/GSP (1995 $/1995 $)					Energy from oil (TBTU)				
		1990	2005 Base	2005 Pol.	2015 Base	2015 Pol.	1990	2005 Base	2005 Pol.	2015 Base	2015 Pol.
1622.4	56.78%	$0.087	$0.084	$0.091	$0.087	$0.083	65.58%	65.68%	60.71%	63.21%	56.65%

ECONOMIC VITALITY

Jobs created relative to base case[a] (job-years)	Change in GSP relative to base case[a] (Mil. 1995 $)	% Change in GSP relative to base case[a]	Avg. change in GSP/capita rel. to base case[a] (1995 $)	Avg. change in per capita disp. income rel. to base case[a] (1995 $)
99,700	4,083,000	0.83%	($311)	$130

AFFORDABILITY

Policy costs per MMBTU saved[ac] (1995 $/ MMBTU)	Societal savings from reduced emissions[ad] (Mil. 1995 $)	Avg. income per household after energy and energy related expenses[e] (1995 $)					Average residential energy expenditure as a % of low income wage[f]				
		1990	2005 Base	2005 Pol.	2015 Base	2015 Pol.	1990	2005 Base	2005 Pol.	2015 Base	2015 Pol.
($13.15)	$4,987	$50,741	$56,495	$55,652	$58,581	$58,875	26.89%	26.64%	26.96%	27.54%	24.11%

ENVIRONMENTAL SOUNDNESS

Pollutant	Emissions (tons)					Emissions reduction rel. to base case[a] (tons)	Emissions reduction as a % of base case[a]	2015 sector emissions as a % of 1990 emissions
	1990	2005 Base	2005 Pol.	2015 Base	2015 Pol.			
Greenhouse Gases (CO_2 eqv.)	7,120,000	9,520,000	7,609,000	11,746,000	8,609,000	53,316,000	21.37%	120.91%
Carbon Dioxide (CO_2)	6,939,000	9,255,000	7,390,000	11,380,000	8,333,000	51,969,000	21.46%11.9	120.09%
Sulfur Dioxide (SO_2)	17,100	15,700	14,600	15,000	11,900	44,500	6%	69.59%
Suspended Particulates (PM-10)	6,000	3,400	3,100	3,400	3,700	200	0.28%	62.21%
Nitrogen Oxides (NO_X)	25,300	26,600	18,500	31,700	19,900	214,000	30.67%	78.66%
Volatile Organic Compounds	21,600	20,000	14,400	19,300	12,400	137,500	28.70%	57.41%
Carbon Monoxide (CO)	116,900	101,700	68,800	93,300	54,100	814,300	33.72%	46.28%

Greenhouse gas intensity, GHG/GSP (tons CO_2 eqv./1995 $)					Policy Costs/GHG Reduction[c] (1995 $/ton CO_2 eqv.)			
1990	2005 Base	2005 Policy	2015 Base	2015 Policy	2000	2005	2015	Cumulative[a]

0.98	0.98	0.78	1.05	0.76	($82)	($139)	($146)	($136)

Note: All data uses delivered energy; greenhouse gases (GHG) include CO_2, NO_x, N_2O, CH_4; see Appendix 5 for more data and explanation of categories

[a] Cumulative impacts, 1997-2020

[b] All sectors

[c] Policy costs include the change between policy and base case of energy cost and capital, operation, and maintenance cost of energy using devices

[d] Calculated using Vt. DPS externality adders, see Appendix 5

[e] Household costs include energy costs, and the change in capital, operation, and maintenance costs of energy using devices that result from the policy

[f] $12,590 fed. poverty line for family of 3, minus $919 Social Security (1995 $)

II. ENERGY IMPACTS

Figure 5.II.1 shows that the composite policy case results in a 16.2% cumulative reduction in *Total energy use* compared to the base case over the life of the forecast. Under the base case or a "business as usual" scenario, total energy can be expected to grow at an average annual growth rate of about 1.1% between 1995 and 2020. Under the composite policy case, total energy use drops in 1997, when most of the policies are implemented. The average annual growth rate from 1995 through 2020 is very slight with the composite policies, about 0.29%.

Figure 5.II.2 shows Vermont's projected energy use broken out by sector: residential, commercial, industrial, and transportation. In both the base case and the composite policy case, *Transportation energy use* accounts for the majority of energy use and the growth in energy use over the forecast period. *Transportation energy use* decreases dramatically with the composite policy case, falling 29.8% (474.4 TBTU) compared to the base case on a cumulative basis.

For *Residential energy use*, the second largest component of *Total energy use*, the composite policy case results in modest energy savings after 1997, and the same is true for *Commercial* and *Industrial energy use*. Over the life of the forecast, cumulative energy use in the residential, commercial, and industrial sectors falls by 3.6%, 8.1%, and 1.4% respectively compared to the base case.

As shown in Figure 5.II.2, initial efficiency improvements and fuel price increases result in a dramatic decrease in transportation energy use. Since no further significant efficiency gains or conservation measures were assumed to occur after 2005, transportation energy use subsequently begins to rise. This initial decrease and later increase is similar to what occurred to transportation energy use during the 1970s and 1980s when a combination of increased prices and efficiency measures resulted in immediate savings which were then eroded by increasing vehicle miles traveled. One significant difference, however, between the motor fuels price increases of the 1970s and those modeled here is that the earlier increases went to oil companies and oil-producing countries, while the increases modeled here are returned to taxpayers in the form of reductions in property or other taxes.

As discussed elsewhere in the Plan, the transportation sector offers the greatest opportunity for energy use reductions in Vermont. Because transportation needs account for about 47% of our projected energy use through 2020, and because efficiency gains have already been made in many other end uses, transportation energy use is the most important policy focus for action by citizens, legislators, and decision makers. The large number of transportation policies in the composite policy case reflects this priority.

Figure 5.II.1 Vermont Total Energy Use

Base Case (BC) and Composite Case (CC)

Figure 5.II.2 Vermont Energy Use by Sector

Base Case (BC) and Composite Case (CC)

III. SUSTAINABILITY IMPACTS

With the composite policy case, *Non-renewable energy use* is cut by a dramatic 25.9% cumulatively compared to the base case, over the life of the forecast. (See Figure 5.I.1.) Since oil is a major factor in *Non-renewable energy use*, this reduction is due primarily to transportation policies that increase vehicle efficiency, reduce vehicle miles traveled, and internalize hidden costs into the price of motor fuels. (See Chapter 5, Section V. Security Impacts below for more information regarding the decrease in oil use.) Most of the transportation policies in the composite case have an immediate impact on *Non-renewable energy use*, which falls off significantly in the first year of implementation.

As illustrated in Figure 5.III.1, use of *Renewable energy sources* (wind, solar, wood, hydro power, etc.) increases under the composite policy case by a cumulative 38.7% over the life of the forecast compared to the base case. The policy that uses renewable wood and wind generation to replace the state's power from Vermont Yankee nuclear station when its operating license expires in 2012 is the most significant factor contributing to this increase. Figure 5.III.1 shows the first wood and wind plants coming on-line in 2009, with more added through 2013. The decrease in *Renewable energy sources* in 2016 reflects the expiration of Hydro-Québec contracts.

Another key indicator of sustainability is *Percent of total energy use from renewables*, which is about 16.0% in 1995. By 2015, the *Percent of total energy use from renewables* increases to 35.7%, or slightly more than one-third of Vermont's total energy use in the composite policy case. In the base case, the *Percent of total energy use from renewables* actually falls slightly by 2015.

Because sustainability is one of Vermont's most important goals for a sound energy future, the sustainability impacts of the composite policy case deserve considerable weight. (See Chapter 2 for a discussion of sustainability.)

Figure 5.III.1 Vermont Oil Use and Renewables Use

Base Case (BC) and Composite Case (CC)

IV. EFFICIENCY IMPACTS

To assess the effect of energy policies, we began by looking at the impact on *Total energy use*. Figure 5.II.1 shows that the increase in *Total energy use* under the composite policy case is significantly less than the increase under the base case. *Total energy use* under the base case increases at an average annual growth rate of 1.1% between 1995 and 2020; the corresponding growth rate under the composite policy case is 0.3% per year. Compared to the base case, this is a cumulative average annual savings of 23.0 TBTU between 1997 and 2020. In the composite policy case, the increase in *Total energy use* is driven mostly by increases in the *Gross State Product* (GSP) and population.

Economic growth increases the demand for energy. To be sustainable, growth needs to be coupled with more efficient energy usage. A common measure of efficiency is *Energy intensity*: the ratio of *Energy use* relative to economic output, which is measured in this chapter as thousand BTU per 1995 dollar of GSP. If energy is used more efficiently, this ratio decreases.

Increased energy demand due to the steady growth in *GSP* is partly offset by reductions in *Energy intensity*. If *GSP* and *Total energy use* increase at the same rate, *Energy intensity* will be unchanged. If an increase in *Total energy use* is less than an increase in *GSP*, energy is being used more efficiently, and the *Energy intensity* ratio will reflect this improvement by decreasing.

Figure 5.IV.1 shows that by 2020, the end of the forecast period, *Gross State Product* under the composite policy case increases by about $4.1 billion or 0.8% cumulatively and *Energy intensity* is reduced by about 16.6% cumulatively compared to the base case. This is significant progress in reducing *Energy intensity*.

Commercial and industrial energy use (including transportation) per dollar of GSP (1995$) is another indicator of energy intensity. Over the forecast period, this indicator decreases by 12.1% cumulatively with the composite policy case as compared with the base case.

In order to achieve economic growth without increasing energy consumption, the percentage increase in *GSP* would have to be matched with the same percentage decrease in *Energy intensity*. This is not projected to occur in either the base case or the composite policy case. However, as discussed elsewhere, shifts to more sustainable energy sources can help ameliorate the effects of rising energy use.

Per capita residential energy use (including transportation) is another measure of energy efficiency. Over the life of the forecast, *Per capita residential energy use* increases very slightly in the base case. In the composite policy case it drops sharply in the first five years of the forecast (12.9%), then continues a gradual decline over the remaining years of the forecast, indicating that the efficiency benefits of the composite policy case extend to residential energy use as well.

Looking at the modeling results from several perspectives and adjusting for economic and population growth, it is clear that the policies selected for the composite case improve the efficiency of energy use in Vermont's commercial, industrial, and residential sectors.

Figure 5.IV.1 Vt. Energy Intensity and Gross State Product (GSP)
Base Case (BC) and Composite Case (CC)

V. SECURITY IMPACTS

Oil use is one of the primary indicators of energy security (see Chapter 2). Figure 5.III.1 shows that *Oil use* declines dramatically in the composite policy case relative to the base case, by about 22.9% cumulatively over the life of the forecast. Between 1995 and 2020, *Oil use* decreases at an average annual rate of 0.4% under the composite case, while it grows at an average annual growth rate of about 1% under the "business as usual" base case. Most of the composite case decline is in the first few years, because most of the transportation policies were modeled to begin implementation in 1997. After 2005, composite case *Oil use* is approximately flat, despite continued growth in the economy and population.

Another of way to look at energy security is *Oil use as a percent of total energy use*, which is about 66% in 1995. By 2015, *Oil use as a percent of total energy use* drops to 56.7% in the composite policy case, while it decreases very slightly in the base case.

These significant impacts in reducing oil use are achieved through the large number of transportation policies in the composite policy case. As one of the state's most important energy goals, energy security is greatly strengthened through the composite policies, while national security also benefits.

VI. ECONOMIC IMPACTS

The economy receives a boost from the selected policy set with the indicator *Employment* showing 100,000 job-years added cumulatively over the life of the forecast in the composite case compared to the base case. In a typical year, Vermont *Employment* is about 3,000 to 5,000 jobs greater in the composite case scenario compared to the base case.

Another economic impact of major significance that is achieved under the composite policy case is the cumulative addition of more than $4.1 billion to Vermont's *Gross State Product* compared to the base case over the life of the forecast; an 0.8% increase. (See Figure 5.IV.1.) It is important to note that with the composite policy case, both *Employment* (number of jobs) and *GSP* increase while energy use and the negative impacts of energy use decline.

Figure 5.I.1 also shows that another key economic indicator, *Per capita disposable income*, grows slightly faster in the composite policy case compared to the base case over the life of the forecast.

The modeling results clearly indicate that at least for the composite policies, good energy and environmental policy can also be good economic policy. In addition, many of the policies presented in Chapter 4 that are not modeled and included in the composite case offer similar opportunities to allow the economy to grow. For example, the policy to Encourage Development of the Hypercar and the Feebates policy are options that could increase and hasten the positive impacts achieved in the composite policy case proposed in this Plan. (See Chapter 4, Section II, B4 and E4.)

VII. AFFORDABILITY IMPACTS

Over the life of the forecast, the composite policies result in a 20.1% cumulative decrease in *Total cost of energy, related costs, and emissions costs* compared to the base case. Specifically, *Energy costs (net of policy taxes)* are 14.8% lower and *Cost of air emissions* is 25.6% lower with the composite policy case than with the base case on a cumulative basis. (See Figure 5.I.1.) The composite policies also result in about $8.6 billion in *Policy taxes* or cost shifts cumulatively through 2020. These shifts are typically matched with an equal reduction in other taxes or costs, resulting in no net increase in total costs to the average consumer when the offsetting reductions are considered. Moreover, as consumers choose conservation and energy efficiency, the *Total cost of energy, related costs, and emissions costs* shows a cumulative savings of more than $12 billion over the life of the forecast. Thus, the composite policies are highly cost-effective for Vermont.

Other indicators reiterate the benefits of the composite policy case to residential and low income consumers. (See Figure 5.I.1.) *Per household residential energy expenditure* also decreases about 1.4% cumulatively under the composite policy case compared to the base case over the life of the forecast. *Per household residential energy expenditure as a percent of poverty level income* also decreases about 1.4% cumulatively under the composite policy case compared to the base case, benefitting low income consumers.

Affordability impacts are some of the most important indicators in considering policy evaluation. The composite policies modeled here result in a significantly improved energy affordability picture.

VIII. ENVIRONMENTAL IMPACTS

All air emissions are dramatically reduced with the composite policy case compared to the base case (except for particulates which decrease only slightly). As shown in Figure 5.VIII.1, *Greenhouse gas emissions, Acid rain precursors*, and *Ground level ozone precursors* fall cumulatively by 21.4%, 24.2%, and 29.9% respectively in the composite policy case compared to the base case. Pollutants that decrease by the greatest amounts over the life of the forecast include *Carbon monoxide (CO) emissions* at 33.7% and *Nitrogen oxides (NO_x) emissions* at 30.7% cumulatively compared to the base case. However, as illustrated by Figure 5.VIII.1, Vermont's energy use still produces significant emissions, even under the composite policy case.

In spite of impressive decreases, the composite policies do not succeed in stabilizing *Greenhouse gas emissions* at their 1990 levels, a goal of U.S. policy and of the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. Even with the implementation of the policies selected for the composite case, *Greenhouse gas emissions* are 33% greater in 2020 than in 1990. While this is substantially better than the 78% increase in *Greenhouse gas emissions* projected in the base case, it does not meet the goal. This illustrates the difficulty of maintaining a state's greenhouse gas levels at 1990 levels without strong action by both state and federal government.

Figure 5.VIII.1 shows a reduction followed by slight growth in *Greenhouse gas emissions* prior to 2011 in the composite policy case, due primarily to the policies that reduce *Transportation energy use*. Increases in *Greenhouse gas emissions* in 2012 and 2016 are due to the increased use of natural gas. Reductions in *Ground level ozone precursors* and *Acid rain precursors* also result primarily from reduced *Transportation energy use* and the choice of wind power (instead of natural gas) to replace one-third of the state's power from Vermont Yankee when its operating license expires. Particulate emissions do not mirror the dramatic decrease of other emissions in the composite policy case due to policies which increase the use of wood energy. However, the positive aspects of increased use of *Renewable energy sources* and decreases in *Non-renewable energy use* still make wood an attractive energy option.

Vermont has a long-standing commitment to minimize the stresses on our environment. The passage of Act 250 and the federal Clean Air Act are examples of state and federal efforts that have enabled Vermont to make huge gains in restoring and protecting our natural resources. Coordinated efforts at the state and federal levels are also focused on greenhouse gas emissions and global warming. With the assistance of a grant from the U.S. Environmental Protection Agency (1993), the Department of Public Service worked with the Agency of Natural Resources and the Agency of Transportation to develop Vermont's Inventory of Greenhouse Gases and their estimated levels in 1990.

In 1995 Vermont received a Phase II grant from EPA's state outreach program's Greenhouse Gas Emissions Reduction Project to evaluate strategies for greenhouse gas emissions reductions and prepare a state action plan that assesses current and potential policies for reducing Vermont's greenhouse gas emissions to the targeted 1990 levels. This 1997 edition of the *Vermont Comprehensive Energy Plan* is our state action plan for reducing greenhouse gas emissions. Further information about Vermont's greenhouse gas emissions from non-energy sources is in Appendix 6 of this Plan. Figure 4.VIII.1. shows that for the first 15 years of the forecast, the composite policy case comes very close to meeting Vermont's targeted 1990 levels for greenhouse gas emissions. This is a significant but temporary achievement. Further diligence is required at both the state and federal levels to take actions that will hold greenhouse gas emissions at their 1990 levels.

Figure 5.VIII.1 Vermont Emissions from Energy Use

Base Case (BC) and Composite Case (CC)

IX. CONCLUSION

The composite policy case illustrates that Vermont's energy use can be made more efficient, more sustainable, and cleaner, while improving affordability, adding jobs, and increasing economic growth. Vermont would lead the nation in sound energy use if the policies modeled in the composite case were implemented.

Substantial policy changes are needed now to move Vermont expeditiously toward the state's energy goals in a significant way. To make serious progress, the state should take action first in the areas that can produce the greatest impacts. These areas include:

- **Improving transportation energy use**. As indicated throughout this Plan, transportation is the largest energy end use in Vermont. Transportation offers the greatest opportunities for reduced energy use, improved emissions, and reduced reliance on oil. Giant steps can be take toward the goals of this Plan through bold actions such as increasing the efficiency of vehicles through higher CAFE standards and a variety of state polices to maximize fuel efficiency and to minimize safety risks and associated emergency service costs. Vapor recovery at gas stations and adoption of a low emissions vehicle standard are two options for directly reducing transportation-related emissions. Efforts to shift travel to more efficient modes (buses, vanpools, trains) and encouraging non-motorized transportation and telecommuting will also contribute to reductions in transportation energy use and emissions.

- **Internalizing energy costs and improving economic efficiency**. Another major theme of this Plan is making the operation of the marketplace more efficient by internalizing energy costs that are now hidden from consumers and not included in the price of fuel. Energy taxes can result in more efficient energy use, with the additional advantage of providing a revenue stream to reduce property and income taxes in Vermont. (Proposals for energy taxes should consider issues of state-to-state comparability and a progressive tax structure.) This Plan's policy options show a number of ways to assure that polluters pay their fair share, while opening opportunities for property and income tax reform. Progress toward internalizing energy costs into energy prices would move Vermont substantially toward reduced energy use, reduced emissions, sustainability, security, and economic efficiency.

- **Increasing the use of renewable energy sources**. Replacing our non-renewable fuel use with renewables is another important step that deserves immediate action. Societally beneficial opportunities to replace non-renewable energy sources with renewable ones should be exploited, particularly when new energy sources are needed as a result of increased demand or the retirement of older plants. The expiration of Vermont Yankee nuclear station's license in 2012 offers an important opportunity to substantially increase our use of renewables. If the state's power from Vermont Yankee is not replaced with non-emitting renewable energy sources, the state's emissions will increase dramatically. By contrast, replacing nuclear power with wind power and the sustainable use of wood energy would not increase net carbon dioxide emissions. Starting to put renewable technologies in place now would allow the state to maintain present levels of emissions when Vermont Yankee closes and significant progress could be made toward improved sustainability and security.

Progress in these three areas, along with progress toward the potential benefits of restructuring Vermont's electric industry, are important first steps on the path to improved energy use, reduced greenhouse gas emissions, and better quality of life and well-being for all Vermonters - those alive today and our descendants living in Vermont in the future.

The policies in the composite case show a variety of ways that Vermont can make fundamental changes to meet the goals discussed in Chapter 2. The Department of Public Service recognizes that some may find that policies included in the composite policy case are not their top choices or even a feasible choice at this time. However, the composite policy case acts as an invitation to citizens and policy makers to consider an alternative scenario that includes a broad array of approaches to the goals set by the state and federal government. The composite policy set is a starting point; a way to stimulate debate.

Come to the public hearings on this Plan. Let the Department of Public Service know your views on these policy options and your additional ideas for reaching our goals for energy use and environmental preservation.

ENDNOTE:

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i. Modifications in the modeling from Chapter 5 that are different from the modeling of individual policies in Chapter 4:

- The policies that involve a tax on motor fuels (roadway construction/maintenance funding, registration fees, police/fire transportation funding, pay-at-the-pump insurance, sales tax, and bus funding policies) were modeled to generate the same total revenue as in the individual policies in Chapter 4, and not by using the same tax rates for the individual policies. The higher prices for fuel would encourage conservation and greater fuel efficiency, thereby reducing the amount of fuel sold. Since less fuel is sold, the tax per gallon must increase to maintain the same revenues for property tax reform, the elimination of registration fees, the decrease in police and fire expenses from local property taxes, etc. Combined with the sales tax, prices for gasoline would increase $0.87 per gallon on gasoline, and $0.75 per gallon for all other fuels (the Pay-at-the Pump Insurance policy applies only to gasoline sales).

- Four policies involve changes to some of the same variables, and as a result, the policies were combined into one new composite policy. These policies were: Adopt 55 MPH Interstate Speed Limit, Enforce Highway Speed Limit, Telecommuting, and the Non-Motorized Transportation.

- The two policies that involve electric generation from methane (landfill methane and farm methane generation) were combined into one policy to achieve a total of 1.961 MW of methane generation.