



ENERGY COSTS AND BURDENS IN VERMONT: BURDENSOME FOR WHOM?

A report for the Vermont Low Income Trust for Electricity, Inc.

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EXECUTIVE SUMMARY

Energy, whether from electricity, natural gas, heating oil, propane, kerosene, or wood, is essential for the well-being of all Vermonters. However, those who spend more than 10 percent of their monthly income on energy services can be considered “fuel poor.” By this definition, we calculate that approximately 125,000 Vermonters, or one in five, live in fuel poverty. People who lack sufficient energy to keep warm in winter face serious, if sometimes subtle, health risks including a higher risk of stroke, heart attack, pulmonary embolism, influenza, pneumonia, asthma, arthritis, depression, anxiety, and accidents within the home. Over the years 1999–2011, Vermont averaged 172 excess winter mortalities per year. This represented 3.3 percent of all deaths in that period, more than double the rate of deaths from automobile and other transportation accidents. In other words, excess winter deaths, caused largely by fuel poverty, kill more Vermonters each year than car crashes.

In this report we analyze the energy burden in Vermont by household income deciles, using data from the Census Bureau’s American Community Survey. This survey provides data on household income as well as household expenditures for electricity, natural gas, and “other fuels,” which includes heating oil, propane, kerosene, wood, coal, and coke. The report’s results show the energy burdens for each of these three energy categories are largely growing. We estimate that approximately 71,000 people suffered from fuel poverty in Vermont in 2000, and in 2012 the number rose to 125,000, or one in five Vermonters. Fuel poverty has grown by 76 percent over the past thirteen years. The results also suggest that Vermont has more aggravated fuel poverty than most other states in New England.

With this in mind, we recommend that the Vermont legislature better fund investments in weatherization among low-income households; supplement federal weatherization programs; and endorse energy efficiency labels for homes, especially rented homes and apartments, which is where many of the fuel poor reside. We propose that community groups and social service agencies scale up the training of energy efficiency coaches, disseminate energy conservation and low-cost efficiency materials (including information), and incorporate awareness and outreach on energy burdens into their existing programs. We recommend that other state agencies engage the problem in creative ways—whether or not through specific, identifiable programs—in order to support the sharing of information; improvements in housing efficiency, with an emphasis on rental properties; and appropriate fuel switching, with an emphasis on cold climate heat pumps. We lastly recommend that utilities and fuel providers offer extra assistance for disconnected households, allow for on-bill financing of efficiency improvements, and pursue (or at least consider) a business strategy of diversifying into energy services companies.

INTRODUCTION

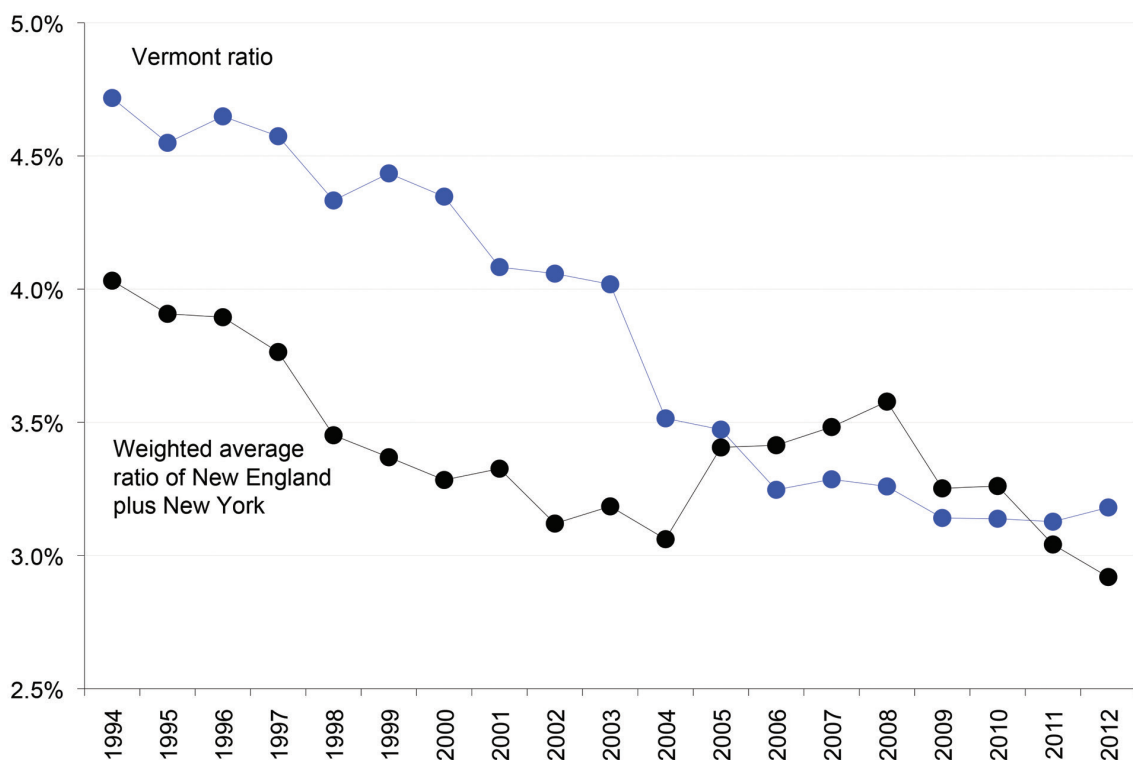
Energy, whether from electricity, natural gas, heating oil, propane, kerosene, or wood, is essential for the well-being of all Vermonters. We need it for warmth during much of the year, to cook our food, and to power the appliances in our homes. As the climate warms, more of us are coming to depend on air conditioning in the summer. Energy is essential not merely to a modern standard of life, but to physical and mental health. The expense required for purchase of energy can be a significant burden, especially for those with relatively low incomes.

The problem of energy affordability can be masked when statistics are studied at the statewide level. For example, Figure 1 shows that Vermonters—as a whole—are paying less of their income for electricity than in the past. This statistic is true. It reveals a socially positive trend in the recent past, and is useful in appropriate contexts. Nonetheless, it portrays an incomplete perspective on how much of electricity takes out of household budgets. In this report we address this issue by analyzing household energy expenditures in Vermont by decile of household income. (A decile is a 10% incremental block of a population).

Generally, those who spend more than 10 percent of their income on energy services can be considered “fuel poor.” By this definition, we calculate that approximately 125,000 Vermonters, or one in five, live in fuel poverty. As Richard Sedano from the Regulatory Assistance Project, an international energy think-tank based in Montpelier, Vermont put it, “Fuel poverty remains a society-wide problem, even here in Vermont.”¹

The World Health Organization defines minimum adequate warmth in the home as 21°C (69.8°F) in the main living space and 18°C (64.4°F) in other rooms.² Though Vermonters may consider this a surprisingly warm standard, keep in mind that the standard must account for those who are most vulnerable, including young children, the elderly, and those with chronic or otherwise serious health conditions. People who lack sufficient energy to keep warm in winter face serious, if sometimes subtle, health risks. In a review of the research on the connection between fuel poverty and human health, Liddell and Morris³ list risks including stroke, heart attack, pulmonary embolism, influenza, pneumonia, asthma, arthritis, depression, anxiety, and accidents within the home, which are presumed to result from reduced mobility and flexibility, especially

Figure 1: Ratio of average annual residential electric bill to per-capita disposable income, 1994-2012⁴



for those with arthritis or similar conditions. Together, these health impacts result in an effect known in the public health community as “excess winter mortality.” Over the years 1999–2011, Vermont averaged 172 excess winter mortalities per year.⁵ This represented 3.3 percent of all deaths in that period, more than double the rate of deaths from automobile and other transportation accidents.⁶ This bears repeating: excess winter deaths, caused largely by fuel poverty, kill more Vermonters each year than car crashes.

When homes are cold and damp, children appear more likely to miss school and to have respiratory problems.⁷ In their review of US-based research regarding children 3 years old and younger, a vicious cycle for poor families in cold climates can occur: children require more calories to maintain healthy development if they are in cold conditions, yet poor families must balance food purchases against fuel purchases. One study found that poor families reduced food intake by an average of 10 percent (measuring in terms of calories) during winter, shifting money toward heating fuels.⁸ It is not surprising that another study comparing low-income households that did or did not receive winter fuel subsidies found that infants in households without the subsidies were less developmentally advanced, had lower weight-to-age measure, and faced an increased chance of requiring emergency medical care.⁹

The affordability of energy supplies is not a function merely of price. For the same quantity of energy, rising prices impose a greater burden only when incomes fail to rise as fast—indeed, if incomes rise faster than the price of energy, the financial burden is reduced. In turn, if use of energy falls while prices hold steady, the burden falls. Even if prices are rising, the burden will fall if the use of energy falls enough to more than offset the rising price. In other words, *what matters to users of energy is not the price, per se, but the size of the energy bill and how it compares to income.* Energy efficiency is the tool which allows people to reduce their bills even as prices rise. Though people with smaller incomes generally use less energy and have smaller bills in absolute terms, they must spend a larger fraction of their income on this energy than households with greater income. This means that the financial burden for lower-income households is more severe even with reduced consumption of energy.

In this report, we take a look at energy burdens in Vermont. Energy burden is defined as *expenditure on energy as a percentage of income.* There are three variables involved in ascertaining the energy burden: the quantity of energy consumed, the price of energy, and income. The two-step formula for determining the energy burden is

$$\text{Quantity of energy consumed} \times \text{price of energy} = \text{Spending on energy}$$

$$\frac{\text{Spending on energy}}{\text{Income}} = \text{Energy burden}$$

When energy burdens are significant, those enduring such burdens are said in the research literature to be in “fuel poverty.”¹⁰ Different writers have adopted different methods to identify the fuel poverty threshold.¹¹ The earliest definition in the research literature set the fuel poverty threshold at twice the median—that is, if median expenditure is X percent of household income, then households are in fuel poverty if they spend 2X percent or more of their income on household energy.¹² For reasons of analytical and explanatory simplicity, we adopt the definition of fuel poverty as occurring when more than 10 percent of income goes toward energy purchases.¹³ In the UK, where significant research into fuel poverty has occurred, the twice-median measure has generally given similar results to the 10 percent measure, though they do sometimes diverge.¹⁴

Readers should be aware of another nuance in fuel poverty definitions. UK researcher Brenda Boardman’s definition, in her landmark 1991 book *Fuel Poverty: From Cold Homes to Affordable Warmth*, focused on the amount that a household would “need to spend” to maintain acceptable conditions (specifically with regard to warmth), acknowledging that actual spending might fall below this level.¹⁵ Subsequent research in the UK found that a great many low-income households spent much less on energy than was required to keep their homes warm enough,¹⁶ thus putting those residents at increased risk for the health impacts listed above.

Due to limitations on available data, we use the simpler definition whereby the threshold is pegged at 10 percent

of actual spending. The result is that our following analysis will not identify households as being in fuel poverty if the household fails to spend over 10 percent of its income on energy, even when that failure means that the household is maintained at unacceptably low temperatures. On the other hand, our analysis below will count households as being in fuel poverty even if the reason for their spending being above 10 percent of annual income is due to their maintaining their home at a higher temperature than is needed to sustain good health.¹⁷ We believe that, while far from ideal, our definition provides useful information in identifying meaningful financial stress—or lack thereof—for Vermont households due to the cost of using energy.

It is important to understand that fuel poverty can occur even when the household in question is not identified as otherwise being in poverty.¹⁸ A family may have enough income to be above the poverty line, yet spend more than ten percent of its income on energy—these expenditures may be high enough that the family’s ability to manage the rest of its financial needs is hampered, possibly significantly so. A report by Fisher, Sheehan, and Coltan found that, in 2012, Vermont households with income between 185 and 200 percent of the Federal poverty line spent, on average, 14 percent of their income on energy.¹⁹ Our research, discussed in detail below, reveals that, in 2012, average energy burdens for the bottom three deciles of Vermont households were above the fuel poverty threshold; for the bottom decile, the average energy burden was a whopping 28 percent.

Keep in mind that our analysis focuses exclusively on the financial burden of energy used within the household. Spending on transportation energy (i.e., gasoline and diesel) is excluded, though it certainly can impose a financial burden and would make for a valuable follow-up study.

ENERGY BURDENS IN VERMONT

In this report we analyze the energy burden in Vermont by household income deciles,²⁰ using data from the Census Bureau's American Community Survey.²¹ This survey provides data on household income as well as household expenditures for electricity, natural gas, and "other fuels," which includes heating oil, propane, kerosene, wood, coal, and coke. The following results show the energy burdens for each of those three energy categories as well as the sum of all expenditures for energy in the household.

Figures 2a and 2b show snapshots of the energy burden in the years 2000 and 2012, respectively. The vertical bars show the average dollar amount spent by households within each decile on all energy used in the household. Throughout this report, all monetary values have been adjusted for inflation and are displayed in "real" 2013 dollars.²² The red lines show how much of a burden those expenditures are, measured as a percentage of the average household income within each decile.

Due to limitations in the data, these results likely understate energy burdens. Many renters have some or all of

their energy costs included in their rent, and therefore show little or no energy expenditure in the survey. As a result, when calculating energy expenditures as a percentage of income, these households likely return misleadingly low values.²³

That said, a few patterns are visible in both years. Though not strictly so, there is a clear tendency for households with more income to spend more money on energy. Despite lower absolute levels of expenditure on energy by households in lower deciles, these purchases take up a greater fraction of their income. The energy burden is quite low for the top decile. Moving to the left, the increase in burden on each lower decile is at first fairly modest, then rises rapidly for the lowest deciles.

As is apparent, the burden in 2012 was greater than in 2000: a greater average quantity of (inflation-adjusted) money was spent on energy by households in each decile, and this quantity was a greater percentage of average household income for each decile. If incomes had grown faster than energy expenditures, then the cost burden would have fallen despite the growing expenditures. Clearly, this has not been the case. Growth in energy expenditures outstripped growth in income.

Figure 2a: Average annual expenditures for all energy used in the household in Vermont, by decile of household income, 2000 (in 2013\$)

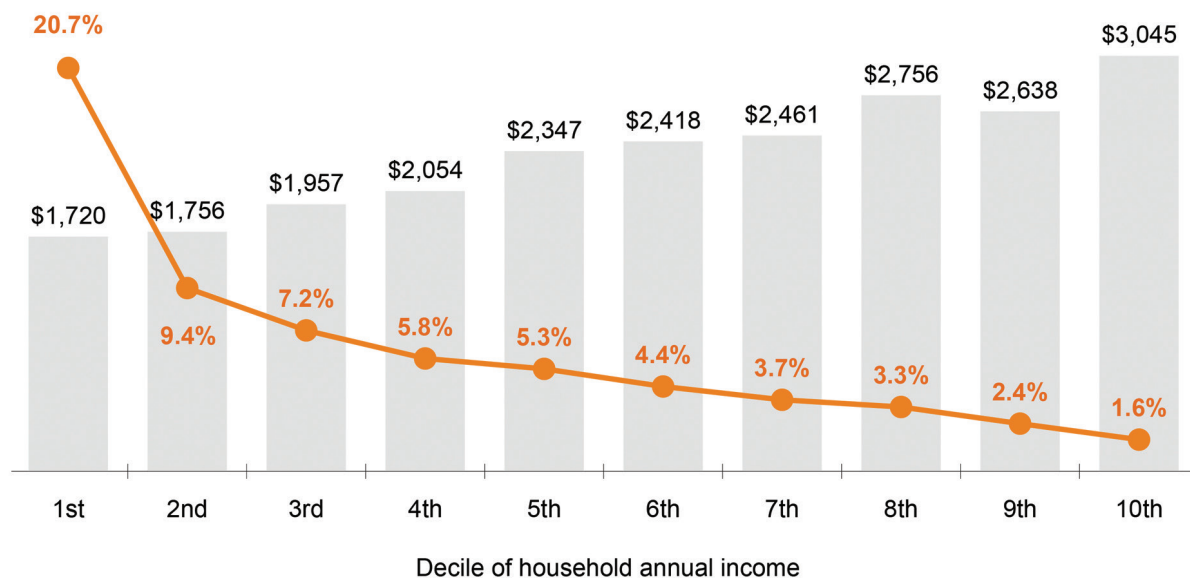
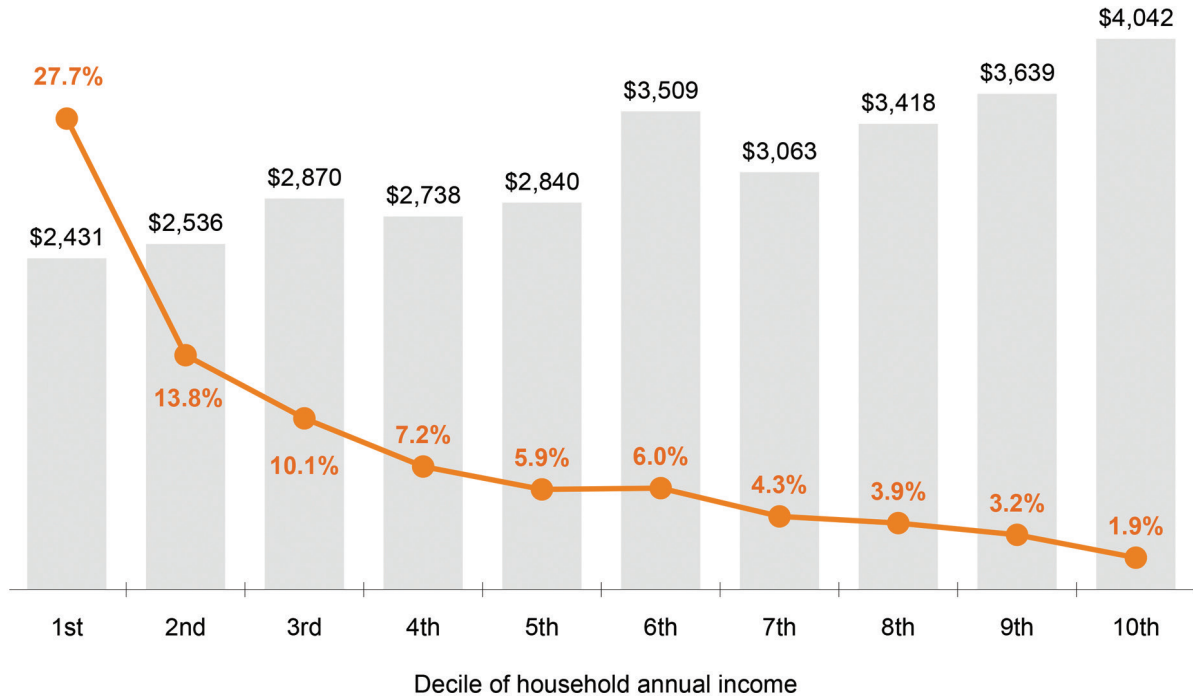


Figure 2b: Average annual expenditures for all energy used in the household in Vermont, by decile of household income, 2012 (in 2013\$)



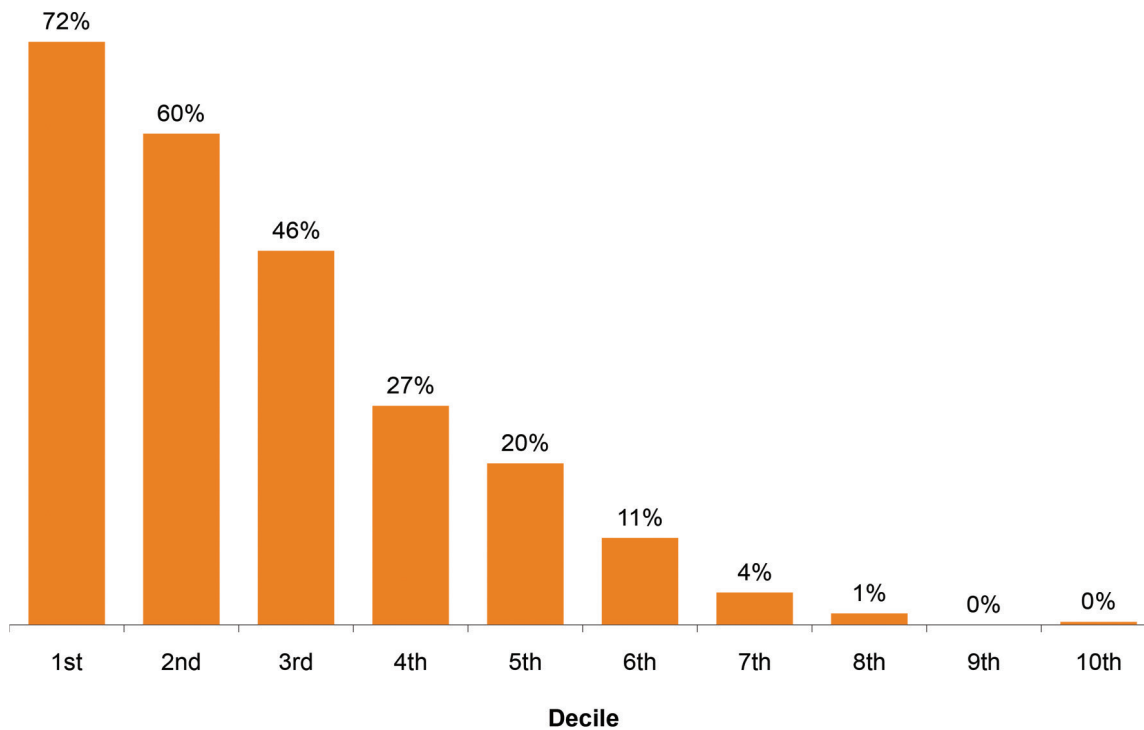
In 2000, only the lowest-income decile had, on average, an energy burden sufficient to qualify as fuel poverty. Recall that these values are averages for the deciles, so it is possible for some households in the lowest decile not to be in fuel poverty, per se, despite their low incomes—and indeed there were such households. In turn, given that the average burden for the second decile was only slightly below the fuel poverty threshold at 9.5%, a large portion of households in the second decile were in fuel poverty. In fact, even the 6th and 7th deciles included nontrivial fractions of households experiencing fuel poverty in 2012, as is seen in Figure 3. To be sure, the impact of a high energy burden on a relatively high-income household is unlikely to be as extreme as on a low-income household. Fuel poverty by itself is an incomplete measure of financial strain.

The statistics indicated above are also a reminder that fuel poverty only partly correlates to financial poverty—not all of Vermont’s poorest households are in fuel poverty, and more than a few households with income well above the “poverty line” nonetheless experience fuel poverty. In 2012, the official US poverty line for a family of four, including two children, was \$23,624 (inflation-adjusted to 2013\$ value).²⁴ As seen in Table 1,

Table 1: Household income decile thresholds: to be in decile, household has real (2013\$) income...

Income decile	2000	2012
10th	\$121,824 and higher	\$133,933 and higher
9th	below \$121,824	below \$133,933
8th	below \$94,698	below \$98,421
7th	below \$72,674	below \$78,757
6th	below \$60,877	below \$64,937
5th	below \$50,731	below \$53,168
4th	below \$39,638	below \$42,980
3rd	below \$31,453	below \$33,078
2nd	below \$22,741	below \$23,844
1st	below \$13,501	below \$14,205
Official US poverty line in 2012 (in 2013\$) ²⁵		\$23,624

Figure 3: Percentage of households in fuel poverty in 2012, by decile



this is approximately the threshold between the 2nd and 3rd deciles. Yet even in the 5th decile, where average incomes are roughly double the poverty line, one in five households was experiencing fuel poverty in 2012.²⁶ For sake of context, Table 1 shows the income thresholds for each Vermont decile in 2000 and 2012.

In 2012, the bottom three deciles all had average energy burdens that qualify as fuel poverty. Compared to 2000, inflation-adjusted energy spending was up by at least 21 percent for all deciles, and as a group the bottom half experienced the largest average increases, as seen in Table 2.

For the lower deciles in general, one possible contributing factor is that these households are less likely to be able to afford efficiency upgrades to their homes, which generally require significant up-front expense. This is exacerbated by rising energy burdens on lower-income households, leaving them less discretionary money with which to make investments in efficiency. Further exacerbating the situation is the fact that lower-income households are more likely to be renters, and therefore have less ability to implement efficiency improvements even if they desire and

Table 2: Increase in inflation-adjusted average household energy expenditure in 2012 relative to 2000

Income decile	Increase	Average increase
10th	32.7%	32.9%
9th	37.9%	
8th	24.0%	
7th	24.5%	
6th	45.2%	
5th	21.0%	37.4%
4th	33.3%	
3rd	46.7%	
2nd	44.5%	
1st	41.3%	

can afford to do so. Table 3 shows rates of rented housing in 2012. We speculate a further exacerbating

Table 3: Percent of renter households in each decile in 2012

Income decile	Renters	Average
10th	4.2%	14.8%
9th	10.8%	
8th	11.3%	
7th	27.4%	
6th	20.5%	39.7%
5th	33.7%	
4th	34.5%	
3rd	35.6%	
2nd	48.0%	
1st	46.4%	

factor for renters, that landlords providing rental housing to lower-income households are less likely than landlords providing housing to higher-income households to be interested in investing in energy efficiency improvements to their properties.

The impact of rising prices is aggravated by stagnant household incomes for lower decile households. Table 4 shows average annual rates of change in household incomes by decile.

Figure 4 shows changes in real prices for the most common energy sources from 2000 to 2012, while Table 5 shows the average annual rates of change for those prices. Note that Figure 4 does not suggest that natural gas has a similar price to propane or heating oil, or that electricity has a similar price to wood; instead, it shows that—relative to their prices at the beginning of the study period—the prices of the three fossil fuels have risen in a similar fashion, while the prices of electricity and wood have held relatively stable.

Two things are clear. First, electricity prices have risen much more slowly than prices for the fossil fuels commonly used for home heating (and, in the case of propane and natural gas, cooking).²⁷ Second, those fossil

Table 4: Changes to average real household income, 2000 to 2012

Income decile	Average annual change in real income ²⁸	Change as % of average annual real income ²⁹
10th	\$2,372	1.2%
9th	\$445	0.4%
8th	\$337	0.4%
7th	\$348	0.5%
6th	\$281	0.5%
5th	\$303	0.6%
4th	\$202	0.5%
3rd	\$123	0.4%
2nd	(\$20)	(0.1%)
1st	\$40	0.4%

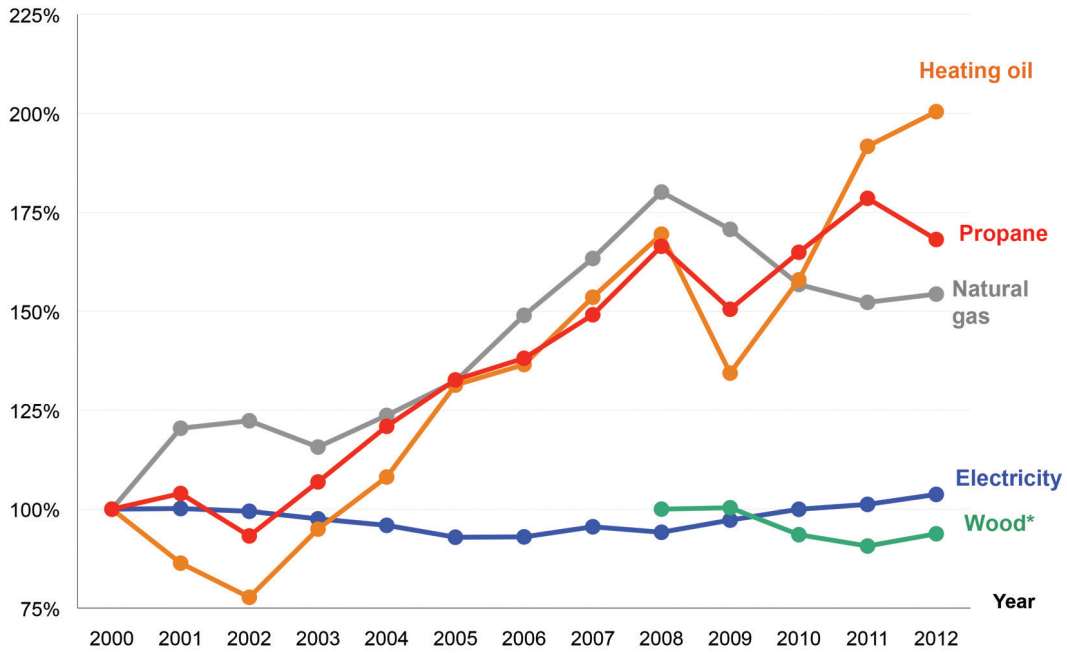
fuels have, on average, risen in price far faster than incomes have risen for any of the deciles. Electricity has risen in price more slowly than the average increase in household income for the upper seven deciles. Income gains by the lowest three deciles have been only just sufficient or slightly insufficient to keep pace even with the low rate of increase in real electricity prices.

Table 5: Average annual change in real price, 2000 to 2012³⁰

Electricity	Heating oil	Propane	Natural gas
0.3%	7.0%	4.8%	4.0%

Perhaps not surprisingly, there has been a shift in fuels used for heating. The primary changes have been a reduction in reliance on heating oil and an increase in reliance on wood, as shown in Figure 5. The percentage of Vermont households relying on heating oil as their primary source of heat has fallen from 61 percent in 2000 to 46 percent in 2012. The percentage of households relying on wood has increased from 9 percent in 2000 to 18 percent in 2012.³¹

Figure 4: Percent change in real price of energy source, 2000-2012



* Data on wood prices date only to 2008 and are based on small, unscientific surveys.

Figure 5: Primary source of home heating

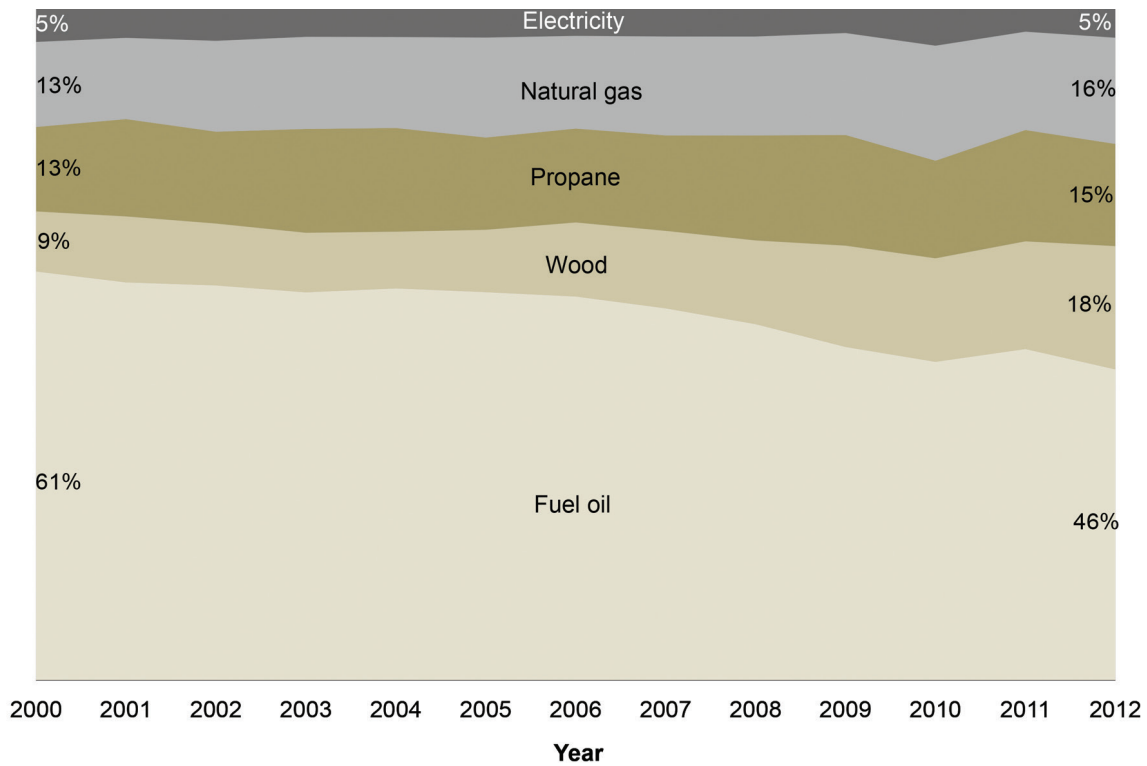
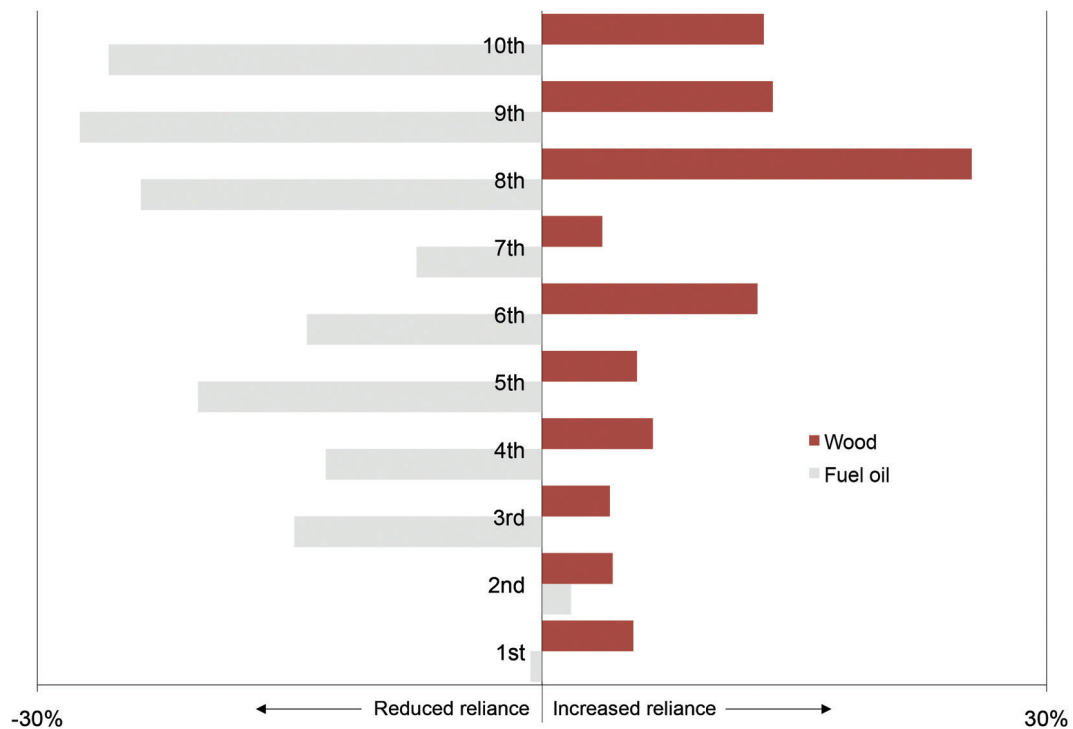


Figure 6: Change in fuel oil and wood as primary heating fuels, 2000–2012, by decile



Households from different deciles have pursued fuel switching to different degrees. As seen in Figure 6, those with more income have, in general, switched out of oil and into wood to a greater extent than those with less income.

Figures 7a, b, c, and d show the trends in energy cost burden in Vermont from 2000 to 2012. These trends are displayed in terms of *income remaining after spending on the energy category*, a measure of post-energy disposable income. Visually, the more income spent by a household on energy, the lower the household will appear in the figure. A household spending more than 10 percent of income on energy (the fuel poverty threshold) will have less than 90 percent of income remaining after that expenditure, highlighted in the figures by the gray shading.

Each figure covers a different energy category: electricity, natural gas, other energy (heating oil, propane, kerosene, wood, etc.), or all household energy combined. Energy consumed for transportation is excluded.³² In Figures 7a, b, c, and d, each dot represents the average for an income decile in a particular year. The lines show trends for the deciles.³³ The five lowest-income deciles

are shown individually. Because the upper deciles all fall below a 5 percent energy burden in each measure, i.e., have more than 95 percent of income remaining after accounting for energy spending, the 6th through 10th deciles are shown combined, to avoid unnecessary visual clutter.

Three patterns are clear: (1) each higher-income decile experienced a smaller cost burden for energy expenditures as compared to lower-income deciles, (2) each higher-income decile experienced a flatter trend in the change of cost burdens over the time period studied as compared to lower-income deciles, and (3) there is less variation in burden from year to year for each higher-income decile as compared to lower-income deciles.

Interestingly, the cost burden of electricity has actually fallen—though only very slightly—for most deciles. For the other categories of energy consumption, the trends for the upper-income deciles show very shallow increases in burden (reductions in post-energy disposable income).

As can be seen, the lowest decile experiences a significantly greater cost burden than other deciles

Figure 7a: Average income remaining after spending on electricity, as a percentage of total household income, by decile

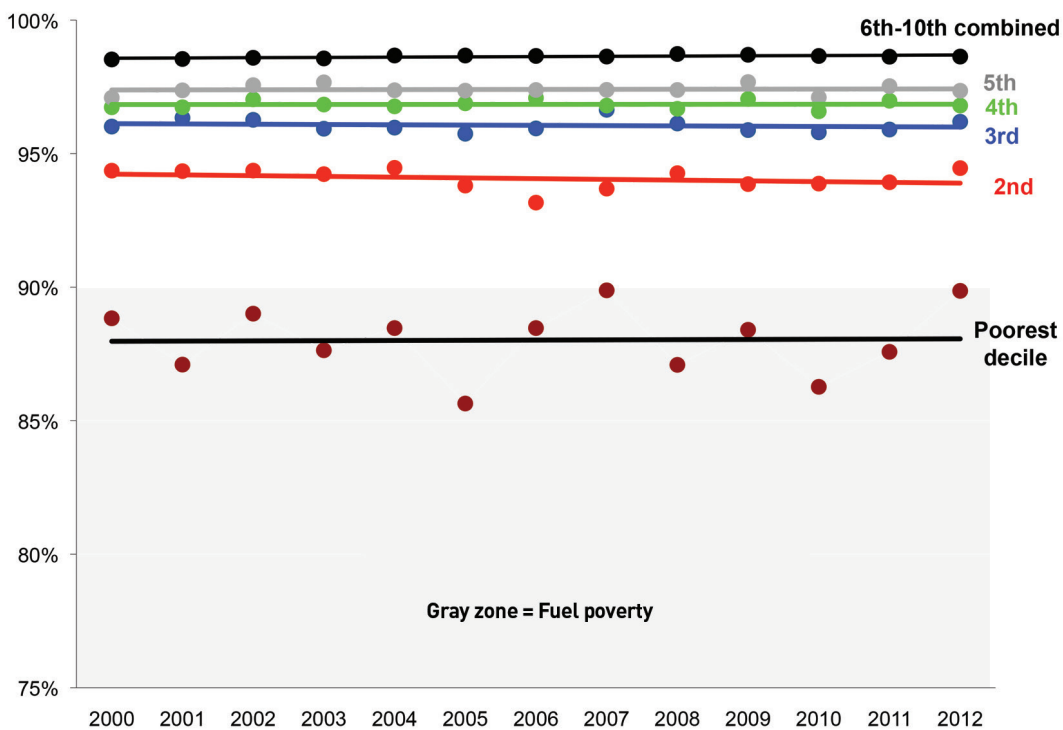


Figure 7b: Average income remaining after spending on natural gas, as a percentage of total household income, by decile

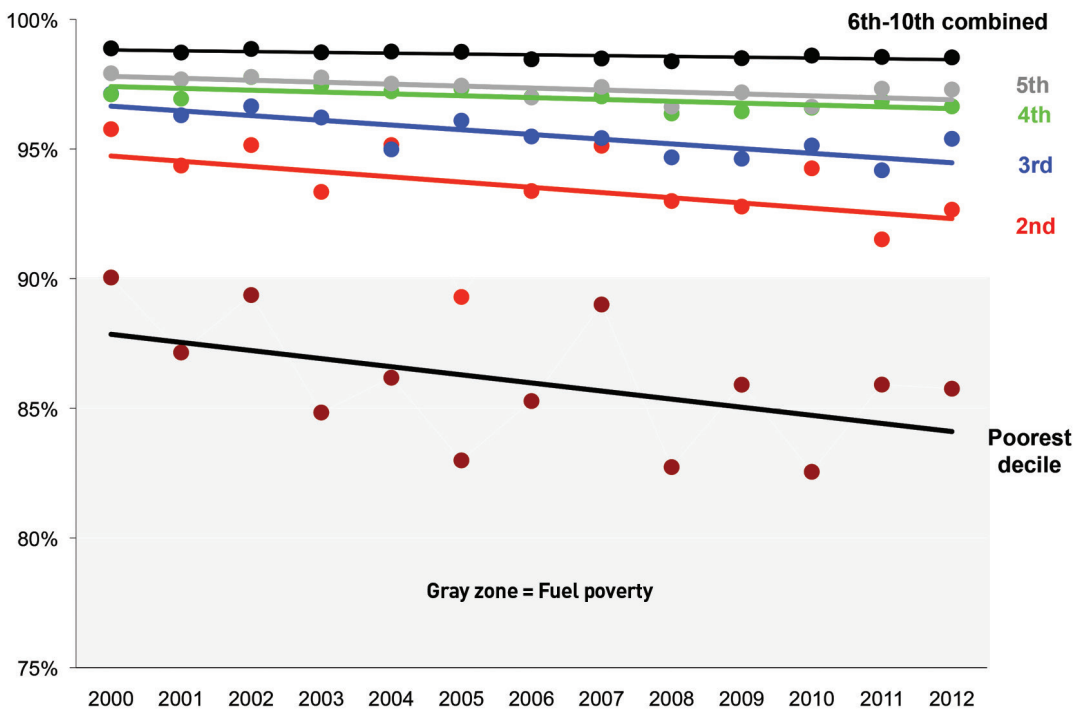


Figure 7c: Average income remaining after spending on other fuels, as a percentage of total household income, by decile

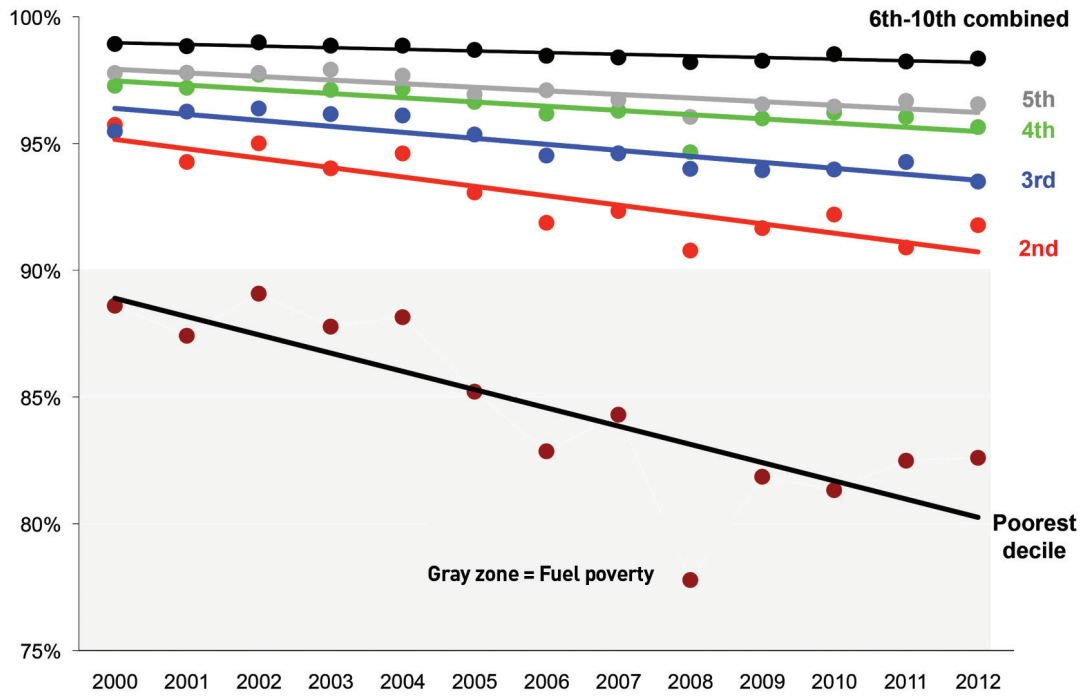


Figure 7d: Average income remaining after spending on all household energy, as a percentage of total household income, by decile

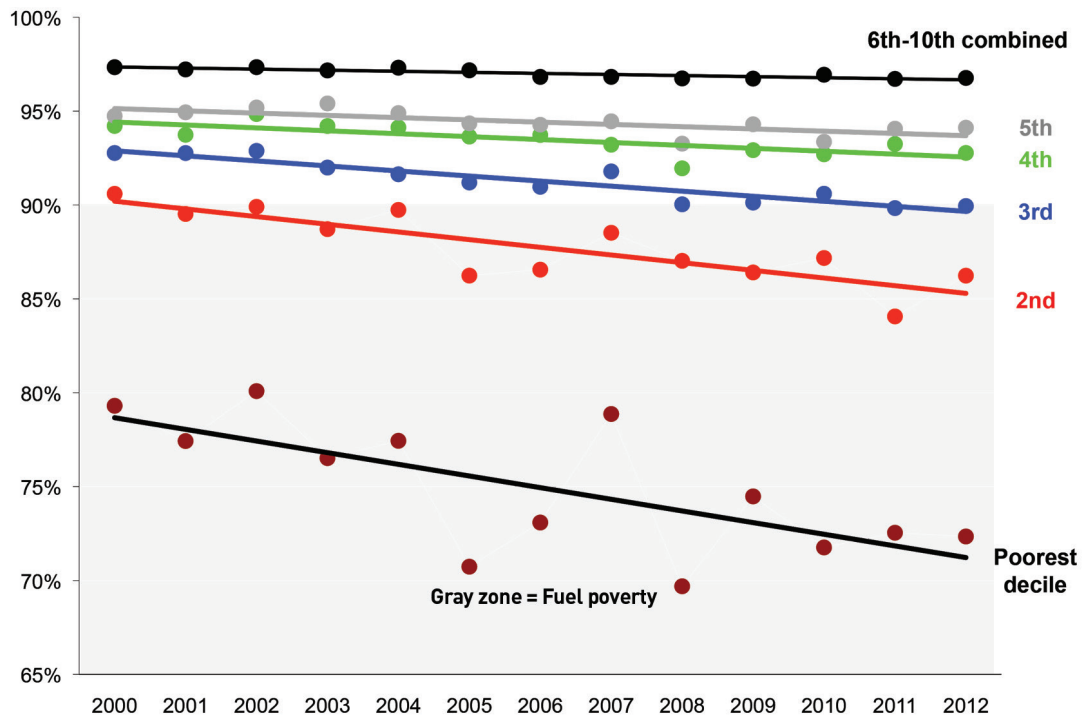
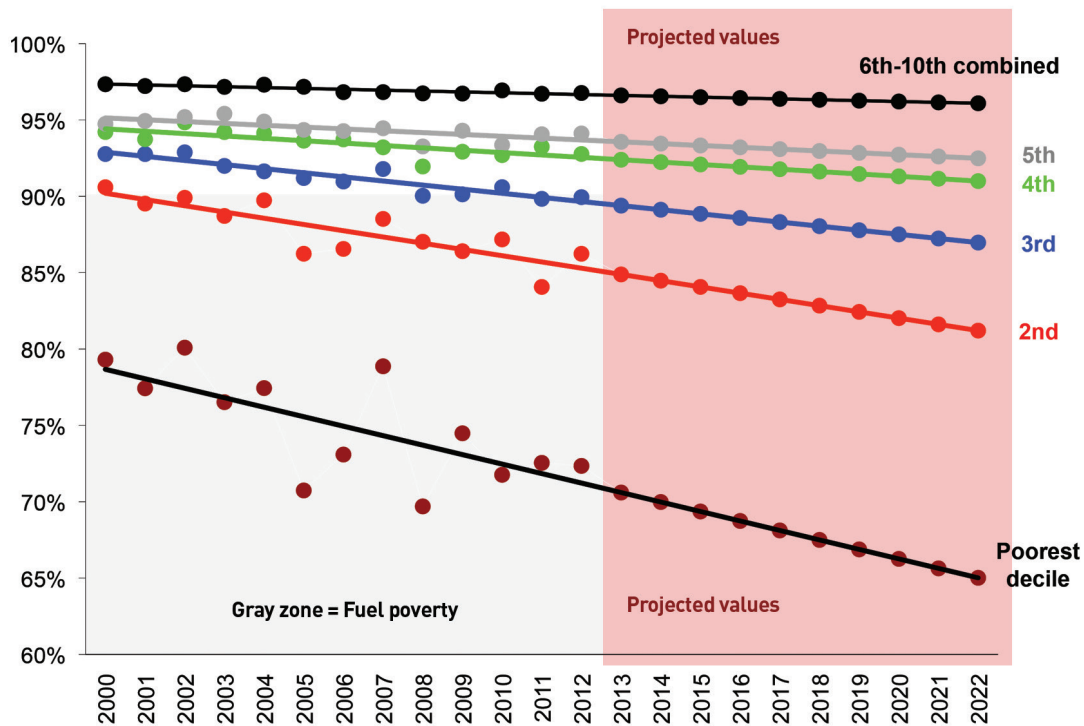


Figure 8: Average income remaining after spending on all energy, as a percentage of total household income, by decile, with 10-year projection



for each energy category. In fact, spending for any one category of energy alone is enough to push the 1st decile well into fuel poverty. Though the burdens shown in Figure 7d for “all energy” are not a simple summation of the burdens from the other three, the combined effect of purchasing multiple forms of energy is to push low-income households into an extreme degree of fuel poverty.

Also apparent are the differences in trends for different energy categories. The trend for electricity is effectively flat, for natural gas it is clearly down-sloping, and for other fuels it is more steeply downward. When analyzed together as all energy, the cumulative effect is a trend that is steeper than for any of the individual energy categories.

In 2000, the first year of the data period, only the 1st decile was in fuel poverty. The 2nd decile crossed the threshold into fuel poverty in 2001. The 3rd decile crossed the fuel poverty threshold in 2011. Figure 8 projects these trends for 10 years into the future. If the trends continue unchanged, the 4th decile will cross the fuel poverty threshold in 2029.

The evidence is clear that many Vermonters endure significant hardship from the financial burden of energy purchases. This burden has been exacerbated by rising energy prices, particularly for fossil fuels. As noted above, rising prices themselves will not create an increasing burden if they are offset by either compensating reductions in energy consumption, compensating increases in real income, or a sufficient combination of both. With the small exception of electricity among higher-income households, these compensating factors have not occurred between 2000 and 2012. Meaningful gains in income have accrued only to the highest-income households.

This leaves open the question of efficiency gains—the ability for households to hold steady or reduce their bills in the face of rising prices. Tables 6a, b, and c show estimated changes over the study period in household use of electricity, natural gas, and other fuels (in this case, a weighted combination of heating oil and propane) respectively.

As households have more income they tend to use more energy. This is most apparent for electricity, with

the richest decile of households using an average 54 percent more than the poorest decile. We assume this is due primarily to higher-income households utilizing more electrical appliances in the home. The difference is smaller for natural gas, with the richest using 36 percent more than the poorest, and smallest for other fuels, with the richest using 30 percent more than the poorest. Since these fuels are used primarily to provide heat, we assume greater usage by higher-income households is due primarily to their having, on average, larger homes.³⁴

Changes in use of electricity are small for all deciles, with lower-income households typically increasing their use and higher-income households typically decreasing their use over the study period. It is not clear why these patterns have occurred. Though there has been a proliferation of electrical appliances available in the first decade of the 21st century, there have also been significant improvements in appliance efficiency. Higher-income households may have been more aware of or better able to choose efficient appliances, which often carry higher up-front costs (as with laptop vs. desktop computers, or efficient vs. incandescent light bulbs).

For the fossil fuels, whose primary use is generating heat, some portion of reduction in use is attributable to relatively milder winters over the course of the study period. Though winter conditions vary widely from year to year, there was a trend between 2000 and 2012 towards fewer heating degree days (HDD) in Vermont.³⁵ As measured in Burlington, winters in the second half of the study period averaged 6 percent fewer HDD than winters in the first half. An alternative measure is to graph the number of HDD and calculate the slope of the trendline: this method shows an average 1 percent reduction in HDD per year. Though use of heating fuel does not correlate exactly with HDD (among other complications, the primary heating fuel usually is used both for space heat and domestic hot water, use of which is not strongly related to outdoor temperatures), this downward trend in HDD over the study period should lead to a reduction in use of heating fuels even in the absence of any efficiency measures. The change in use of natural gas (see table 6b) is in the same ballpark as the reduction in HDD. Other fuels (heating oil and propane; see table 6c), on the other hand, show roughly twice as much of a percentage reduction in use as there was in HDD. This suggests that households using these fuels have been more aggressive, relative to households using natural

Table 6a: Annual consumption and change in use of electricity, 2000-2012, by decile³⁶

Income decile	Average annual use ³⁷	Average annual change in use ³⁸	Annual change as % of overall average	Average annual use	Average annual change
10th	10,166 kWh	(81) kWh	(0.8%)	9,086 kWh	(15 kWh) (0.1%)
9th	9,254 kWh	(14) kWh	(0.1%)		
8th	9,096 kWh	25 kWh	0.3%		
7th	8,468 kWh	5 kWh	0.1%		
6th	8,444 kWh	(11) kWh	(0.1%)		
5th	7,836 kWh	39 kWh	0.5%	7,247 kWh	46 kWh 0.6%
4th	7,551 kWh	40 kWh	0.5%		
3rd	7,104 kWh	43 kWh	0.6%		
2nd	7,149 kWh	63 kWh	0.9%		
1st	6,594 kWh	44 kWh	0.7%		

Table 6b: Annual consumption and change in use of natural gas, 2000-2012, by decile

Income decile	Average annual use ³⁹	Average annual change in use ⁴⁰	Annual change as % overall average	Average annual use	Average annual change
10th	110 mcf ⁴¹	(1.4 mcf)	(1.2%)	96 mcf	(1.2 mcf) (1.2%)
9th	97 mcf	(1.8 mcf)	(1.9%)		
8th	92 mcf	(1.3 mcf)	(1.5%)		
7th	90 mcf	(0.2 mcf)	(0.2%)		
6th	89 mcf	(1.1 mcf)	(1.2%)		
5th	84 mcf	(0.9 mcf)	(1.1%)	81 mcf	(0.5 mcf) (0.7%)
4th	76 mcf	(1.1 mcf)	(1.4%)		
3rd	84 mcf	0.3 mcf	0.3%		
2nd	82 mcf	(0.3 mcf)	(0.3%)		
1st	81 mcf	(0.7 mcf)	(0.8%)		

Table 6c: Annual consumption and change in use of other fuels, 2000-2012, by decile

Income decile	Average annual use ⁴²	Average annual change in use ⁴³	Annual change as % overall average	Average annual use	Average annual change
10th	684 gallons	(15.8 gallons)	(2.3%)	582 gallons	(10.8 gallons) (1.8%)
9th	582 gallons	(8.7 gallons)	(1.5%)		
8th	560 gallons	(10.9 gallons)	(2.0%)		
7th	549 gallons	(9.2 gallons)	(1.7%)		
6th	534 gallons	(8.7 gallons)	(1.6%)		
5th	545 gallons	(10.7 gallons)	(2.0%)	534 gallons	(11.3 gallons) (2.1%)
4th	520 gallons	(11.0 gallons)	(2.1%)		
3rd	559 gallons	(13.0 gallons)	(2.3%)		
2nd	523 gallons	(8.4 gallons)	(1.6%)		
1st	524 gallons	(13.4 gallons)	(2.5%)		

gas, in making changes to reduce consumption. These changes may be purely of a conservation or efficiency nature, such as turning down thermostats or replacing an inefficient boiler with an efficient model. Alternatively, these changes may be in the form of fuel switching (introducing or increasing use of a secondary heating source, such as wood or electric space heaters) which may or may not equate to a reduction in total energy consumption or total energy spending.

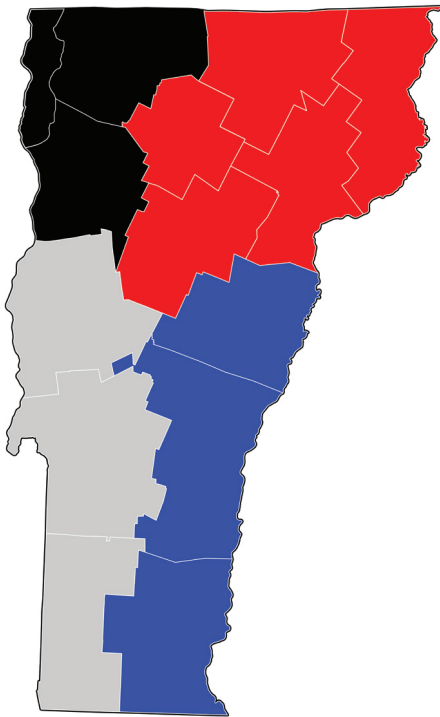
Fossil fuels in the household are the energy sources imposing the greatest burdens, and the most rapidly growing burdens. To date, Vermonters' have had only modest luck in reducing use of these fuels outside of fuel switching, where some fuel switching is between one fossil fuel and another. Since their prices are largely unregulated (natural gas is the exception,⁴⁴ and the state's taxing authority affects heating oil and propane prices at the margins), and since the most important financial impact on households comes in the form of the bill, conservation and efficiency are the main strategies available to reduce fuel poverty. Care must be taken with conservation, since poor households aren't done any favors when, for example, they set their thermostats below healthy temperatures. That leaves efficiency as the most important strategy to pursue, along with measures to increase household incomes. Fuel poverty expert Brenda Boardman writes, "We have learnt a lot about what fuel poverty is and is not, since the mid-1970s when the term first came into use.... [w]hile fuel prices and low incomes are constituent factors, the real cause of fuel poverty is the energy inefficiency of the home."⁴⁵

Boardman's conclusion is based largely on research conducted in the UK and Ireland, where homes are frequently old and constructed with solid masonry walls providing little insulation value, and therefore does not apply in full to Vermont. However, like those countries, Vermont has a relatively old housing stock, making comparisons useful. As is noted below, some Vermonters with an inside perspective on fuel poverty put a stronger emphasis on poverty in general as the principal issue behind fuel poverty. Specific ideas for addressing energy burdens and fuel poverty in Vermont are listed in the Twelve Policy Recommendations section below.

REGIONAL COMPARISONS

Energy burdens are not experienced equally across the geography of Vermont or the northeast United States. Within Vermont, the available data allow narrowing the view only to the level of Public Use Microdata Area (PUMA). There are four PUMAs in Vermont, roughly corresponding to the northwest, northeast, southeast, and southwest quadrants of the state.⁴⁶ Figure 9 shows a map of Vermont’s PUMAs.

Figure 9: Map of Vermont Public Use Microdata Areas



Regional variation in energy burden differs depending on the energy category and income level.⁴⁷ For all of the energy categories, the greatest variation is for the 1st decile. As incomes increase, energy burdens tend to equalize across geography. Figures 10a, b, and c shows these variations within Vermont. The burden from electricity alone is highest for the 1st decile in the northeast. For other fuels alone, the highest burden is for the 1st decile in the southwest. For all energy combined, the 1st deciles in the northeast and southeast have the highest burdens, each being more than 6 percent higher than for the 1st deciles in the two western quadrants of the state. (We do not analyze natural gas alone by Vermont

quadrant, since gas service is only available in the northwest PUMA. Its use is included with all energy.)

When looking at electricity or other fuels alone, the only clear pattern for energy burden by Vermont quadrant is that the northwest quadrant has consistently lower burdens. When considering all energy combined, there appears to be an additional general pattern of greater burden for the eastern half of the state. Since energy burden depends in part on income, it is possible that this east-west difference may result from a difference in income across Vermont. Table 7 shows average income within deciles of each of Vermont’s PUMAs as they compare to the statewide average income within the deciles. As can be seen, there is very little variation, with two exceptions: the 1st and 10th deciles in the southwest quadrant each have noticeably higher incomes than the statewide average for those deciles.⁴⁸ Even allowing for these outliers, we can say that there is not enough difference in income across the state to account for the apparent difference in energy burden from east to west.

Table 7: Ratio of average income in decile in PUMA to overall state average income for the decile, 2012

Decile	NW	NE	SE	SW
10th	95%	103%	100%	111%
9th	102%	100%	97%	99%
8th	100%	100%	100%	100%
7th	100%	100%	100%	100%
6th	101%	100%	98%	100%
5th	100%	100%	100%	100%
4th	101%	98%	100%	100%
3rd	100%	101%	99%	100%
2nd	103%	102%	96%	99%
1st	94%	99%	94%	113%
6th – 10th	100%	101%	99%	102%
1st – 5th	100%	100%	98%	102%
All	100%	100%	99%	102%

Figure 10a: Spending on electricity as percentage of income in 2012, by decile and Vermont PUMA district

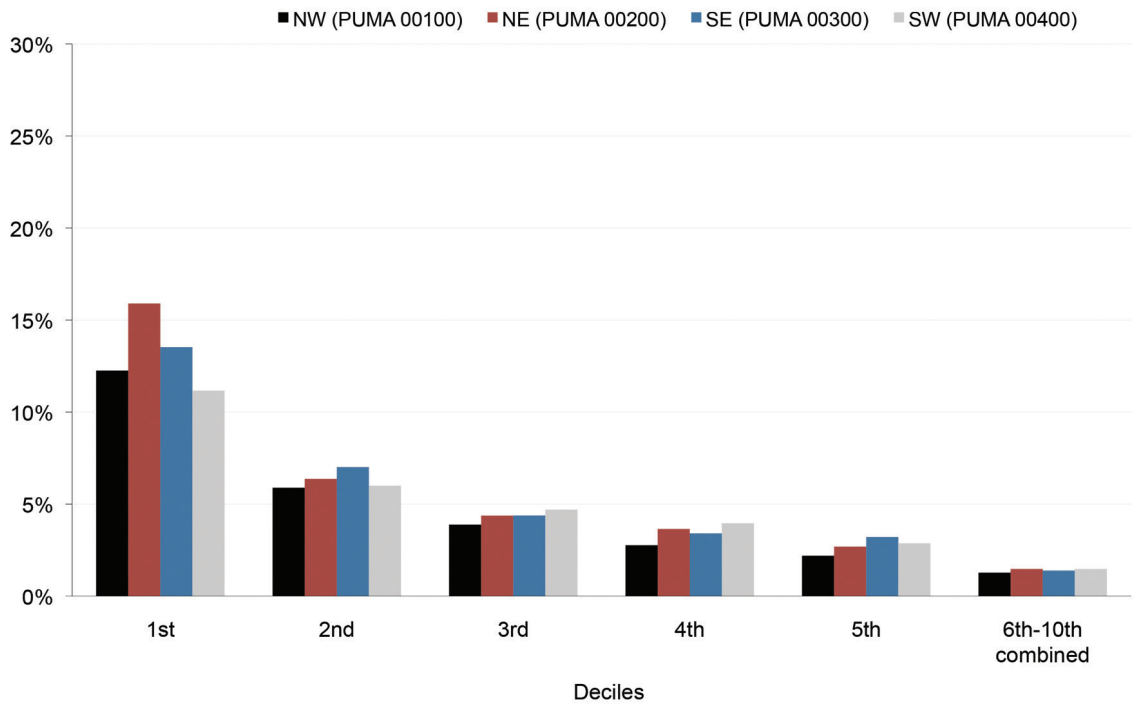


Figure 10b: Spending on other fuels as percentage of income in 2012, by decile and Vermont PUMA district

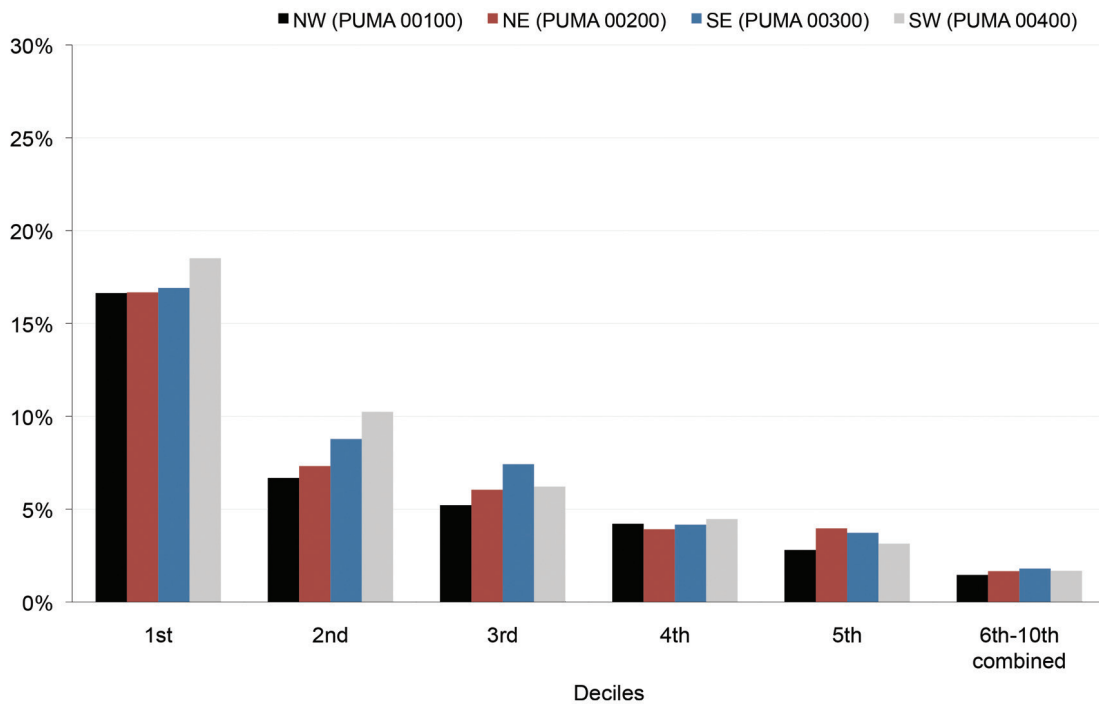
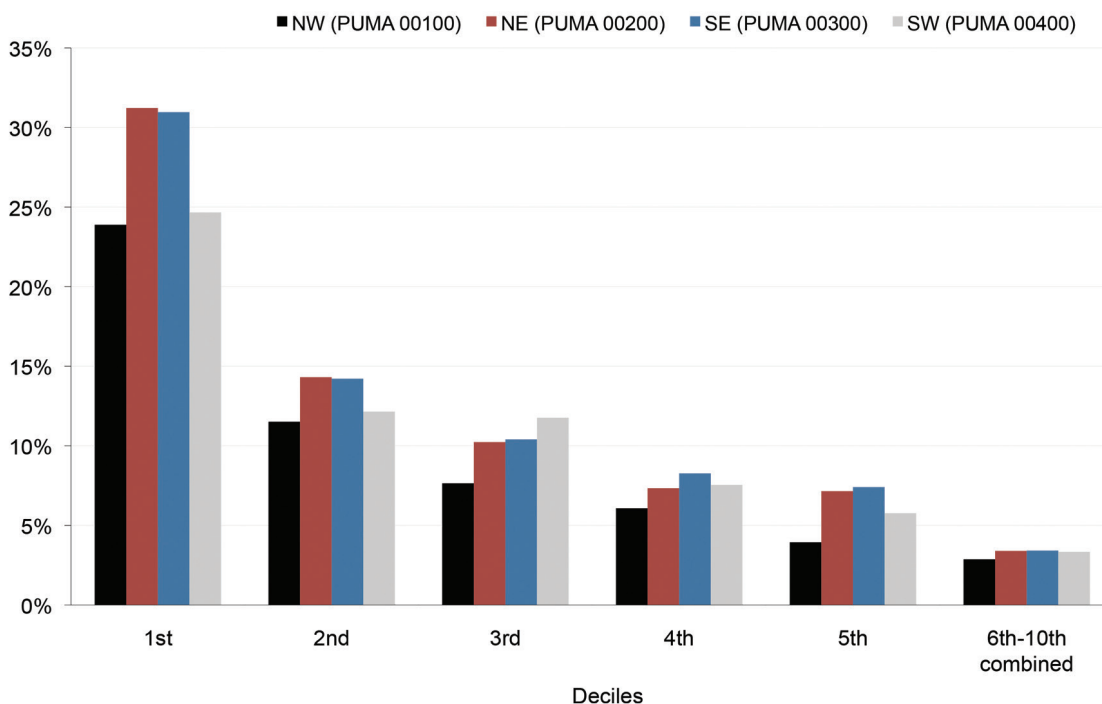


Figure 10c: Spending on all energy as percentage of income in 2012, by decile and Vermont PUMA district



While incomes by decile are fairly consistent across Vermont, primary heating fuel definitely varies. Figure 11 shows that the northwest of Vermont is clearly different from the other quadrants in its heavy reliance on natural gas. Also clear in the figure is the relatively greater reliance on wood in the two eastern quadrants, and the fact that the southwest has the heaviest reliance on heating oil. The one conclusion we feel confident in drawing is that natural gas has contributed to the northwest of Vermont experiencing a smaller energy burden than the rest of the state. Other, unidentified factors may also contribute to this intrastate variation in burden.

Comparing Vermont to the other Northeastern states shows that Vermont's lowest-income households face relatively smaller energy burdens. This is seen in figures 12a, b, c, and d, which focus on burdens for the three lower deciles. For electricity alone, Vermont's 1st decile has the smallest burden of all the states, nearly half the burden of the weighted average for the region. For both natural gas alone and other fuels alone, Vermont's 1st decile has the second smallest burden, after New Hampshire. For all energy spending

combined, Vermont's 1st decile has the third smallest burden among the seven Northeastern states, after New Hampshire and Massachusetts. Connecticut, New York, and Rhode Island have the largest burdens for their 1st deciles.

Unfortunately, this Vermont "advantage" (small consolation, given the burdens involved) does not hold for the 2nd and 3rd deciles. For both of these deciles, Massachusetts and New Hampshire have smaller burdens for electricity alone. Vermont's 2nd and 3rd deciles have the largest burdens in the entire Northeast for natural gas alone, relative to the same deciles in the other states.⁴⁹ For other fuels alone, only one state (New Hampshire) has a smaller burden than Vermont for its 2nd decile, but three states have smaller burdens than Vermont for their 3rd deciles. When looking at all energy combined, Vermont's 2nd and 3rd deciles have the second-highest burdens in the region, after Maine. For all Northeastern states, the 2nd deciles were in fuel poverty in 2012 when counting all household energy purchases; only in Vermont and Maine were the 3rd deciles in fuel poverty in that year.

Figure 11: Households relying on fuel type as primary heating source by PUMA⁵⁰

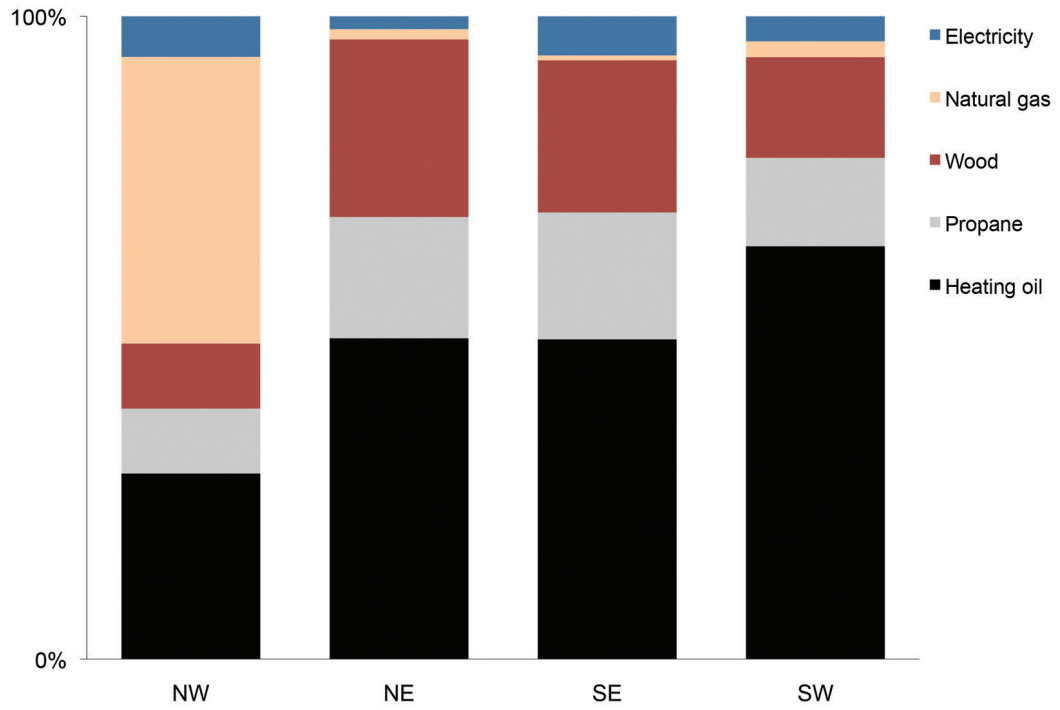


Figure 12a: Spending on electricity as percentage of income in 2012 in Northeast states, by decile⁵¹

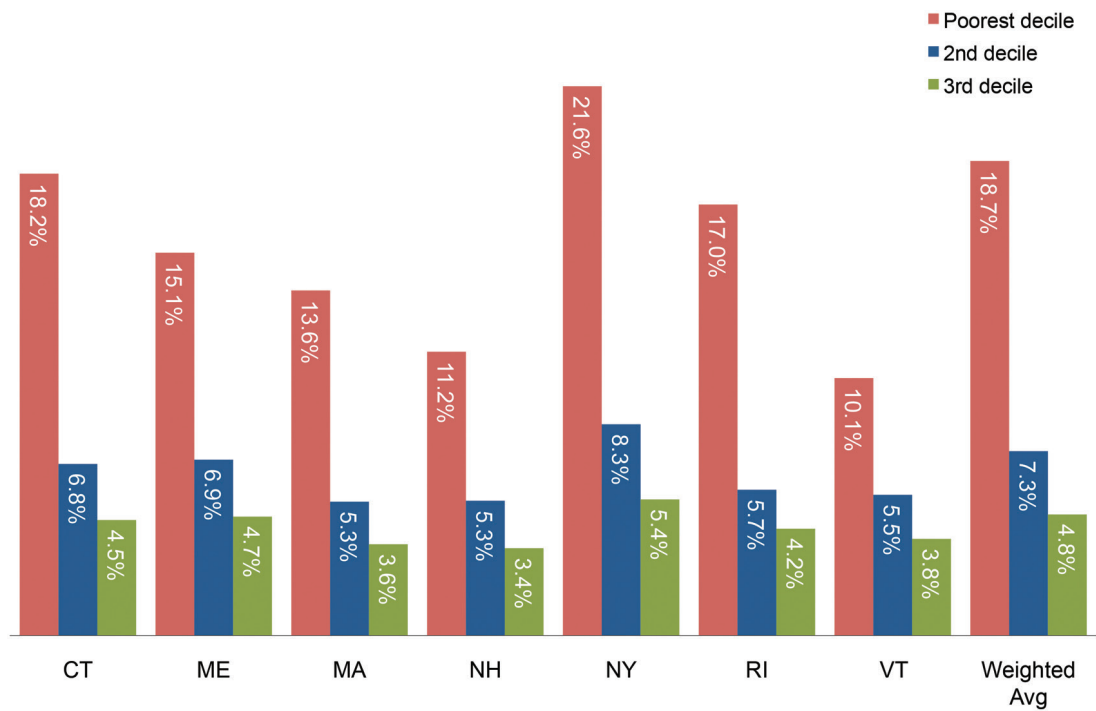


Figure 12b: Spending on natural gas as percentage of income in 2012 in Northeast states, by decile

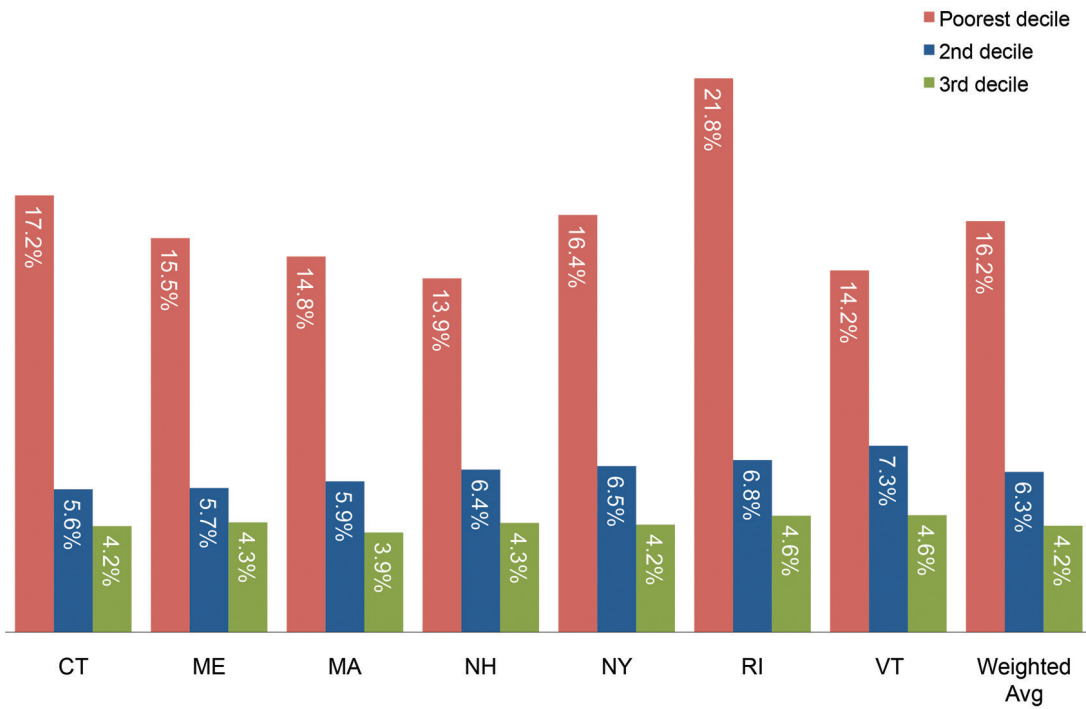


Figure 12c: Spending on other fuels as percentage of income in 2012 in Northeast states, by decile

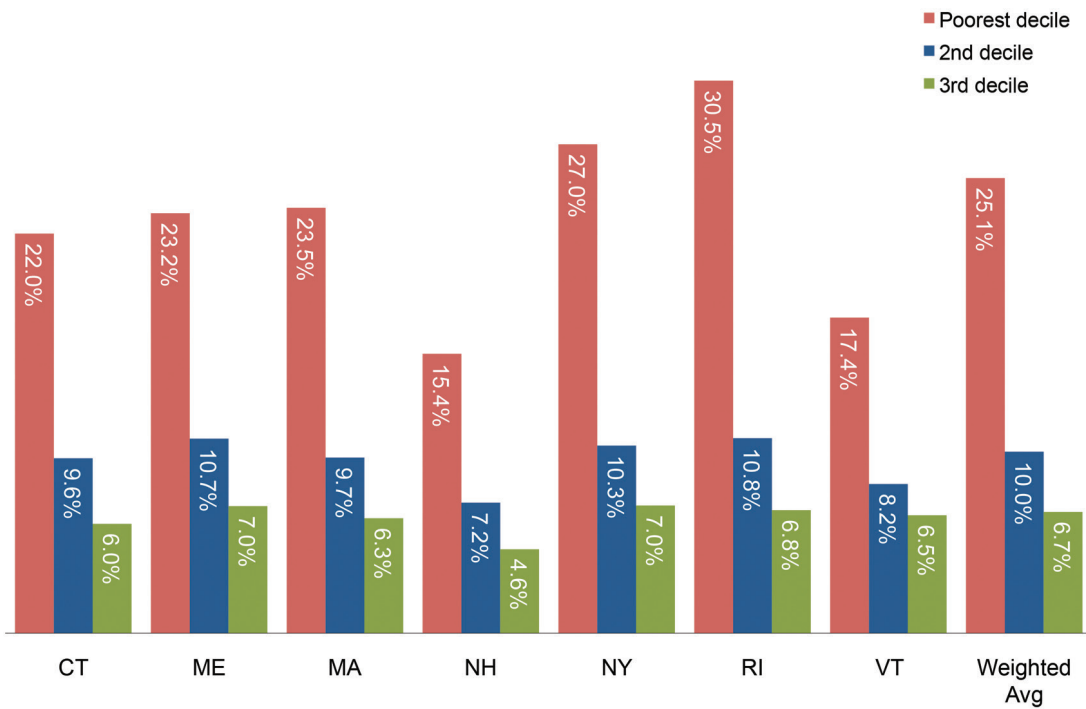
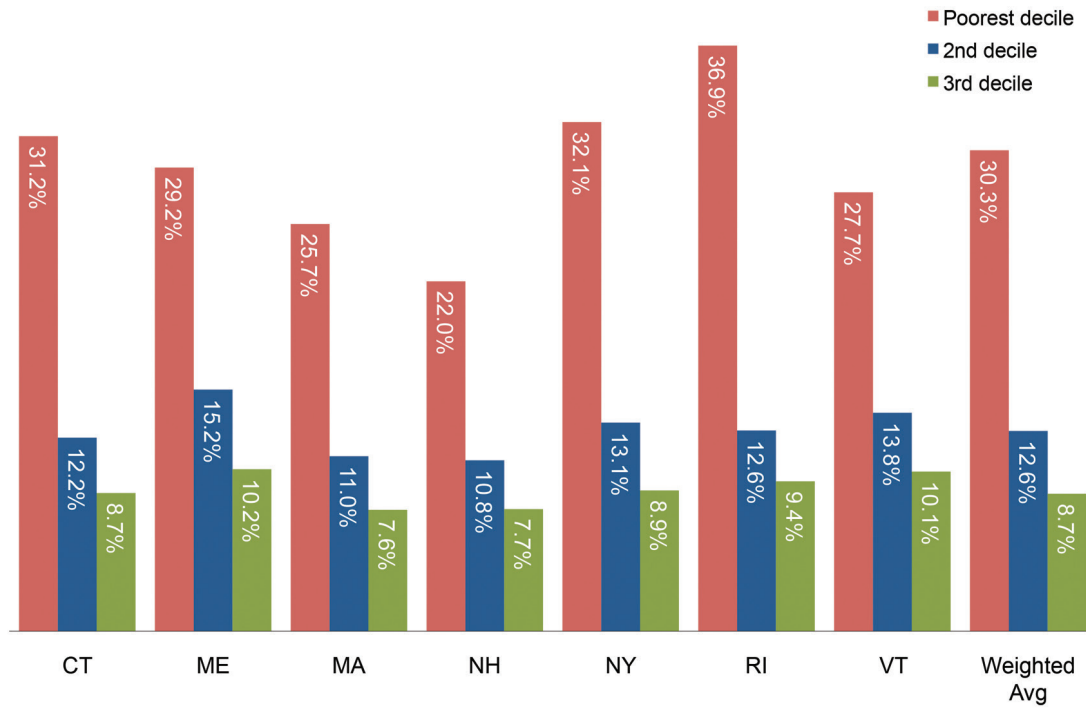
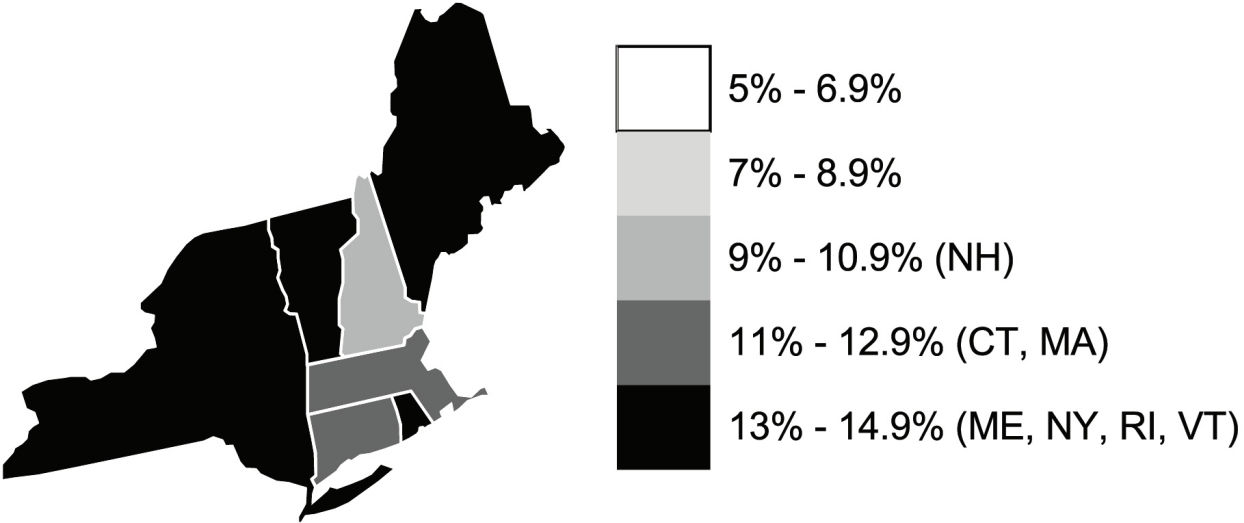
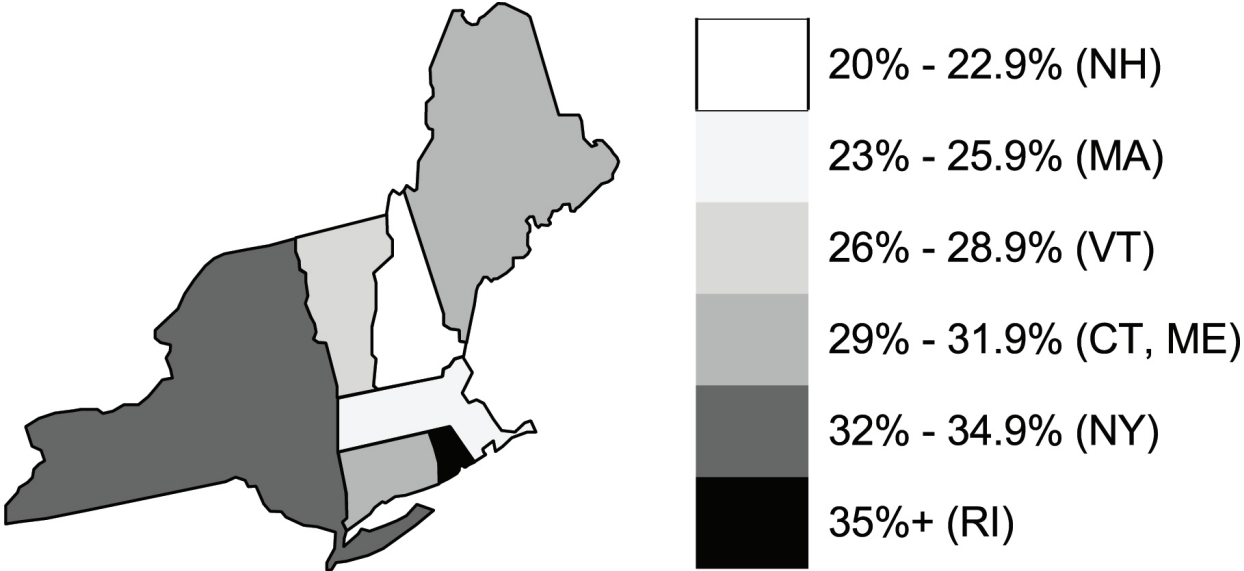


Figure 12d: Spending on all energy as percentage of income in 2012 in Northeast states, by decile



We also present the regional results for burdens from all energy in map format in Figure 13. As the bottom panel indicates, when the 1st through 3rd deciles are viewed in combination, Vermont drops to the pack of “worst performers” including Maine, New York, and Rhode Island.

Figure 13: Map of regional distribution of fuel poverty from all energy expenditures in 2012 for the lowest decile (top panel) and the lowest three deciles combined (bottom panel)⁵²



TWELVE POLICY RECOMMENDATIONS

There are four primary actors who have key roles in advocating for low-income households to decrease energy burdens in Vermont. These are the legislature, community groups and social service agencies, other state agencies, and utilities and fuel providers. To best determine recommendations with the most achievable potential, the Institute for Energy and the Environment interviewed various stakeholders and inquired what each of these actors could do to address energy and fuel poverty in Vermont. These were semi-structured interviews in which each interviewee was asked four questions:

1. What could the state legislature do to address energy and fuel poverty in Vermont?
2. What could state agencies do to address energy and fuel poverty in Vermont?
3. What could community groups do to address energy and fuel poverty in Vermont?
4. What could energy companies do to address energy and fuel poverty in Vermont?

Eight of the nine interviews were conducted via telephone or Skype, in which interviewees did not have access to the questions beforehand. One interview was conducted via email, in which the interviewee had time to plan his/her answers.

We spoke with representatives from the Regulatory Assistance Project (RAP), Vermont Fuel Dealers Association (VFDA), Capstone Community Action, Department of Public Service (DPS), Vermont Energy Investment Corporation (VEIC), Vermont Natural Resources Council (VNRC), Vermont Communities Foundation and High Meadows Fund (VCF), and Green Mountain Power (GMP).⁵³ The interviewees all recognized that an energy burden exists for many Vermont low-income households, as well as the need to proactively combat this trend. Below are twelve policy recommendations on fundamental ways to decrease the energy burden for Vermont low-income households, organized by each of the four primary actors.

THE VERMONT LEGISLATURE

We have three recommendations for the Vermont legislature:

1. Increase funding for low-income weatherization;
2. Continue supplementing federal programs; and
3. Mandate energy efficiency labeling for homes.

As Hal Cohen from Capstone Community Action explained, "What's the biggest hurdle to alleviating fuel poverty in Vermont? The answer is simple: it's a shortfall of funds."⁵⁴ To counter this shortfall, we recommend first that the legislature increase support for the low-income Weatherization Assistance Program (WAP) by expanding the Fuel Gross Receipts Tax.⁵⁵ "For every \$1 invested, the program returns about \$2.51 to the household and society, including \$1.80 in reduced energy bills and \$0.71 in non-energy benefits (e.g., increased local employment and improved housing quality)" and better health and safety.⁵⁶

Weatherization and efficiency measures are a tried and true solution to reducing energy bills, improving quality of life in the home, or both. Across the United States, the average household receiving weatherization through WAP has first-year energy savings of \$466.48.⁵⁷ Assuming that value for Vermonters, providing WAP to all eligible households would reduce the number of households in fuel poverty by approximately 19 percent.

In Vermont, the low-income housing stock tends to be older and less efficient than housing available to higher-income households. Currently, the Fuel Gross Receipts Tax is low, generating only about 0.5 percent of all revenues raised. Gradually raising this tax to 2 percent or greater would provide an important increase in money available for WAP.

Our second recommendation is that the legislature continue supplementing the Federal Low Income Home Energy Assistance Program (LIHEAP). Although weatherization and efficiency should be primary measures, they cannot reach everyone in the time needed to ensure all Vermonters are warm in the frigid winter months of the next few years. Capstone Community Action informs us that it has a waiting list of 18 months for people waiting

to get weatherization assistance. Low-income assistance must remain available as a safety net. Funding from the state for the program may be an opportunity to design programs that can use the funding more efficiently and reach more Vermonters, with their tax dollars ideally going further than the federal money could.

Third, we recommend that the legislature mandate energy efficiency labels in housing. The legislature set up a working group on energy disclosure. The working group concluded with a vote of 12-0 “to support a requirement that property sellers provide a disclosure of building energy performance, delivered through a mechanism such as an online tool with no cost to the end user, and tracked through a database of a form to be determined,” with two abstentions and two absences.⁵⁸ We agree with the working group that, for any disclosure tool required of sellers, “that tool should have no cost to the end user,” and that for “any buyer tool requirement... costs for such a tool would need to be subsidized” for low-income users.⁵⁹ The next step is for the legislature to recognize and incorporate one labeling scheme in order to set minimum standards across all of Vermont’s housing stock. One draft for how this labeling scheme could work is shown in Figure 14.

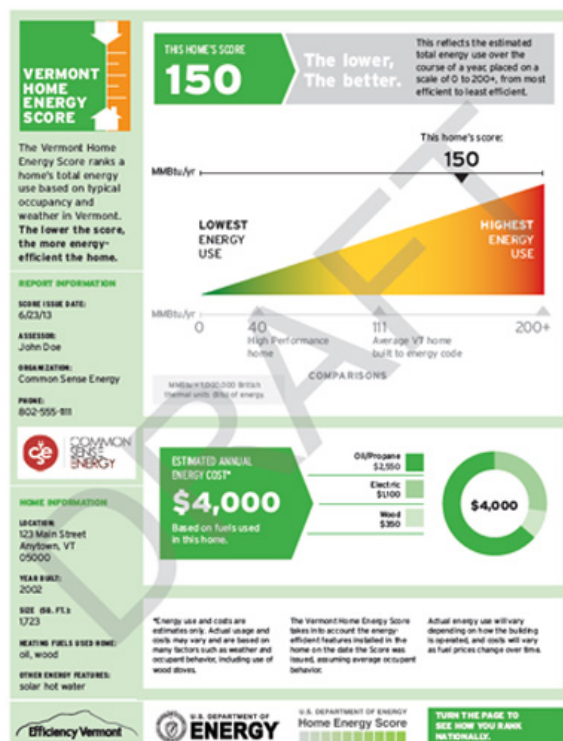
COMMUNITY GROUPS AND SOCIAL SERVICE AGENCIES

We propose that community groups and social service agencies:

1. Provide, if they do not already, and prioritize energy efficiency audits and coaching;
2. Distribute energy conservation and efficiency materials; and
3. Ramp up educational awareness and outreach programs.

First, Vermont needs more energy efficiency coaches, people who are trained in low-income outreach, energy efficiency strategies, and community-based social marketing concepts. This is currently taking place within Vermont’s Sustainable Energy Resources for Consumers program.⁶⁰ Other Vermont groups can adopt and expand on the concept. The benefit of this program is that it is a more rigorous approach to weatherization, helping clients every step of the way to make sure that not only are efficiency technologies installed, but that

Figure 14: Draft home energy efficiency label being considered by Efficiency Vermont



they are enhanced by proper guidance and behavior change to ensure that efficiency is actually achieved.

Second, we believe that social service agencies and health clinics serving lower-income populations should be utilized as points of distribution for energy conservation and efficiency materials. Materials that would otherwise require payment by the low-income recipient should be subsidized to the extent possible. These materials might be offered individually or in kits, which need not cost more than \$50 to \$150 each, and could include:

- CFL or LED light bulbs,
- low-energy night lights,
- window plastic kits,
- hot water temperature gauges,
- faucet aerators,
- refrigerator thermometers,
- information on WAP, and
- information for owner-occupied and rental-property efficiency improvement programs and subsidies.

These materials should come with pamphlets describing the savings that can be achieved through energy conservation and efficiency, explanations for how to effectively use the materials, and other tips for safely reducing energy consumption. In addition to the direct efficiency benefits they provide, they can also serve as a first-step introduction to weatherization, and a great tool for advertising various Vermont energy programs. If people have a positive experience with efficiency, they are more likely to do it again or change other behaviors.

Third and lastly, educational programs need to be refined and likely scaled up. As Richard Sedano from RAP told us, “due to a mix of social stigma and lack of knowledge, it’s unclear whether those most in need of energy assistance are getting access to it here in Vermont.”⁶¹ Robert Dostis from GMP adds that “many Vermonters are not aware of the availability of existing assistance programs or they are reluctant to take

advantage of them.”⁶² Community groups should understand the importance of fuel poverty and connect Vermonters with resources. A good way to position low income energy-efficiency policies is to re-cast low income weatherization in a light that is less stigmatizing, as many who are in fuel poverty do not see themselves as in “poverty” and will not seek out or accept assistance.⁶³ Personal success stories are a great way to build trust and confidence that these programs, whether assistance, efficiency, or weatherization, are worthwhile. As Riley Allen from RAP explains, “Community action is a vital element for overcoming fuel poverty here.... We need a mechanism for raising awareness and connecting customers to potential service providers and making the public aware of the support mechanisms that exist.”⁶⁴

OTHER STATE AGENCIES

Vermont’s government agencies can help address fuel poverty and energy burdens by directly or indirectly supporting residential efficiency efforts and energy affordability through appropriate fuel switching. As Johanna Miller, VNRC’s Energy Program Director, noted, these agencies “need to be [sufficiently] funded and have a trained and educated workforce to help reduce consumption and make energy savings.”⁶⁵ We therefore have three recommendations for state agencies other than those directly providing social services:

1. Train staff in energy efficiency;
2. Focus on improvements to multi-family housing; and
3. Incentivize appropriate fuel switching, cold climate heat pumps, and heat pump water heaters

First, agency staff across the entire Vermont government should receive basic training in the value of energy efficiency and in the existence of leading energy programs in the state. Vermont’s government employees not only communicate with a large fraction of the state’s residents in any given year, they are themselves residents and from a social science perspective represent “nodes” in the social network. Concerns regarding energy affordability are liable to crop up in communication that agency employees have with residents, even

when the ostensible subject seems unrelated, such as regarding permitting of various activities. Simple awareness of energy concerns and of the existence of programs to address them—from Weatherization Assistance to Efficiency Vermont rebates—enables agency staff from all Vermont agencies to act as conduits for sharing useful information.

Second, relevant agencies should focus on multi-family housing units for weatherization programs, especially those that serve low-income renters. Rental properties are prone to the problem of “split incentives,” which occur when one party (the property owner) is responsible for the cost of an energy efficiency upgrade, but another party (the renter) will reap the energy savings benefit. Programs can confront split incentives by providing rebates or incentives that cover the incremental cost of more energy-efficient upgrades and equipment. Efficiency Vermont has programs in place to support energy efficiency improvements to rental properties.⁶⁶

Promoting rental property improvements and transparency regarding energy costs is tricky but necessary to address Vermont’s widespread fuel poverty and significant energy burdens. Vermont’s government agencies can utilize carrots (such as direct or indirect assistance to rental property owners) and sticks (such as legal requirements for energy use reporting or building efficiency standards). Some of these efforts may be within existing regulatory powers, while others will require legislative authorization

State agencies that deal with rental property owners can, at the very least, promote utilization of Efficiency Vermont’s existing programs whenever communicating with rental property owners. Regarding rental housing, relevant agencies may include, but are not necessarily limited to,

- Agency of Commerce and Community Development;
- Agency of Natural Resources;
- Department of Public Safety;
- Department of Taxes.
- Natural Resources Board;

- Vermont Commission on Women;
- Vermont Economic Development Authority;
- Vermont Housing and Conservation Board;
- Vermont Human Rights Commission;
- Vermont Office of Veterans Affairs;
- Vermont State Housing Authority;
- and municipal housing authorities.

Though not state agencies, the Vermont Apartment Owners Association, real estate agents, Vermont Center for Independent Living, and Vermont Legal Aid can each play a similar role.

Thirdly, Vermont’s agencies should consider when and how they might support households in switching to wood, natural gas, or—especially—electricity in the form of heat pumps.⁶⁷ At current energy prices in Vermont, heat pumps deliver heat at a lower cost than most other alternatives; unvented natural gas room heaters and (cord) wood stoves operate at slightly lower cost (assuming wood is purchased),⁶⁸ though each of these types of heating entails small risks of carbon monoxide or other negative health impacts. If natural gas and electricity prices continue their general trends, cold climate heat pumps will be more affordable to operate in the near term. At current prices, wood pellets and natural gas utilized in vented room heaters or central boilers or furnaces are slightly more expensive to operate than heat pumps, though still significantly less expensive than systems fueled by propane or heating oil.

Regarding fuel switching, relevant agencies may include, but are not necessarily limited to,

- Agency of Agriculture, Food, and Markets;
- Agency of Commerce and Community Development;
- Agency of Natural Resources;
- Department of Public Safety;
- Department of Public Service;

- Natural Resources Board;
- Public Service Board;
- Vermont Commission on Women;
- Vermont Economic Development Authority;
- Vermont Housing and Conservation Board;
- Vermont Office of Veterans Affairs;
- Vermont State Housing Authority; and
- municipal housing authorities.

To offer some guidance to these agencies, Efficiency Vermont already provides rebates for heat pump water heaters, a program worth continuing. A recent improvement to the current Vermont statute, Sec. 1. 30 V.S.A. § 209, may enable Efficiency Vermont funding to be used to promote cold climate heat pumps as well. This statute, through S. 202, signed into law on June 11th, 2014, has been amended to bring in the possibility of using the electricity efficiency charge to cover thermal efficiency achieved with heat pumps. The Public Service Board may authorize the use of funds raised through an energy efficiency charge on electric ratepayers to reduce the use of fossil fuels for space heating by supporting electric technologies that may increase electric consumption, such as (cold climate) air source or geothermal heat pumps. As seen in Figure 5 above, approximately 5 percent of Vermont households currently use electricity as their primary heating fuel, and it is likely that most of those are using less-efficient and therefore more costly resistance electric heating. For many Vermonters, there is great savings potential in switching to electric space and water heating, when the heat is provided through heat pumps. The relatively high up-front cost of the technology can be lessened by a rebate or subsidy from state agencies. Despite the high upfront cost, the payback on the installations is short, owing to the fact that they greatly reduce heating bills. Energy savings may be felt across the state from switching to space heating with heat pumps: even if the market penetration is only at 10 percent, Vermonters could save \$15 million annually in reduced fuel costs; at 50 percent market

penetration the estimate is \$85 million in energy bill savings.⁶⁹ The efficiency of heat pumps, in combination with Vermont's relatively low-carbon electric supply, has the added benefit of reducing greenhouse gas emissions when replacing fossil heating fuels.⁷⁰ State agencies can improve marketing and outreach to convey all of these benefits to Vermont consumers.

Efficiency Vermont currently offers rebates for central wood pellet boilers and furnaces.⁷¹ The Air Quality and Climate Division within the Agency of Natural Resources currently maintains an outdoor wood boiler change-out program.⁷² This program was created primarily to address concerns over air pollution from older outdoor wood boilers, and its incentives may be applied toward replacement equipment, such as propane fired furnaces or boilers, whose operation may increase spending on fuel. The program's administrator should be encouraged to keep up to date on the relative operating costs of equipment supported by the program, so that s/he may advise applicants accordingly.

Vermont has in the past offered incentives to replace older, less-efficient wood stoves with EPA-certified alternatives, a program also administered by the Air Quality and Climate Division. The financial gains to be had from the efficiency these change-outs provide are modest, but sufficient to warrant the state considering offering the program again. (Admittedly, this would require legislation, and so is somewhat beyond the scope of agency discretion.)

In the part of Vermont that has natural gas service, agencies should consider promoting its use by eligible residences not currently doing so, though as indicated above this is likely to be less effective than adoption of cold climate heat pumps for reducing energy burdens in all but the short term.

VERMONT UTILITIES AND FUEL PROVIDERS

Our final three recommendations are for utilities and fuel providers. We recommend that these private sector stakeholders:

1. Provide extra assistance for those about to be disconnected;

2. Utilize on-bill financing for efficiency improvements; and
3. With regard to fuel dealers, diversify into energy services companies.

First, we recommend that Vermont utilities and fuel providers set up an arrangement for customers to be put in contact with social service agencies whenever the customers are about to be disconnected or no longer supplied with fuel, other than due to switching to a competing fuel provider. With electricity in particular, the coming smart grid will likely make these disconnections increasingly automatic and impersonal. It would be beneficial for households facing disconnection to receive assistance from social service agencies. No Vermonter should be disconnected without knowing what other options and safety nets are out there to help them. Customer service representatives at Vermont energy companies could be trained in directing customers to assistance programs once they see a pattern in unpaid bills and before they send out disconnection notices.

Second, we strongly suggest that these companies consider utilizing on-bill financing for efficiency improvements, whether or not the financing is provided by the companies themselves. From improved boilers to thermal efficiency, these improvements can be paid as part of the monthly billing scheme. Although on-bill financing programs are relatively new, there is a growing body of evidence indicating these programs are both effective and inclusive.⁷³ On-bill financing also allows efficiency improvements to become a more affordable option for Vermont households. Because on-bill financing does not create traditional consumer debt, it has the potential to overcome most of the first-cost related barriers to investing in energy efficiency upgrades and it can reach a majority of Vermonters, including low-income homeowners as well as landlords. Perhaps most importantly, on-bill tariffed financing allows all utility customers—including those who do not qualify for traditional loans—to install energy efficiency upgrades with no upfront payments and no personal debt obligation.⁷⁴ On-bill financing can be used for the purchase of infrastructure or capital improvements that will remain with the house or apartment. In California, a Financing Initiative for Renewable and Solar Technology (FIRST) program in Berkeley allows financing for efficiency upgrades or investments in renewable energy to be paid

back through a line item on their property tax. Vermont already offers a similar program through Property Assessed Clean Energy (PACE).⁷⁵ However, there are advantages in offering financing through the utility bill rather than through property taxes.

Third, we propose that company managers accelerate the transition of traditional fuel dealers into energy service companies. These energy service companies could become capable of profitably providing valuable efficiency improvements to their customers. The Efficiency Excellence Network, a collaboration between the Vermont Fuel Dealers Association and Efficiency Vermont, is off to a great start.⁷⁶ A number of fuel dealers are participating in this pilot program. They have already made available \$6.5 million dollars for loans and they're planning to market themselves to customers as "energy service providers," not just fuel dealers. They will make the transition into a more holistic business wherein they also help their customers get more efficient boilers, solar hot water and heat pumps. To the extent that fuel dealers adopt the recommendation above to provide on-bill financing for these products and related services, they increase their value to customers and enhance this transition into energy services providers.

CONCLUSION

By our estimate, just over 71,000 people suffered from fuel poverty in Vermont in 2000, and in 2012 this number had grown to just over 125,000, or one in five Vermonters. Put another way, fuel poverty has grown by 76 percent over the past thirteen years.

Absent significant efforts from the public and private sectors, this problem will only grow more severe. Having a warm, comfortable, well-lit home is something, sadly, all too many Vermonters aspire to rather than experience. When energy prices rise and households can't compensate with sufficient improvements in efficiency or increased income, it is functionally the same as if they lacked access to reliable energy services altogether. In addition, less affluent Vermonters spend a larger share of their income on heat and electricity than other households, even though they consume less energy, hindering the accumulation of wealth needed to make investments to escape their poverty. When it doesn't kill and sicken people directly, fuel poverty forces households to cope by resorting to wearing coats and outdoor clothing indoors, sleeping together with pets or in one room to keep warm, relying on hot drinks, or even staying with relatives—actions that can all negatively impact mental health.

Clearly, this is an issue that Vermont's people and leaders must recognize and address as significant, one that takes its toll on the state more seriously (in terms of fatalities) than automobile crashes. Fuel poverty is related to, but independent of, traditional conceptions of poverty, and therefore requires different policies and strategies to alleviate.

With this in mind, we recommend that the Vermont legislature better fund investments in weatherization among low-income households; supplement federal weatherization programs; and endorse energy efficiency labels for homes, especially rented homes and apartments, which is where many of the fuel poor reside. We propose that community groups and social service agencies scale up the training of energy efficiency coaches, disseminate energy conservation and low-cost efficiency materials (including information), and incorporate awareness and outreach on energy burdens into their existing programs. We recommend that other state agencies engage the problem in creative ways—whether

or not through specific, identifiable programs—in order to support the sharing of information; improvements in housing efficiency, with an emphasis on rental properties; and appropriate fuel switching, with an emphasis on cold climate heat pumps. We lastly recommend that utilities and fuel providers offer extra assistance for disconnected households, allow for on-bill financing of efficiency improvements, and pursue (or at least consider) a business strategy of diversifying into energy services companies.

Perhaps when these 12 recommendations are pursued in a synergistic manner, the scourge of fuel poverty in Vermont can become a distant memory, rather than a miserable reality for thousands of future households.

END NOTES

1. Semi-structured research interview with the research team, July 16 2014.
2. World Health Organization, p. 4.
3. Liddell and Morris, pp. 2988 and 2992.
4. Sources for Figure 1: bills from Energy Information Agency, "Electricity Sales, Revenue, and Average Price; for years 1994- 1997, calculated using Tables 5 and 7; for years 1998-2001, Table 1; for years 2002-2007, Table 5; for years 2008-2012, Table 5a; per-capita income from Bureau of Economic Analysis, "SA51-53 Disposable personal income summary"; weighting based on calculations from Energy Information Agency, "Retail Sales of Electricity by State by Sector by Provider, 1990-2012 (EIA-861)."
5. We define "winter" as December through March. Data from Centers for Disease Control.
6. Centers for Disease Control.
7. Liddell and Morris, pp. 2991-2992.
8. Liddell and Morris, p. 2992.
9. Liddell and Morris, p. 2992.
10. Though it might seem intuitive to use the term "energy poverty" instead of "fuel poverty," the term energy poverty is used to describe the condition in developing nations in which people lack physical access to modern energy sources and systems, while fuel poverty refers to the situation in which modern energy sources are technically available but too costly—due to some combination of price, inefficiency in utilization, and income—for reasonable use. Some researchers use "energy insecurity" or "lacking affordable warmth" as synonyms for fuel poverty.
11. Liddell, et al, and Sovacool, p. 44.
12. Liddell, et al, p. 27-28.
13. Liddell, et al, p. 28, and Sovacool, p. 44.
14. Liddell, et al, p. 28-29.
15. Liddell, et al, p. 28.
16. Boardman, p. 143.
17. Similarly, our analysis cannot weed out other discretionary, expensive uses of energy, such as those with indoor marijuana growing operations.
18. Sovacool, p. 46.
19. Fisher, Sheehan, and Coltan.
20. A "decile" is 10 percent of the population—in this case, counted as households, and ordered from lowest to highest by annual income.
21. Income and spending data are from Census Bureau, American Community Survey. Energy prices are from Energy Information Agency and Vermont Department of Public Service.
22. Inflation adjustment was made using the CPI-U index from Bureau of Labor Statistics.
23. Additional, and more sophisticated, analysis in the future may allow us to correct for this factor.
24. Census Bureau, "Poverty Data – Poverty thresholds."
25. For a family of four, including two children.
26. It is worth noting that the method for determining the official US poverty line has been heavily criticized for many years. For example, see Blank. That said, this paper is not the place to analyze that debate.
27. As of 2012, wood was the second most common fuel for home heating. However, there are very limited statistics on wood prices, so we are unable to analyze and compare how those prices have changed over the study period.
28. The second column was calculated by measuring the change from each year relative to the prior year, and then averaging the results. Values are in 2013 dollars.
29. The third column was calculated by dividing the

- result in the second column by the average of annual real income in the decile for all the years covered.
30. Calculated by measuring the change from each year relative to the prior year, and then averaging the results.
 31. Note that this represents only the primary heating fuel. For example, a household switching from oil to wood for *primary* heating fuel does not necessarily cease to use oil, and may rely on wood only slightly more than on oil.
 32. Households using plug-in electric vehicles are theoretically included, but there were so few such vehicles in Vermont in the study period that they can be safely ignored.
 33. Specifically, these are linear (ordinary least squares) regressions.
 34. Interestingly, some survey evidence suggests that lower-income households in the US tend to maintain warmer indoor temperatures in winter. See Barkenbus. If this is the case in Vermont, it would reduce the difference in usage between lower- and higher-income households.
 35. Weather Data Depot.
 36. In each table, values are calculated based only on those households that utilized the form of energy in question.
 37. These are estimates calculated by dividing average annual expenditures on electricity within the decile by average retail price per kWh in Vermont in each year.
 38. Calculated as the slope of the linear regressions of annual changes for each decile.
 39. These are estimates calculated by dividing average annual expenditures on natural gas within the decile by average retail price per mcf of gas in Vermont in each year.
 40. Calculated as the slope of the linear regressions of annual changes for each decile.
 41. “mcf” stands for “thousand cubic feet.”
 42. These are estimates calculated by dividing average annual expenditures on a weighted combination of heating oil and propane within the decile by average weighted retail price per gallon of those fuels in Vermont in each year.
 43. Calculated as the slope of the linear regressions of annual changes for each decile.
 44. Keep in mind that, with limited exceptions, the state cannot regulate prices so strictly that it prevents the suppliers from being able to garner a fair return on investment. Thus when wholesale prices rise, regulations must (more or less) allow the regulated gas utility to recover costs.
 45. Boardman, p. 143.
 46. Specifically, the northwest (PUMA 00100) consists of Chittenden, Franklin, and Grand Isle counties; the northeast (PUMA 00200) consists of Caledonia, Essex, Lamoille, Orleans, and Washington counties; the southeast (PUMA 00300) consists of Orange, Windham, and Windsor counties; and the southwest (PUMA 00400) consists of Addison, Bennington, and Rutland counties.
 47. Readers should be aware that the sample sizes within the American Community Survey are fairly large overall, with between 2,000 and 3,000 households surveyed in Vermont in each year of the study except 2000, in which 900 households were surveyed. However, once these households are divided by PUMA and then further divided by decile, the sample sizes within each of these subgroups are small enough to make the statistical results quite a bit less reliable. For this reason, readers should treat the results in this section as broadly indicative of tendencies, but not reliable for purposes of identifying specific values.
 48. But see end note 47 above cautioning against putting too much reliance on specific numerical results in this section of the report.
 49. This does not contradict the analysis above showing that natural gas in Vermont, where it is accessible,

- contributes to smaller energy burdens. Natural gas in Vermont is more expensive than natural gas in the other regional states. (Energy Information Agency, Natural Gas Annual.) Simultaneously, natural gas in Vermont is more affordable (on a per-BTU basis) than heating oil and propane in the state. It is also possible that Vermont's users of natural gas face relatively colder winters than users of natural gas in the other regional states, leading to greater consumption and thus greater burdens.
50. The figure shows that some survey respondents in the northeast, southeast, and southwest Vermont PUMAs claimed to have used natural gas as their primary heating fuel. We believe these are mistaken responses, perhaps by residents who have confused propane with natural gas.
 51. In these figures, the regional averages are weighted by state population in 2012.
 52. Note that the color scale differs for the top and bottom panels.
 53. The interviewees are named in the Acknowledgements section at the beginning of this report.
 54. Semi-structured research interview with the research team, July 14 2014.
 55. All deliveries of kerosene, heating oil, and other dyed diesel fuels to customers' residential or business locations are subject to the fuel gross receipts tax.
 56. Vermont Department for Children and Families, p. 38.
 57. Eisenberg, p. v. The value has been inflation adjusted from the original (2010) to 2013 value.
 58. Working Group on Building Energy Disclosure, p. 3.
 59. Working Group on Building Energy Disclosure, p. 23.
 60. Department of Energy, Office of Energy Efficiency and Renewable Energy, "Sustainable Energy Resources for Consumers (SERC) Vermont Highlight."
 61. Semi-structured research interview with the research team, July 8 2014.
 62. Semi-structured research interview with the research team, July 7 2014.
 63. Heffner and Campbell.
 64. Semi-structured research interview with the research team, July 11 2014.
 65. Semi-structured research interview with the research team, July 10 2014.
 66. Information on Efficiency Vermont's rental property programs is available at <https://efficiencyvermont.com/For-My-Business/Solutions-For-Residential-Rental-Properties>.
 67. Information on cold climate heat pumps and heat pump water heaters is available through Efficiency Vermont at, respectively, <https://efficiencyvermont.com/For-My-Home/ways-to-save-and-rebates/Audits-Heating-Insulation/Cold-Climate-Heat-Pumps/Overview> and <https://efficiencyvermont.com/For-My-Home/ways-to-save-and-rebates/Appliances/Heat-Pump-Water-Heater/Overview>.
 68. Energy Information Administration, "Heating Fuel Comparison Calculator," with prices adjusted to represent recent Vermont prices (as of July 2014). The calculator incorporates typical system efficiencies to estimate the cost of delivered heat from each fuel source.
 69. Letendre, et al, p. 6.
 70. The greenhouse gas emission impact of wood is hotly debated by researchers, with many complex factors, such as the time scale and method of harvest considered, affecting the results. Depending on the analysis utilized, electrically powered heat pumps may result in fewer or more GHG emissions than wood.
 71. For information, see [https://www.efficiencyvermont.com/For-My-Business/Ways-To-Save-and-Rebates/Heating-Ventilation-Air-Conditioning-\(HVAC\)/single-item/index/central-wood-pellet-boilers-and-furnaces](https://www.efficiencyvermont.com/For-My-Business/Ways-To-Save-and-Rebates/Heating-Ventilation-Air-Conditioning-(HVAC)/single-item/index/central-wood-pellet-boilers-and-furnaces).

72. For information, see <http://www.anr.state.vt.us/air/html/OWBchangeoutprogram.htm>.
73. See, e.g., Sonja Persram, *Property Assessed Payments for Energy Retrofits*, David Suzuki Foundation, 31 (Mar. 2011), <http://www.davidsuzuki.org/publications/downloads/2011/.Property%20Assessed%20Payments%20for%20Energy%20Retrofits.pdf>
74. Marianne Tyrell Colin Hagan, Rebecca Wigg, *Financing Energy Efficiency in Vermont*.
75. For information on PACE, see <https://www.encyvermont.com/For-My-Home/Financing/Financing/PACE-Overview>.
76. For more information on the Efficiency Excellence Network, see <https://www.encyvermont.com/For-My-Home/ways-to-save-and-rebates/Audits-Heating-Insulation/Find-A-Contractor/een>.

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