

# FINAL REPORT

## Vermont Energy Efficiency Potential Study for Oil, Propane, Kerosene and Wood Fuels

*Prepared for the*

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*Prepared and Submitted by:*



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## 1.0 EXECUTIVE SUMMARY – ENERGY EFFICIENCY SAVINGS POTENTIAL IN VERMONT FOR OIL, PROPANE, KEROSENE AND WOOD FUELS

This study was prepared in response to Vermont Legislative Act 208 (H.859) of 2006, Sec.18, directing the Department of Public Service (VDPS) to analyze the “costs and benefits of establishing a coordinated and comprehensive program to maximize cost-effective energy efficiency savings in all buildings, regardless of a particular building’s source of fuel and regardless of the income of the building owner.” The legislation also requires the study to consider program options to reduce consumption of oil, kerosene, propane, and other fuels not provided by regulated utilities.

This study estimates the achievable cost effective potential for energy savings from energy-efficiency measures for oil, propane, kerosene and wood fuels in Vermont over the ten-year period from 2007 through 2016. The results of this study, shown in Table 1-1 below, indicate that there is significant energy savings potential in Vermont for cost effective energy-efficiency savings for each fuel in each sector. The total achievable cost effective energy savings potential (savings as a percent of the forecast of fuel consumption) by the year 2016 is 14% for fuel oil; 8% for propane; 6% for kerosene and 14% for wood. On a combined MMBTU basis after ten-years of program activity the study estimates a 12% reduction in total fuel consumption annually in the residential, commercial, and industrial sectors from these four fuel categories.

Year	Sector	Oil	Propane	Kerosene	Wood
2016	RES	10.2%	5.6%	3.3%	18.3%
2016	COMM	24.2%	21.7%	21.9%	16.0%
2016	IND	10.2%	6.7%	10.2%	9.7%
2016	TOTAL	14.0%	8.0%	5.9%	14.2%

Energy-efficiency opportunities typically are physical, long-lasting changes to buildings and equipment that result in decreased energy use while maintaining the same or improved levels of energy service. The results of this study indicate that fuel oil provides the greatest amount of energy savings over the ten-year period. Of the total amount of energy savings the study estimates is cost effectively achievable, fuel oil provides 72% of these savings, propane 16%, kerosene 4%, and wood 8%. The study analyzed many energy efficiency measures; in the residential and commercial sectors the measures primarily consisted of building shell improvements, and space and water heating equipment upgrades. In the industrial sector energy efficiency improvements in industrial boilers, process heating, and space heating were studied.

In the residential and commercial sectors the greatest savings are available through building shell improvements. Building shell improvements account for

63% of total savings. In the industrial sector boiler improvements provided the greatest savings opportunities with 65% of the savings.

In developing the base case estimates of achievable cost effective energy efficiency savings potential, GDS focused its consideration of savings opportunities on market driven energy efficiency program strategies (those strategies that involved strategic interventions at the time of equipment retirement or replacement – sometimes referred to as “replace-on-burnout”). The base case projection for the achievable cost effective potential energy savings is based upon cost effectiveness screening<sup>1</sup>. The net present savings for the State of Vermont for long-term implementation of energy efficiency programs for oil, propane, kerosene and wood throughout the State over the next decade (2007 to 2016) is \$486 million.

The costs to implement the energy efficiency program modeled in the study would be \$149 million in nominal dollars, or approximately \$14.9 million per year from 2007 to 2016. In addition to the program costs, there are participant costs associated with making the investment in the actual efficiency measure. This study estimates the participant costs to total \$92 million over the next decade (2007 to 2016).

A notable difference between energy efficiency programs targeting unregulated fuels versus regulated fuels are differences in ‘system benefits’ (those benefits that accrue to both participants and non-participants). Regulated fuels rely disproportionately on common infrastructure elements and market products that are paid for by all ratepayers collectively and are recovered through cost-based rates. Energy efficiency programs help avoid these additional common costs and effectively provide a system financial benefit to all ratepayers. Unregulated fuels may rely on some common infrastructure and avoid some system costs, but energy efficiency programs targeted at oil, propane, kerosene and wood occur under market conditions that may or may not result in financial gain to other ratepayers.

Tables 1-2 and 1-3 below show the cumulative annual achievable cost effective energy savings by fuel type by sector for the period 2007 to 2016 in MMBTU and gallons respectively. Table 1-4 illustrates the cumulative annual emissions reductions for CO<sub>2</sub>, methane (CH<sub>4</sub>), and NO<sub>2</sub> based on the potential energy efficiency savings for fuel oil, propane, kerosene, and wood discussed in this report.

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<sup>1</sup> The Vermont Societal Test was used as the primary test for screening, but the results are robust relative to the choice of tests and would vary little had the Total Resource Cost Test been used as the primary test. A cost effectiveness screening analysis using the Participant test was also evaluated.

Table 1-2: Summary of Cumulative <b>Annual Fuel Savings</b> for the Achievable Cost Effective Potential Scenario for Vermont (in mmbtu)					
Year	Total for <b>All Sectors</b> - Cumulative Annual Fuel Savings				Total Cumulative Annual mmbtu savings
	Fuel Oil	Propane	Kerosene	Wood	
2007	334,630	75,056	16,948	35,850	462,484
2008	670,067	150,526	33,895	71,785	926,273
2009	1,006,309	226,417	50,843	107,806	1,391,375
2010	1,343,374	302,721	67,791	143,859	1,857,746
2011	1,681,246	379,447	84,738	180,052	2,325,482
2012	2,019,915	456,585	101,686	216,223	2,794,409
2013	2,359,390	534,138	118,633	252,481	3,264,642
2014	2,699,671	612,112	135,581	288,824	3,736,187
2015	3,040,758	690,499	152,529	325,252	4,209,038
2016	3,380,002	768,833	169,476	361,727	4,680,037
<b>Total</b>	<b>18,535,362</b>	<b>4,196,334</b>	<b>932,120</b>	<b>1,983,857</b>	<b>25,647,673</b>

Note: The numbers in this table are cumulative annual fuel savings numbers. The numbers listed for the year 2016 are the achievable cost effective potential by the year 2016.

Table 1-3: Summary of Cumulative <b>Annual Fuel Savings</b> for the Achievable Cost Effective Potential Scenario for Vermont (Gallons & Cords)				
Year	Total for <b>All Sectors</b> - Cumulative Annual Fuel Savings			
	Fuel Oil (Gal.)	Propane (Gal.)	Kerosene (Gal.)	Wood (Cord)
2007	2,421,348	819,391	124,068	1,630
2008	4,848,530	1,643,300	248,135	3,263
2009	7,281,543	2,471,801	372,203	4,900
2010	9,720,510	3,304,819	496,270	6,539
2011	12,165,309	4,142,429	620,338	8,184
2012	14,615,881	4,984,557	744,406	9,828
2013	17,072,285	5,831,203	868,473	11,476
2014	19,534,522	6,682,441	992,541	13,128
2015	22,002,592	7,538,196	1,116,609	14,784
2016	24,457,320	8,393,369	1,240,676	16,442
<b>Total</b>	<b>134,119,841</b>	<b>45,811,507</b>	<b>6,823,719</b>	<b>90,175</b>

Note: The numbers in this table are cumulative annual fuel savings numbers. The numbers listed for the year 2016 are the achievable cost effective potential by the year 2016.

Table 1-4: Summary of Cumulative <b>Annual Emissions Savings</b> for the Achievable Cost Effective Potential Scenario for Vermont - <b>All Sectors</b>				
Year	Cumulative Annual Emissions Savings Derived from Energy Savings (Tons)			
	Total Cumulative Annual mmbtu savings	CO2 Emissions Reduction (tons)	Methane (CH4) Emissions Reduction (tons)	NO2 Emissions Reduction (tons)
2007	462,484	33,255	12.5	0.4
2008	926,273	66,603	25.0	0.9
2009	1,391,375	100,045	37.5	1.3
2010	1,857,746	133,581	50.1	1.7
2011	2,325,482	167,210	62.7	2.2
2012	2,794,409	200,932	75.3	2.6
2013	3,264,642	234,747	88.0	3.0
2014	3,736,187	268,655	100.7	3.5
2015	4,209,038	302,656	113.4	3.9
2016	4,680,037	336,506	126.2	4.4
Total	25,647,673	1,844,189	691.3	23.9
Note: The numbers in this table listed for 2007 to 2016 are cumulative annual savings numbers. The numbers listed for the year 2016 are the achievable cost effective potential by the year 2016.				
1. Complete Sources for Emissions Savings Factors can be found in Appendix E				

The results of this study demonstrate that there is significant cost effective potential for an oil, kerosene, propane, and wood fuels energy efficiency program. Table 1-5 below shows the present value<sup>2</sup> (\$2007) of benefits and costs associated with implementing the achievable potential energy savings in Vermont using the Vermont Societal Test.<sup>3</sup> The overall Vermont Societal Test benefit/cost ratio for the achievable cost effective potential scenario is 4.03.

<sup>2</sup> The term “present value” refers to a mathematical technique used to convert a future stream of dollars into their equivalent value in today’s dollars.

<sup>3</sup> Vermont Participant Test results are described in Chapter 2, Table 2-3

Table 1-5: Vermont Societal Test Benefits and Costs for Oil, Propane, Kerosene and Wood Energy Efficiency Measures for <b>All</b> Sectors in Vermont				
Energy Efficiency Savings by Fuel Source	NPV of BENEFITS	NPV of COSTS	NPV SAVINGS (\$2007)	B/C Ratio VT Societal Test
Oil	\$433,041,956	\$107,651,232	\$325,390,724	4.02
Propane	\$150,027,617	\$35,883,950	\$114,143,667	4.18
Kerosene	\$22,354,386	\$6,542,484	\$15,811,902	3.42
Wood	\$40,476,594	\$10,011,226	\$30,465,368	4.04
<b>Grand Total - All Sectors</b>	<b>\$645,900,553</b>	<b>\$160,088,893</b>	<b>\$485,811,661</b>	<b>4.03</b>

Four key assumptions were made in order to determine achievable cost effective potential energy efficiency savings:

- A program administrator structure similar to Efficiency Vermont is used to design and implement new energy efficiency programs to achieve energy savings for the four fuels considered in this study.
- The costs for program administration, design, management, data tracking and reporting are assumed to be equivalent to those experienced by Efficiency Vermont.
- Financial incentives paid to program participants are assumed to be fifty percent of energy efficiency measure costs.
- A “replace on burnout” programmatic strategy is the main method used to acquire the achievable cost effective potential savings in order to get the most savings at the lowest cost. Selected retrofit programs are included for measures such as insulation and air sealing.

This study shows that there is significant potential to reduce the consumption of oil, kerosene, propane, and wood fuels in Vermont. The remainder of this report is organized as follows:

- Section 2: Energy Efficiency Savings Potential in Vermont For Oil, Propane, Kerosene and Wood Fuels
- Section 3: Historical and Forecast Oil, Propane, Kerosene and Wood Energy Consumption Trends in Vermont
- Section 4: Methodology for Determining Energy Savings Potential
- Section 5: Energy Efficiency Potential – Residential Sector
- Section 6: Energy Efficiency Potential – Commercial Sector
- Section 7: Energy Efficiency Potential – Industrial Sector