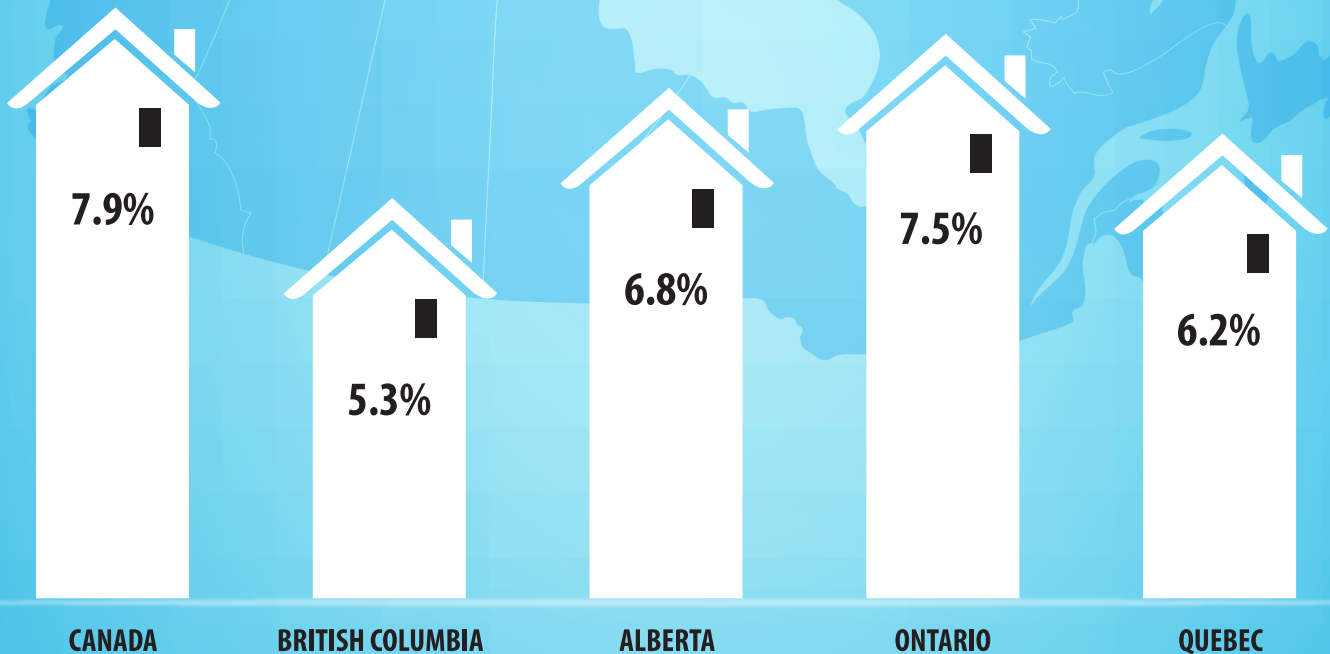


# ENERGY COSTS AND CANADIAN HOUSEHOLDS:

## HOW MUCH ARE WE SPENDING?

by Kenneth P. Green, Taylor Jackson, Ian Herzog and Milagros Palacios





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# Executive Summary

Energy is the basis of our modern lives. It fuels our economy, generating the economic production that underpins the high living standards Canadian households have achieved. But energy costs have been rising for Canadians in recent years, potentially placing burdens on Canadian families.

From 2010 to 2013, electricity prices have risen by an average of 1.31¢ per kWh, with increases of over 4¢ occurring in some Canadian cities. Electricity prices are also higher in Canada than in the United States, with wide variances in the amount of tax applied contributing to this difference. Prices have risen for gasoline as well, increasing by 53¢ in real terms from 1994 to 2013. Canadians also pay on average 31.2¢ more for gasoline than their American counterparts. Growth in energy prices has outpaced both income growth and the rate at which household energy intensity is declining.

This study begins by estimating the average energy expenditure as a percentage of total expenses across Canada and seven regions. Estimates throughout the paper were calculated in two ways: first, including energy used just in the home—electricity, natural gas, and other heating fuels; and second, these sources of energy plus gasoline, an important energy expenditure that has often not been factored into previous analyses.

Energy use within the home represents a relatively modest portion of total expenses. The Canadian average in 2013 was 2.6%, ranging from a high of 4.0% in Atlantic Canada to a low of 2.1% in British Columbia. Adding vehicle fuel to energy expenditures has a substantial impact on the percentage of expenditures being devoted to energy. In 2013, the share of the average Canadian family's expenditures devoted to all energy goods was 5.8%. Atlantic Canada was again the highest, with 8.2% of expenditures on average being devoted to energy.

This study also used a benchmark measure of 10% or more of expenditures going to energy goods—commonly referred to as “energy poverty”—to determine how many Canadian households are facing relatively high energy costs. Energy poverty is an issue because of the effect high energy expenditures has on consumption and discretionary income, thereby placing a burden on households. When a household's high energy bills force them to substitute away from consuming other goods, this is in a sense a deprivation of access.

When only energy used within the home was included in the calculation, 7.9% of Canadian households were classified as being energy poor in 2013, up slightly from 7.2% in 2010. Atlantic Canada had the highest incidence of energy poverty in 2013—20.6% of households—while British Columbia had lowest, 5.3%. Energy poverty using this basket of energy goods has risen in most Canadian regions since 2010.

When the gasoline expenses of Canadian households are also included in the calculation, the incidence of energy poverty increases substantially. In 2013, 19.4% of Canadian households devoted at least 10% or more of their expenditures to energy. Alberta had the lowest incidence of energy poverty in 2013 at 12.8%. Five out of seven Canadian regions experienced a decline in the incidence of energy poverty from 2010 to 2013 when gasoline expenditures are included.

Estimates of energy poverty were also calculated for income quintiles. Energy poverty disproportionately affects lower-income Canadian households. The incidence of energy poverty in 2013 was estimated to be over 15% of households in each of the two lowest income quintiles. Including gasoline expenditures further exacerbates energy poverty in the low income groups and uncovers a prevalence of high energy spending amongst middle-income Canadians.

The high incidence of energy poverty in Canada, particularly when gasoline expenditures are included, should be of central concern when policies regarding energy are being devised. Policies that raise prices could exacerbate problems faced by families who are in energy poverty or those on the cusp of energy poverty.

# Introduction

Energy is the basis of our modern lives. It fuels our economy, generating the economic production that underpins the high living standards Canadian households have achieved (McKittrick and Aliakbari, 2014; Epstein, 2014). Energy consumption also allows us to be connected across Canada’s vast land mass and heat our homes during the cold Canadian winters. These extensive energy needs require a level of affordability if we are to experience the full benefits of our modern lifestyles.

Energy costs have been rising steadily since the end of the twentieth century. Canadian energy prices included in the consumer price index (CPI) more than doubled over the two decades between 1994 and 2013 (Statistics Canada, 2015b). This increase exceeds growth in disposable income and the rate at which residential energy intensity is declining (Natural Resources Canada, 2015a; Statistics Canada, 2015d). Certain governments within Canada have also been pursuing policies—Ontario’s Green Energy Act is an example—that have been contributing to increases in prices for consumers (McKittrick and Adams, 2014). [1] Price increases force households to spend more on the energy they require, perhaps making them energy poor—a situation where a household spends more than 10% of its income on energy (Boardman, 2010; Lesser, 2015; Phimister, Vera-Toscano, and Roberts, 2015).

This publication seeks to determine how the energy expenditures of Canadian households have changed in recent years, and how they compare with total spending. We also calculate how many Canadian households are experiencing relatively high energy costs—how many are “energy poor”—and how energy poverty differs across income groups. The estimates in this paper are intended to be a starting point for broader research focusing on the impact of energy costs upon Canadians and policies that might increase those costs. It is first necessary, however, to examine how important energy is as a proportion of spending by Canadian households.

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[1] For example, McKittrick and Adams (2014) found that Ontario’s policy of shifting towards greater reliance on wind and solar for electricity generation has resulted in these two systems providing just under 4% of Ontario’s power, while accounting for roughly 20% of the average commodity cost.

# Trends in Energy Prices, Income, and Efficiency for Canadian Households

Previous research has identified that a household's energy expenditures can be traced to three fundamental factors: energy prices, household incomes, and the efficiency with which households use energy. Before analyzing how energy costs have affected Canadian household spending in recent years, we first consider how the three components of expenditure have trended over this time period.

Compared to much of the world, Canada has relatively low energy costs. According to data compiled by the OECD (2013), households in European countries face much higher costs for electricity, oil, and natural gas than do Canadian households. A large part of this difference comes from wide variances in the taxes that governments choose to levy on energy goods and, in the case of many European countries, these high taxes are used to subsidize increases in renewable energy production.

While the cost of energy in Canada may compare well with countries around the world, there are large differences in energy costs both within Canada and compared to the United States. Angevine and Green (2014) recently compared residential electricity costs in 119 Canadian and American cities. [2] The study found that only four Canadian cities (Montreal, Winnipeg, Vancouver, and Moncton) had electricity costs below the average of 12.12¢ per kWh (excluding taxes). The three Canadian cities with the lowest electricity costs were Montreal (ranked first of 119), Winnipeg (fourth of 119), and Vancouver (12<sup>th</sup> of 119). Conversely, the three Canadian cities with the most expensive residential electricity rates were Halifax (104<sup>th</sup> of 119), Charlottetown (98<sup>th</sup> of 119), and Calgary (97<sup>th</sup> of 119).

Residential electricity prices have been rising in Canada. From 2010 (the first year for which the electricity price data was available) to 2013,

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[2] The comparison included 12 Canadian cities: Montreal, Winnipeg, Vancouver, Moncton, Ottawa, Toronto, St. John's, Regina, Edmonton, Calgary, Charlottetown, and Halifax.



**Table 1: Residential electricity costs for selected Canadian and US cities, 2013**

	Canadian ¢/kWh			Canadian ¢/kWh	
	Excluding taxes	Including taxes		Excluding taxes	Including taxes
Montréal	6.87	7.89	Toronto	12.48	14.30
Winnipeg	7.63	8.73	St. John's	12.55	13.17
Vancouver	8.91	9.55	Regina	13.15	15.12
<i>Seattle</i>	8.97	8.97	Edmonton	13.90	14.60
<i>Miami</i>	9.46	10.86	Calgary	14.81	15.55
<i>Houston</i>	10.10	10.20	Charlottetown	14.87	16.95
<i>Nashville</i>	10.62	10.62	Halifax	15.45	16.22
<i>Portland</i>	10.63	10.80	<i>Detroit</i>	15.54	17.24
<i>Chicago</i>	11.43	12.94	<i>Boston</i>	16.50	16.50
Moncton	11.82	13.36	<i>New York</i>	21.75	23.67
Ottawa	12.39	14.00	<i>San Francisco</i>	22.94	24.69

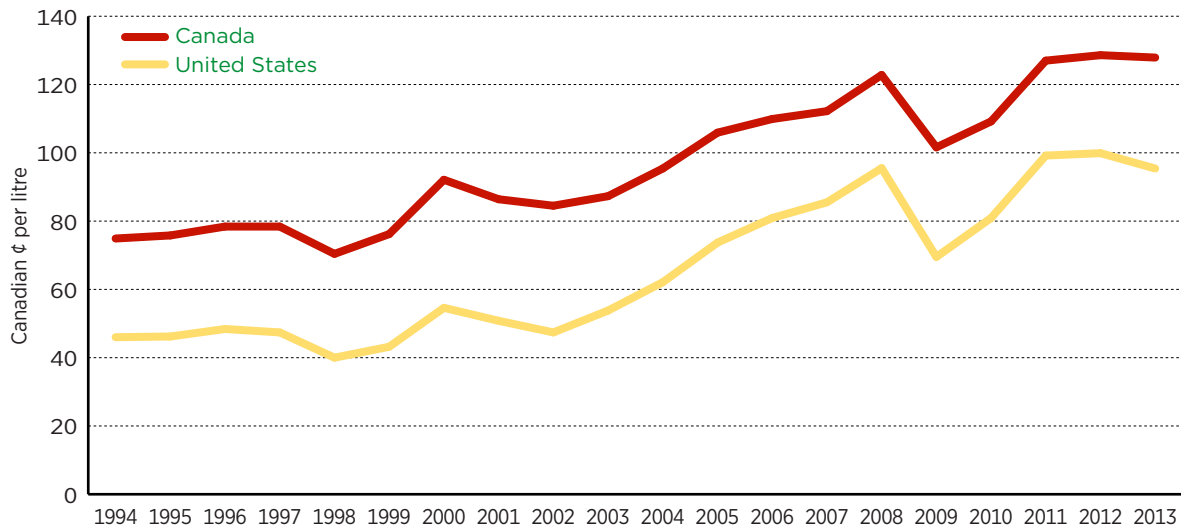
Source: Hydro-Quebec, 2013.

electricity increased by an average of 1.31¢ per kWh (Hydro-Quebec, 2010, 2013). The largest increases over this four-year period were in Edmonton and Calgary, both of which saw electricity prices increase by more than four cents per kWh. Only Charlottetown experienced a significant decrease in residential electricity prices, after prices fell by almost 1.30¢ per kWh in the four-year period.

**Table 1** displays a comparison of residential electricity rates in 2013 [3] both excluding and including taxes for 12 Canadian cities and several major American cities. All values in table 1 are in Canadian cents to allow easy comparisons between the two countries. One interesting difference between Canadian and American cities is the different amounts of taxation applied to electricity rates. For example, the average amount of tax applied across the 12 Canadian cities is 1.22¢ per kWh, from a low of 0.64¢ in Vancouver to a high of 2.08¢ in Charlottetown. Cities in the United States, on the other hand, applied on average 0.86¢ of tax per kWh, from a low of zero in Seattle, Nashville, and Boston, to a high of 1.92¢ in New York. The differences in the amount of taxation applied will add to the spread between average residential electricity prices in Canada and the United States.

[3] Although 2014 rates are available, we used 2013 rates because the last available year of energy expenditures for Canadian households, used below, is 2013. For this reason, all subsequent graphs in this section focus on the 20-year period from 1994 to 2013.

Figure 1: Retail gasoline prices, Canadian ¢ per litre, 2013



Sources: Natural Resources Canada, 2015b; United States, Energy Information Administration, 2015; Bank of Canada, 2013; Bureau of Labor Statistics, 2015; calculations by authors.

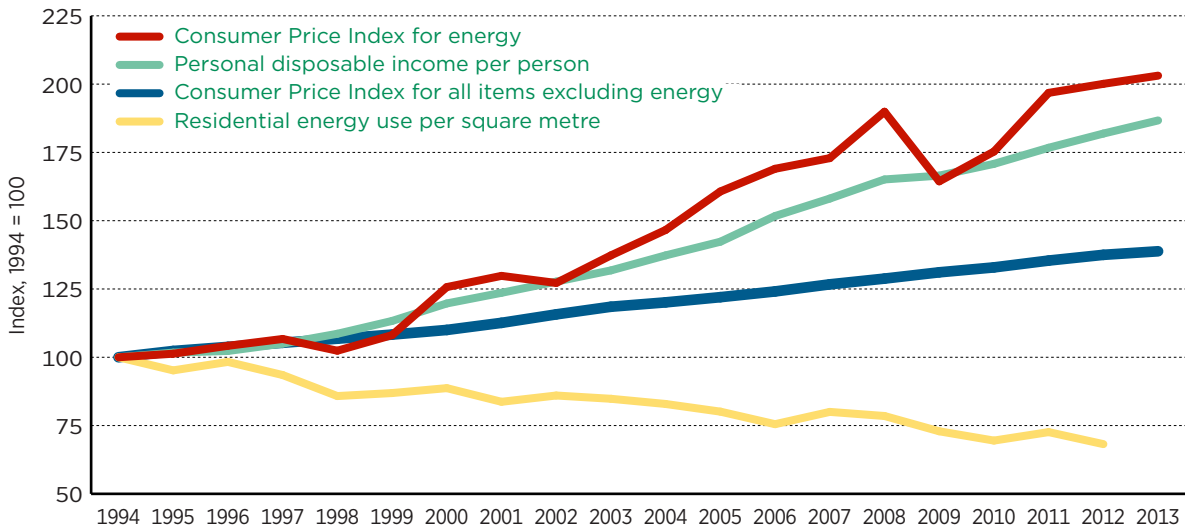
While spending on electricity is the largest component of energy spending within the home [4] (Statistics Canada, 2015h), another crucial component of a household's energy costs is gasoline. Figure 1 compares average prices of regular gasoline in Canada and the United States over time (in inflation-adjusted Canadian dollars). In 1994, a litre of gasoline cost Canadian consumers approximately 74.9¢, while Americans had to spend 46.0¢ a litre. Twenty years later, in 2013, real Canadian prices had increased by 53¢ to 127.9¢ a litre and American prices reached 95.4¢. [5] During this period, Canadian consumers paid on average 31.2¢ more per litre of gasoline than did Americans in a given year.

Government policy, beyond taxes, can also play an important role in the price that consumers pay for various energy products. In their review of electricity prices, Angevine and Green (2014) found that cities with low electricity costs generated most of their electricity either through hydroelectric or coal-fired power plants. Yet recent policy developments such as Ontario's Green Energy Act (GEA) or the United States' Clean Power Plan appear to be moving away from these options (mainly from coal) for electricity generation to others, particularly renewables (wind and solar), even though retrofitting coal plants in Ontario with the latest technologies could have provided

[4] Energy spending within the home includes electricity, natural gas, and other fuel for the principal accommodation.

[5] Note that consumers in both countries have seen some relief in prices in 2014 and 2015 as oil prices have dropped significantly. The reason our analysis of prices stopped at 2013 is that the data on consumer expenditures used below ends at this point.

Figure 2: Comparative growth in prices, income, and energy use, Canada, 1994–2013



Notes: 1. Data series describing household energy intensity ends in 2012. 2. These are nominal price indices.

Sources: Statistics Canada, 2015c (CANSIM table 051-0001), 2015b (326-0021), 2015d (CANSIM table 380-0042); Natural Resources Canada, 2015a; calculations by authors.

environmental benefits at significantly lower costs (McKittrick, 2013). The result of Ontario's recent shift to increase the share of its electricity generation coming from renewables has resulted in price increases for residential consumers (McKittrick and Adams, 2014). [6]

Another example of how policies can affect costs is seen in the recent increases in the use of hydraulic fracturing to unlock large quantities of oil and gas within shale resources. Focusing on the United States, Hausman and Kellogg (2015) found that the reduction in natural gas prices from increased supply has significantly benefitted both consumers and producers. However, when governments place moratoria on hydraulic fracturing this can reduce the supply of natural gas and may raise the price that consumers pay (see Green, 2014).

Overall, Canadian energy prices included in the consumer price index (CPI) grew by 103% between 1994 and 2013, while the prices of the rest of the CPI basket grew by 39%. [7] As figure 2 shows, Canadian energy prices grew quickly in the mid-2000s, and rebounded from a 2009 dip by 2011. Meanwhile, nominal disposable income per person grew by 87%. Given the current rate of

[6] Prices have also been increased on commercial and industrial consumers and, as a result, Ontario's businesses have been adversely affected (see Ontario Chamber of Commerce, 2015).

[7] It is worth noting that at the end of 2014 and continuing into 2015 both oil and natural gas commodity prices declined, considerably in the case of oil. While the reasons behind these price decreases are beyond the scope of this paper, it is likely that these changes have contributed to lower energy expenditures as a percentage of total expenditures for Canadian households. However, at this time, data for those years is unavailable.

change in prices and incomes, to compensate for the effects of higher energy costs on household income, much greater energy efficiency gains would have been required. Natural Resources Canada (2015a) estimates that energy use per square meter of residential floor space dropped by 32% from 1994 to 2012 (see figure 2), but it is unclear if this is primarily driven by efficiency gains or is a response to rising prices.

Overall, energy prices in Canada have risen faster than income, at least from 1994 to 2013. Moreover, some Canadians are paying much higher prices than many of their peers, both within Canada and the United States. Next we look at how important energy is in the average household's expenditure budget.

# Canadian Households and Energy Spending

**Table 2** and **figure 3** represent the average energy expenditure as a percentage of total expenses across Canada and seven regions. Panel A describes spending on energy used at home—electricity, natural gas, and other heating fuels. **[8]** Household energy consumes a relatively modest portion of total spending in most provinces, and this share has generally declined between 2010 and 2013, reaching 2.6% of Canadian household spending in 2013. Among regions, energy spending as a share of household spending ranges from 2.1% in British Columbia to 4.0% in Atlantic Canada (New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland & Labrador).

Adding vehicle fuel to the energy basket has a substantial impact on expenditure shares, as shown in panel B of table 2. While the trend of low and decreasing total energy costs remains in the provinces of Alberta and British Columbia, adding vehicle fuel reverses the trend for the rest of the regions in Canada, where energy expenditures including gasoline is consuming a larger proportion of total expenditures across recent years. Quebec’s relatively low household energy expenditures are offset by spending on vehicle fuel, which consistently elevates energy’s share of household expenditures in Quebec above that in Ontario.

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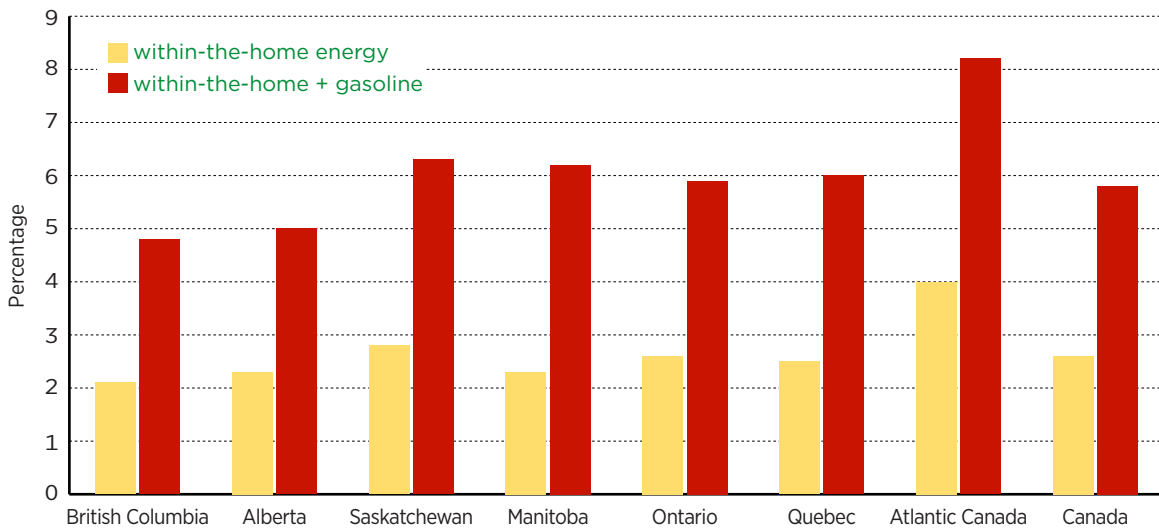
**[8]** Energy expenditures consisting of these goods will be referred to throughout the text as within-the-home energy.

Table 2: Energy spending as a percent of total household spending

	Panel A: Within-the-home energy				Panel B: Within-the-home + gasoline			
	2010	2011	2012	2013	2010	2011	2012	2013
British Columbia	2.2%	2.2%	2.2%	2.1%	5.0%	5.2%	5.1%	4.8%
Alberta	2.6%	2.7%	2.4%	2.3%	5.5%	5.8%	5.1%	5.0%
Saskatchewan	3.3%	3.1%	2.8%	2.8%	6.7%	7.0%	6.3%	6.3%
Manitoba	2.6%	2.6%	2.2%	2.3%	5.7%	6.5%	5.5%	6.2%
Ontario	2.8%	2.9%	2.6%	2.6%	5.5%	6.5%	5.8%	5.9%
Quebec	2.6%	2.4%	2.6%	2.5%	5.6%	6.2%	6.0%	6.0%
Atlantic Canada	4.1%	4.0%	3.9%	4.0%	8.1%	8.3%	8.0%	8.2%
Canada	2.7%	2.7%	2.6%	2.6%	5.7%	6.3%	5.8%	5.8%

Sources: Statistics Canada, 2015h, CANSIM table 203-0021; calculations by authors.

Figure 3: Energy spending as a percentage of total household spending, by province, 2013



Sources: Statistics Canada, 2015h, CANSIM table 203-0021; calculations by authors.

# Measuring Energy Poverty

It is especially important to measure how many households have relatively high energy costs, and therefore may face additional stresses or burdens. This report will use a benchmark measure of 10% or more of expenditures going to energy goods—a situation commonly referred to as “energy poverty”—to determine how many Canadian households are facing relatively high energy costs.

## What is energy poverty?

The issue of having relatively large expenditures on, or lack of access to, energy has been conceptualized in many different ways. For developing countries, the focus is primarily on guaranteeing the access to modern energy services [9] for all households, as many people around the world still do not meet the basic energy requirements needed for cooking (IEA, 2010; Pachauri and Spreng, 2011). In the developed world, the term “energy poverty” or “fuel poverty” means something quite different. Most of the households within these countries have stable access to energy. Rather the issue is more about energy affordability and the effect that large energy expenditures have on the consumption of other goods. In particular, certain groups of households (e.g., lower income, the elderly) are more prone to spending relatively higher portions of their incomes on energy (Shammin and Bullard, 2009; Sovacool and Brown, 2010). Sovacool and Brown (2010) also point out that affordable energy often includes stable prices. Prices that face large swings can affect how households and businesses plan and can affect budgets considerably, particularly in the short run.

In the United Kingdom, the term “energy poverty” goes beyond simple affordability, directly focusing on a situation where a household is unable to consume a necessary amount of energy using a certain percentage of their income. Specifically, to be fuel poor in the United Kingdom, a household would

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[9] In this context, energy services are defined as household access to electricity and clean cooking facilities.

have to spend more than 10% of its income on fuel to maintain an adequate level of warmth, defined as 21° for the main living area and 18° for other occupied rooms (UK-DECC, 2014). [10] Other estimations of energy poverty have used the 10% measure more broadly, moving away from the specifics of being able to heat specific rooms in a dwelling for a given percentage of income. Phimister, Vera-Toscano, and Roberts estimated the incidence of energy poverty in Spain using an “expenditure-based energy poverty measure ... based on household expenditures on gas and electricity as a proportion of net household income (excluding housing costs), with an individual considered energy poor if the proportion of household income spent on energy is greater than 10 per cent” (2015: 156). Their analysis found that energy poverty in Spain rose from 6.3% of individuals in 2007 to 10.4% in 2010.

Recently, Lesser (2015), motivated by California’s energy policies that have contributed to significant price increases, estimated the incidence of energy poverty in California. Lesser used total household income to evaluate “the percentage of households in counties where electricity and natural gas expenditures exceed 10 percent of household income; and the percentage of households in counties where electricity spending alone exceeds 10 percent of household income” (2015: 9). [11] In 2012, 4.9% of California’s households were spending more than 10% of their income just on electricity. When natural gas was included, the percentage of Californian households that were energy poor increased to 7.4%. Lesser also found there to be an inverse correlation between household income and energy poverty, meaning that the poorest counties were the ones that were most affected by expensive electricity prices.

This report takes an approach similar to Lesser’s (2015) to identify energy poverty in Canada. One notable difference is that our estimates will span a time series of four consecutive years, allowing for a comparison of trends over time. [12]

A typical way of measuring poverty is to evaluate the extent to which households cannot obtain basic necessities (Sarlo, 2001, 2008; Smeeding, 2006). This is somewhat different from what the measure of energy poverty seeks to capture. Energy poverty in the developed world is less about being

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[10] Note that the UK changed its measurement of fuel poverty in 2013. See appendix B for a discussion of how and why the change was made, and for a longer discussion of different energy and fuel poverty measures.

[11] Lesser (2015) notes that transportation fuel is another important energy expenditure. However, due to data limitations this measure was not added to the estimate of Californian energy poverty.

[12] For discussions of energy poverty similar to Lesser (2015) in the Canadian context, see McEachern and Vivian, 2010; Kelly, 2007; *Toronto Sun*, 2015.



deprived of access to energy goods and more about the effect high energy expenditures have on consumption and discretionary income, thereby placing a perhaps unnecessary burden on households. Indeed, when a household's high energy bills force them to reduce consumption of other goods, this could in a sense be considered a deprivation of access. [13]

As Kilian (2008) explains, high energy costs can affect the spending decisions of households in different ways. A range of estimates show that the demand for energy goods—gasoline, electricity, natural gas, and so on—tends to be relatively inelastic to price changes (Kilian, 2008). This means that price changes tend to have a small impact on the quantity consumed. As a result, price changes can have an effect on discretionary income and the consumption of other goods. Kilian describes the effect of high energy prices upon discretionary income, stating that “higher energy prices are expected to reduce discretionary income, as consumers have less money to spend after paying their energy bills” (2008: 881). This reduction in discretionary income is money that cannot be spent on other needs or wants. Kilian also notes that higher energy prices can lead to a reduction or postponement of the consumption of durable goods. One particular reason that this is an issue is, as Sarlo argues, “[c]onsumption is more directly connected to the actual living standard of a household than is income” (2001: 45).

We shall begin by estimating the incidence of energy poverty in Canada using only within-the-home energy expenditures (that is, electricity and natural gas), as this is the approach most often taken in previous research. However, the restricted focus on energy services directly in the home does not capture the full burden placed on families by high energy bills. In particular, it misses the cost of fuel for transportation, a large energy expense for many families, considering that 79.7% of working Canadians commute to work in private motor vehicles (car, truck, or van) (Statistics Canada, 2011). Energy poverty will be estimated again to include gasoline expenditures.

## Estimating energy poverty

As a first step to assessing the impact of energy expenditures on Canadian households, we set out to estimate the number of Canadian households who are energy poor. There is a particular attraction for using a benchmark, in that it lets us gauge the number of Canadian households with relatively high percentages of their expenditure devoted to energy goods. Thus, we consider households with energy expenditure shares above the 10% benchmark to be in

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[13] See appendix B (p. 23) for a description of some additional consequences of high energy costs.

energy poverty or energy poor. This concept reflects empirical work that has found a negative effect on health and spending from high energy expenditures, placing a burden on families. [14]

To measure energy expenditure shares, we obtained data on the expenditure patterns of a representative sample of Canadian households from Statistics Canada's Survey of Household Spending (SHS). The SHS has been a key source of information on household expenditures since its inception in 1997. In each year, the SHS is a representative sample of households from Canada's 10 provinces, excluding those living in institutions, military camps, and Indian reserves. In certain years, the SHS collects data from the territories, which we do not use in this analysis. Following the procedure of Lesser (2015), we exclude households with negative income, or energy expenditures higher than total expenditure when counting the energy poor.

Substantial changes were made to the SHS in 2010, making it difficult to compare data from 1997 to 2009 with recent years. For this reason, we focus on energy spending from 2010 to 2013, obtaining estimates of energy poverty's incidence as a custom tabulation of the most recent data available. Trends from 1997 to 2009 are calculated using public-use microdata files from the original SHS format and presented in appendix A.

Total energy expenditure is created by summing together responses to four [15] energy expenditure categories: electricity; natural gas; other heating and cooking fuel for principal residences; and fuel for owned and leased vehicles (including gasoline). [16]

We identify households as being in energy poverty if energy accounts for at least 10% of their total expenditure. Total expenditure includes a wide

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[14] See appendix B. One criticism of the 10% measure may be that it is arbitrary, and that shares of consumption can change over time, which could make the measure much less useful. While the 10% measure is arbitrary to a certain degree it does roughly represent twice the median total energy expenditures in Canada, which is how the measure was initially derived. Having to spend twice the median expenditure on energy has also been linked to various negative outcomes in the existing body of literature, which increases the utility of using such a benchmark. Also, in the absence of better data that would allow us to estimate minimum energy consumption required by Canadian households, the benchmark proves to be a useful tool to estimate relative hardships. In addition, median energy expenditures have remained quite constant across our sample period, so changes over time are not an issue at this time.

[15] Up until 2004, there were three energy expenditure categories: electricity, vehicle fuel, and other household fuel. In 2004, the final category was divided to report expenditures on natural gas separately from other fuels.

[16] Electricity, natural gas, and other fuel expenditures are measured by interviews and based on the most recent payment for the former two and last 12 months for other fuels. Expenditures on gasoline and other vehicle fuels are tracked in expenditure diaries following 2009 (Statistics Canada, 2010b).

range of expenses such as housing, food, gifts, personal taxes, and pension contributions. This measure of budget shares is consistent with previous research that analyzed food expenditures using similar data (Costa, 2001; Beatty and Roaed Larsen, 2004). [17]

While related research has focused on energy costs as a percentage of income, we use total expenditure, which is likely measured more accurately. In the early years of the SHS (before 2010), when reported income is used, households may underreport their incomes and not include various government transfers or in-kind gifts that may considerably influence the resources available [18] (Brzozowski and Crossley, 2011; Sarlo, 2001). A recent paper from the Bank of Canada found that roughly 35% to 50% of households appeared to underreport some income (Dunbar and Fu, 2015). [19] In 2010, collection of income from the prior year's tax returns was introduced into the SHS. Consequentially, income data in our primary sample refers to household income the year before expenditure data are collected (Statistics Canada, 2010a). This measure is a useful indicator of socio-economic status, which we measure in five fixed income groups and is unlikely to change drastically between years, but is inappropriate for measuring energy poverty, which is more sensitive to inaccuracies in its components.

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[17] Beatty and Roaed Larsen (2004) used the Survey of Household Spending to calculate food's share of household expenditures and estimate bias in the CPI. They follow Costa (2001) who did similar work using data from the American Consumer Expenditure Survey.

[18] In 2009, the last year for which public microdata are available, 6.16% of all households spent at least 10% of their income on energy (excluding gasoline), and 5.21% of households devoted at least 10% of their total expenditures to energy.

[19] Under-estimated measures of income would produce an over-estimated incidence of energy poverty in Canada. By using total expenditure, we likely keep our pre-2010 results conservative.

# Energy Poverty and Canadian Households

In this section, we measure the incidence of energy poverty in Canada's provinces. First, we consider energy poverty where only within-the-home energy spending (electricity, natural gas, and other heating fuels) is included. We continue by re-estimating the incidence of energy poverty while including gasoline in the energy expenditure basket.

## Energy poverty from within-the-home spending only

**Figure 4** and Panel A in **table 3** contain estimates of the incidence of energy poverty in Canada using only expenditures for within-the-home energy spending. From 2010 to 2013, the share of households in energy poverty across Canada has risen slightly from 7.2% in 2010 to 7.9% in 2013. The peak over this four-year period came in 2012, when energy poverty in Canada reached 8.7%, an increase of more than 1.5 percentage points from the previous year.

### Atlantic Canada

Atlantic Canada (an amalgamation of Newfoundland & Labrador, Prince Edward Island, Nova Scotia, and New Brunswick) has the highest incidence of energy poverty of any region in Canada in 2013, with 20.6% of households considered to be energy poor based on their within-the-home energy expenditures. [20] The incidence of energy poverty in Atlantic Canada has grown by over 20% since 2010, when 17.1% of households were energy poor.

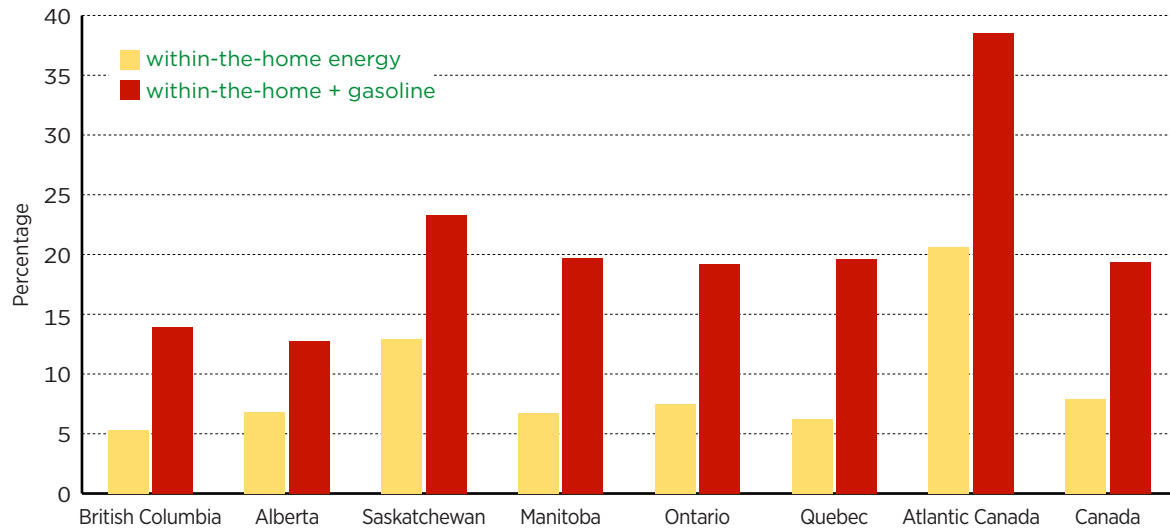
### Saskatchewan

In 2013, Saskatchewan had the second highest percentage of households in energy poverty at 12.9%. This is still more than seven percentage points below

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[20] Data for Atlantic Canada cannot be disaggregated by individual province because doing so would cause some data to be suppressed due to sampling.

Figure 4: Incidence of energy poverty, percentage of households, by province, 2013



Sources: Statistics Canada, 2015a; calculations by authors.

Table 3: Incidence of energy poverty by province (percent of households)

	Panel A: Within-the-home energy				Panel B: Within-the-home + gasoline			
	2010	2011	2012	2013	2010	2011	2012	2013
British Columbia	5.0%	4.6%	6.4%	5.3%	13.7%	17.3%	11.9%	13.9%
Alberta	5.6%	5.9%	8.1%	6.8%	15.8%	17.9%	14.9%	12.8%
Saskatchewan	13.3%	11.9%	10.7%	12.9%	27.0%	27.6%	27.5%	23.3%
Manitoba	6.0%	6.5%	6.9%	6.7%	20.7%	22.1%	13.1%	19.7%
Ontario	8.0%	8.5%	8.3%	7.5%	19.5%	23.8%	17.8%	19.2%
Quebec	4.4%	4.0%	7.7%	6.2%	15.6%	20.5%	17.2%	19.6%
Atlantic Canada	17.1%	16.7%	20.2%	20.6%	39.2%	42.3%	38.7%	38.5%
Canada	7.2%	7.2%	8.7%	7.9%	19.0%	22.9%	18.2%	19.4%

Sources: Statistics Canada, 2015a, custom tabulation from the 2010–2013 *Survey of Household Spending*; calculations by authors.

Atlantic Canada. In comparison to 2010, Saskatchewan’s incidence of energy poverty has decreased slightly, although the 2013 measure is more than a percentage point above the period low in 2012.

### Ontario

Ontario also had a comparatively high incidence of energy poverty, with a 2013 measurement of 7.5% of households. While this number is high relative to other Canadian regions, it is a slight decrease from 2010, when the incidence of energy poverty was 8.0% in the province.

### Alberta

Alberta's incidence of energy poverty was in the middle of Canadian regions, with their 2013 estimate being 6.8%. The increase in energy poverty of 21.2% from 2010 in Alberta was the second highest in Canada in this period, behind only Quebec.

### Manitoba

Manitoba had a slightly lower incidence of energy poverty than Alberta. In 2013, 6.7% of households in Manitoba were considered to be energy poor based on their expenditures on within-the-home energy goods.

### Quebec

Quebec's incidence of energy poverty grew by over 40% from 2010 to 2013, reaching 6.2% in the final year. Even though Quebec saw a sharp increase, the province still had the second lowest level of energy poverty in 2013. Like other regions, energy poverty peaked in Quebec in 2012, falling by more than a percentage point in 2013.

### British Columbia

When focusing solely on within-the-home energy expenditures, British Columbia has the lowest incidence of energy poverty at 5.3% in 2013. This is almost a full percentage point below the next closest province Quebec. The relatively low levels of energy poverty in these provinces are likely to some extent the result of comparatively low electricity prices, driven by the provinces' substantial hydroelectric production (Angevine and Green, 2014).

## Energy poverty from within-the-home spending plus gasoline

**Figure 4** and Panel B in **table 3** include estimates of the proportion of Canadian households experiencing energy poverty when both within-the-home energy expenditures and gasoline are included between 2010 and 2013. In 2013, 19.4% of Canadian households devoted at least 10% or more of their expenditures to energy. This trend has been relatively consistent between 2010 and 2013. The incidence of energy poverty peaked in 2011 at 22.9% when gasoline prices rose sharply in that year.

### Atlantic Canada

Including gasoline expenditures, Atlantic Canada again had the largest proportion of households facing energy poverty in 2013 at 38.5%. Over the four-year period starting in 2010, Atlantic Canada has consistently had the highest share of its population in energy poverty.

### Saskatchewan

Saskatchewan follows Atlantic Canada with 23.3% of households being in energy poverty in 2013 when gasoline is included in energy expenditures. While Saskatchewan still has the second highest incidence of energy poverty with gasoline included, this inclusion shrinks the gap between Saskatchewan and other provinces.

### Manitoba

Manitoba is in the upper half of Canadian regions in terms of the percentage of households experiencing energy poverty when gasoline is included. In 2013, 19.7% of households were experiencing energy poverty using this measure. This is in contrast to the estimation of energy poverty using only within-the-home energy expenditures, where Manitoba ranked in the lower half.

### Quebec

Quebec's incidence of energy poverty is in the middle among these regions. In 2013, 19.6% of households in Quebec were energy poor. A recent report comparing electricity prices in North America noted that Quebec had some of the lowest electricity prices in Canada, likely driven by its abundance of hydroelectric generation (Angevine and Green, 2014). Indeed, when analyzing the percentage of the population that is in energy poverty based only on within-the-home energy expenditures, Quebec has the second lowest incidence of energy poverty in Canada, surpassed only by British Columbia. This suggests that the comparably high levels of energy poverty are possibly the result of other factors. That being said, when considering how energy poverty has changed from 2010 to 2013, Quebec experienced an increase of almost four percentage points in the incidence of energy poverty when gasoline is included, by far the largest of any region.

### Ontario

Ontario's incidence of energy poverty remained relatively consistent between 2010 and 2013, ending at 19.2%. Ontario experienced a spike in energy poverty (gasoline included) in 2011, along with other regions in Canada, likely caused by the large increase in gasoline prices in that year (see figure 1 above).

### British Columbia

Compared to the rest of Canada, British Columbia has a relatively low percentage of energy-poor households when gasoline is included, likely attributable to some extent to the province's abundant production of hydroelectricity, as seen when British Columbia incidence of energy poverty was estimated using only within-the-home energy (Angevine and Green, 2014). The mild climate that many of the province's residents experience may also contribute to low levels of energy poverty. In 2013, British Columbia's incidence of energy poverty reached 13.9%, a level similar to where the province was at in 2010.

## Alberta

When gasoline included in the calculation, Alberta has the lowest number of energy-poor households in 2013 at 12.8%. Since 2010, energy poverty has declined by just under three percentage points or 18.0%, the largest decline in Canada. Alberta's comparatively low gasoline prices during this period likely contributed to the lower level of total energy poverty (Natural Resources Canada, 2015b).

It is worth noting that the differences between provinces are not necessarily derived strictly from differences in energy costs. As noted above, there are three criteria that contribute to a within-the-home energy costs: prices, income, and efficiency. Electricity prices for example, are influenced by methods of electricity generation, which vary widely across Canada (Angevine and Green, 2014; McKittrick and Adams, 2014). In addition, temperature will be a factor in determining relative energy consumption levels. It is likely that variations in temperature and income contribute widely to the interprovincial differences observed above. However, a complete analysis of the reasons behind the regional variations is beyond the scope of this paper.

## Income and energy poverty

Previous research into energy spending found that low-income individuals tend to spend higher portions of their incomes on energy (Shammin and Bullard, 2009; Sovacool and Brown, 2010). We investigate this possibility, presenting estimates of the incidence of energy poverty by household income.

**Figure 5** and **table 4** present the percentage of households facing high energy costs in five income groups. **[21]** Energy poverty is inversely related to household income. The first and second groups (\$27,000 or less; \$27,000.01–\$47,700) have the highest proportion of energy-poor households when results are calculated only on within-the-home energy and also when gasoline is included. In 2013, 30% of households in the first group and 28.8% in the second were spending more than 10% of their total expenditures on energy (including gasoline). Interestingly, when within-the-home energy (electricity, natural gas, and other heating fuels) only was considered, the second income grouping had a greater incidence of energy poverty than did the first.

The third income group (\$47,700.01–\$72,600) and the fourth (\$72,600.01–\$107,600) both experience relatively low levels of energy poverty

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**[21]** Income groups were defined by sorting families from lowest to highest incomes (in inflation-adjusted dollars) from 1997 to 2009 using the SHS's public user microdata files (PUMF) sample. Each group contains 20% of all families over this time. These income groups were adjusted to reflect 2013 dollars and rounded to the nearest hundred.



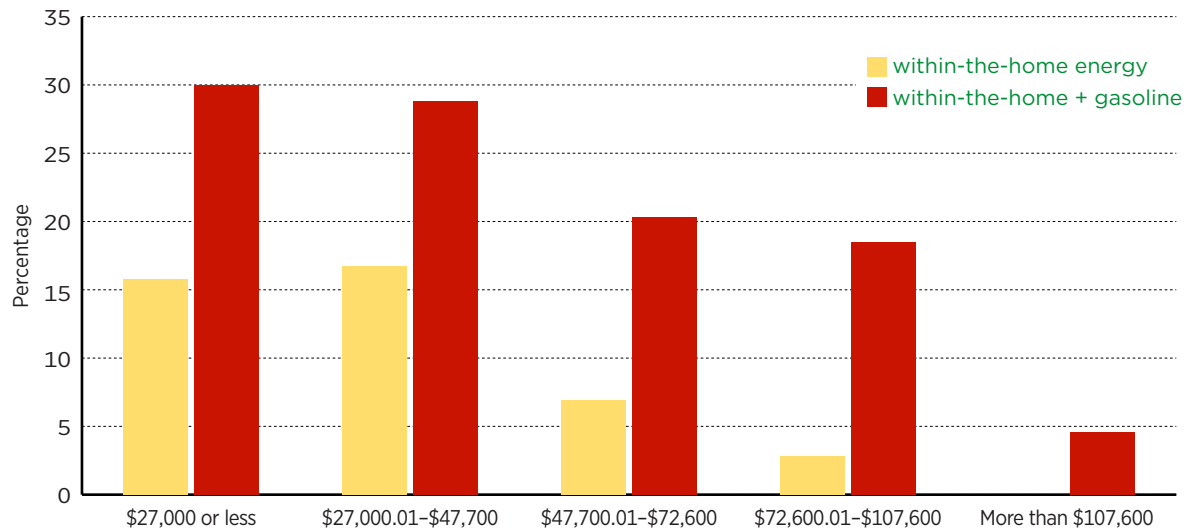
Table 4: Incidence of energy poverty by income group (percent of households)

	Panel A: Within-the-home energy				Panel B: Within-the-home + gasoline			
	2010	2011	2012	2013	2010	2011	2012	2013
\$27,000 or less	16.9%	18.3%	19.3%	15.8%	28.5%	28.5%	23.5%	30.0%
\$27,000.01-\$47,700	12.5%	12.3%	16.2%	16.7%	28.8%	31.5%	28.5%	28.8%
\$47,700.01-\$72,600	5.7%	4.9%	6.3%	6.9%	20.1%	29.3%	22.9%	20.3%
\$72,600.01-\$107,600	2.0%	1.7%	2.4%	2.8%	14.0%	16.5%	14.0%	18.5%
More than \$107,600	—	—	—	—	6.1%	10.4%	4.7%	4.6%

Note: “—” indicates data not available

Sources: Statistics Canada, 2015a, custom tabulation from the 2010–2013 Survey of Household Spending; calculations by authors.

Figure 5: Incidence of energy poverty, percentage of households, by income group, 2013



Sources: Statistics Canada, 2015a; calculations by authors.

when only within-the-home energy is considered. In 2013, the incidence of household energy poverty in the third and fourth income groups was 6.9% and 2.8%, respectively. Both groups saw increases from 2010 to 2013. When gasoline expenditures are included in the energy poverty estimates for these two groups, the incidence of energy poverty increases significantly (by more 13 percentage points for the third grouping and over 15 for the fourth), indicating that gasoline expenditures are likely a considerable component of these households' total expenditures.

In general, our analysis of Canadian data fits with research conducted abroad. We find that low income households are more likely to spend higher proportions of their expenditures on energy goods. An in-depth determination of the drivers of differences across income groups will require future research.

## Conclusion

We set out to analyze energy spending by Canadian households and the state of energy poverty in Canada. In general, we found that from 2010 to 2013 Canadian households were spending a smaller percentage of their total expenditures on within-the-home energy goods while devoting a growing share of their expenditures to all energy goods, which includes gasoline spending. From 2010 to 2013, the share of Canadian households that were energy poor—defined as devoting more than 10% of total expenditures to energy—rose from 7.2% to 7.9%, a growth of 9.4%, when spending on electricity, natural gas, and other heating fuels only is considered. When gasoline expenditures were added to other energy spending, in 2013 approximately 19.4% of Canadian households were considered energy poor. Regional differences in the extent of energy poverty persisted across this period, with a larger share of households in Atlantic Canada burdened by unaffordable costs than the rest of Canada. Focusing on demographic differences, energy costs that are relatively high were found to be more prevalent among households with lower incomes. These households are the most vulnerable to the potential negative effects of rising energy costs.

The high incidence of energy poverty in Canada, particularly when gasoline expenditures are included, should be of central concern when policies regarding energy are being devised. Policies that raise prices could exacerbate problems faced by families who are in energy poverty or those on the cusp of energy poverty.

## Appendix A: All Additional Data, 1997–2009

Table A.1: Incidence of energy poverty from 1997 to 2009, by region

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Panel A: Within-the-home energy													
British Columbia	2.2%	1.4%	2.0%	3.1%	3.0%	2.5%	2.5%	2.5%	3.1%	3.9%	2.8%	3.5%	2.8%
Alberta	2.9%	3.2%	2.7%	3.4%	3.6%	5.3%	5.2%	5.2%	5.2%	4.2%	4.6%	6.3%	5.1%
Saskatchewan	7.5%	8.9%	7.6%	8.2%	10.2%	12.1%	11.5%	12.0%	10.8%	11.1%	10.1%	9.8%	6.6%
Manitoba	6.4%	5.6%	5.7%	5.2%	5.0%	5.6%	6.3%	5.8%	4.6%	6.2%	4.8%	5.6%	3.4%
Ontario	4.5%	5.3%	4.5%	5.0%	5.1%	5.3%	6.6%	4.6%	4.6%	6.2%	4.9%	6.3%	5.9%
Quebec	5.4%	4.6%	4.1%	4.3%	4.3%	2.8%	3.5%	4.1%	3.8%	3.2%	3.6%	3.7%	3.3%
Atlantic Canada	14.1%	13.3%	12.0%	12.7%	13.3%	11.8%	12.5%	12.7%	13.4%	13.0%	14.8%	15.0%	13.3%
Canada	4.8%	5.0%	4.4%	4.7%	4.9%	4.8%	5.6%	4.8%	4.7%	5.2%	4.6%	5.5%	4.9%
Panel B: Within-the-home energy + gasoline													
British Columbia	9.1%	7.4%	8.6%	13.1%	11.6%	12.2%	11.6%	12.7%	14.3%	15.7%	13.9%	15.6%	14.5%
Alberta	11.4%	11.2%	12.6%	14.5%	13.0%	17.6%	17.2%	17.4%	17.3%	16.7%	19.6%	21.5%	19.2%
Saskatchewan	25.6%	24.7%	26.1%	27.0%	30.0%	30.6%	28.8%	32.1%	32.6%	31.9%	31.8%	29.0%	25.0%
Manitoba	17.5%	18.7%	16.2%	19.8%	19.5%	20.4%	20.9%	20.8%	20.6%	21.8%	21.7%	20.4%	18.0%
Ontario	13.4%	13.0%	13.1%	16.9%	14.5%	16.4%	17.7%	17.4%	16.3%	19.5%	20.4%	20.2%	20.5%
Quebec	17.5%	15.0%	16.0%	18.3%	16.4%	13.9%	16.0%	16.3%	18.3%	16.7%	19.9%	16.5%	15.5%
Atlantic Canada	37.2%	34.3%	34.5%	37.8%	36.0%	36.0%	34.8%	38.1%	41.1%	37.7%	42.3%	42.2%	38.0%
Canada	14.4%	13.2%	13.8%	17.0%	15.2%	15.8%	16.8%	17.1%	17.4%	18.4%	19.6%	18.9%	18.2%

Sources: Statistics Canada, 2015i; calculations by authors.

Table A.2: Incidence of energy poverty from 1997 to 2009, by income

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Panel A: Within-the-home energy													
\$27,000 or less	17.2%	16.2%	16.3%	16.4%	17.4%	17.2%	17.8%	16.6%	16.2%	18.1%	17.0%	20.0%	15.7%
\$27,000.01–\$47,700	5.8%	5.9%	4.9%	6.3%	6.6%	7.0%	8.3%	6.7%	8.1%	8.5%	8.2%	9.0%	8.9%
\$47,700.01–\$72,600	1.0%	1.6%	0.9%	1.7%	0.9%	1.0%	1.4%	1.7%	1.6%	1.6%	2.1%	2.2%	2.5%
\$72,600.01–\$107,600	0.2%	0.1%	0.0%	0.3%	0.6%	0.5%	0.3%	0.3%	0.4%	0.5%	0.6%	0.4%	0.7%
More than \$107,600	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Panel B: Within-the-home energy + gasoline													
\$27,000 or less	29.1%	28.1%	28.1%	30.1%	29.3%	28.1%	30.1%	28.9%	28.3%	30.3%	30.9%	31.6%	27.6%
\$27,000.01–\$47,700	26.4%	24.5%	25.2%	31.3%	28.7%	29.8%	29.6%	30.8%	32.2%	31.3%	33.5%	30.6%	30.8%
\$47,700.01–\$72,600	14.1%	12.4%	12.8%	18.3%	15.1%	17.3%	18.0%	21.2%	20.9%	21.2%	24.3%	25.2%	22.2%
\$72,600.01–\$107,600	5.3%	4.6%	6.5%	7.8%	7.8%	8.9%	8.0%	9.3%	11.7%	11.9%	14.4%	13.9%	14.2%
More than \$107,600	1.1%	1.3%	2.6%	3.0%	2.3%	3.3%	3.9%	3.3%	3.6%	5.5%	7.1%	5.5%	4.4%

Sources: Statistics Canada, 2015i; calculations by authors.

## Appendix B: The Concept of Energy Poverty and Its Consequences

Governments and researchers in the European Union (EU) have focused much more on issues of energy and fuel poverty than have their peers in the rest of the developed world. Much of this concern in the EU originated in 1991, when Brenda Boardman published the book, *Fuel Poverty: From Cold Homes to Affordable Warmth*. Boardman argued that households that needed to spend 10% or more of their incomes on energy services [1] were considered to be fuel poor. The 10% figure was adopted because it was double what the median household had to spend on energy. [2] In 1988, 30% of households exceeded that threshold (Boardman, 2010; Moore, 2012). By 2013, 17% of households in the United Kingdom were considered to be fuel poor (UK-DECC, 2015).

After Boardman’s work helped to identify the issue, in 2000 the legislature of the United Kingdom (UK) passed the Warm Homes and Energy Conservation Act (WHECA), setting out the their definition of fuel poverty. According to the original act, a person was regarded as being fuel poor if “he is a member of a household living on a lower income in a home which cannot be kept warm at a reasonable cost”. This bill also established that the governments of England and Wales had to implement plans for the reduction of fuel poverty (UK-DTI, 2001). Since 2001, the United Kingdom has been compiling annual statistics on the level of fuel poverty within its borders.

Until 2013, to quantify this definition, a household was considered to be in fuel poverty if it needs to spend more than 10% of its income on fuel to

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[1] Energy services here include space heating, water heating, lights, appliances, and cooking.

[2] It is important consider whether the 10% benchmark figure is applicable to Canada. It is quite possible that including an additional category—vehicle fuel—may render this benchmark too low. Despite including vehicle fuel in Canadian energy expenditures, these budget shares are roughly comparable to the European data from which the 10% figure was derived. Canadians devote less of their spending to within-the-home energy (such as heating and lighting) than their European counterparts, likely because they face lower energy costs (OECD, 2013). In general though, this measure has become widespread in its use across various countries that all have different average energy expenditures. Most of the recent research into the energy poverty has taken a broader approach to the issue, moving away from the original finite concept. It is in this sense that we use the measure to assess how many Canadian households are burdened by high energy expenditures. As well, using this measure likely keeps our estimates conservative, rather than leading to an over-estimate of the problem.

maintain an adequate level of warmth, defined as 21° for the main living area and 18° for other occupied rooms (UK-DECC, 2014). The figure of a 10% share of income results from a calculation that in 1988 the median household spent 5% of its net income on fuel. Twice the 5% was deemed to be unreasonable (Hills, 2012).

The ratio used to calculate the number of households in fuel poverty is:

$$\text{fuel poverty ratio} = \frac{\text{fuel costs (usage} \times \text{price)}}{\text{income}}$$

If the ratio is greater than 0.1 a household is considered fuel poor. Hills (2012) argues that the indicator's main strength is that it models a household's fuel requirement, rather than using consumption data. [3] Consumption data is alluded to as being problematic in that a household may have a low actual expenditure because they cannot afford enough fuel, with the result that they are not classified as fuel poor. Another strength alluded to by Hills (2012) is that this approach included measures of incomes, energy requirements, and energy costs, the three key components of fuel poverty.

The number of people who were fuel poor in the United Kingdom in 2012, the most recent year of data available, was estimated at 4.5 million (UK-DECC, 2014). The number of vulnerable persons, defined as those households containing elderly, children, or someone who is disabled or has a long-term illness, was estimated at 3.5 million.

The 10% measure is not without its deficiencies. Hills (2011) argues that one of the weaknesses is that the 10% measure is derived from the behaviour of households in 1988 and not from that of contemporary households. He also argues that it is an issue that most of the variation in fuel poverty over time has been dominated by prices, and that this may mask the actual number of fuel poor. [4] Finally, Hills points out that the current measure focuses on the extent of fuel poverty rather than its depth.

Hill's recommendations (2012) have prompted the UK government to shift methodologies for their fuel poverty calculations and it now uses a Low Income High Costs definition that considers a household to be fuel poor if "they

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[3] While our consumption-based measure of energy poverty is subject to Hills' (2012) criticism, it certainly is useful as an indicator of the number of households devoting large shares of their spending to energy. This is more closely related to "Engle's law", the long-standing observation that the poorer families tend to devote larger budget shares to basic goods (Chai and Moneta, 2010).

[4] While Hills (2011) argues that the effects of price changes are a problem and warrant a shift in methodology, the effect they have on increasing the burden of energy costs and possible substitution away from energy expenditures is undeniable. Governments can also significantly shift prices through their policies, as has been the case with Ontario's Green Energy Act (see McKittrick, 2013; McKittrick and Adams, 2014).

have required fuel costs that are above average (the national median level)” and “were they to spend that amount, they would be left with a residual income below the poverty line” (UK-DECC, 2014: 7). The new measure is relative since it compares households to the median national fuel costs and income. The Low Income High Cost measure is seen as ensuring that contemporary trends in usage are reflected. [5]

It should be noted that the broader 10% measure continues to be used throughout the United Kingdom, while currently only England also uses the low-income, high-cost measure.

The government of the United Kingdom considers fuel poverty to be a combination of three factors:

1. the energy efficiency of the dwelling;
2. the cost of energy;
3. household income.

At any given time, changes to one of these factors can exert significant influence on the calculation of the number of people who are considered to be fuel poor. For example, fuel poverty dropped in the United Kingdom between 1996 and 2003 because of rising incomes and decreasing fuel prices. Between 2004 and 2009, the number of fuel poor steadily increased as a result of the rising costs of natural gas (almost 120%) and electricity (more than 75%). The UK Department of Energy and Climate Change (DECC) notes that, since 2004, increasing prices have far outweighed any increases in income and energy efficiency (UK-DECC, 2014).

While the focus for fuel poverty in the United Kingdom has been on objective quantifications, some have argued that a subjective approach is more suited to understanding the depth of the problem. Price, Brazier, and Wang (2012) suggest that the measurement of fuel poverty should be based on one’s own subjective assessment as to whether or not they feel fuel poor. Such measures may capture more accurately households that are rationing the consumption of energy (Phimister, Vera-Toscano, and Roberts, 2015).

The concept of energy or fuel poverty has also begun gaining attention in US policy debates under the name of energy insecurity. In a recent white paper, Senators Lisa Murkowski (R-AK) and Tim Scott (R-SC) of the Senate Committee on Energy and Natural Resources, defined families that are “energy insecure” as those having to make tradeoffs in other areas of their budget to

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[5] Relative measures of poverty are not without their deficiencies. As Sarlo (2013) explains, these types of measures are essentially assessing inequality or one’s relative position in a given distribution of income, not necessarily the ability to acquire basic needs. Relative measures are also provide poor intertemporal comparisons, given that median values shift over time.

afford energy services; accumulating increased debt attributed to energy bills; having to switch to less expensive but less efficient fuels (i.e. natural gas to firewood); having to maintain low or high indoor temperatures; and having to close off rooms or sections of the dwelling to avoid heating or cooling those areas (Murkowski and Scott, 2014). As in Europe, the broad issue is one of energy affordability for households.

## Consequences of high energy costs

While the primary concern associated with energy poverty is the effect that relatively high energy expenditures have on the discretionary income of households and the burden this places on families, living in energy poverty can also have other effects. Most of the health effects that have been found to be associated with being fuel poor stem from being unable to heat one's house to an adequate level. Research has found that low indoor temperatures are associated with increased respiratory problems as well as increases in circulatory and coronary issues (Liddell and Morris, 2010; Hills, 2011; WHO, 1987), although some evidence suggests that lower temperatures show a stronger relationship to mortality from cardiovascular disease than mortality from respiratory disease (Hills, 2011). Indeed, the risk of mortality from being unable to heat one's dwelling adequately is one of the reasons that "excess winter deaths" [6] are tracked in the United Kingdom as a way to assess progress in the mitigation of fuel poverty (Hills, 2011).

Mental health impacts have also been linked to fuel poverty. Previous research has found correlations between lacking affordable warmth and symptoms of mental health issues (Liddell and Morris, 2010; Hills, 2011). The link between affordable warmth and mental health is often the result of increased stress and discomfort that is induced by residing in sub-optimal living conditions (Hills, 2011).

In addition, Murkowski and Scott (2014) found that unaffordable energy was associated with food insecurity, more frequent relocations, diminished educational performance, and reductions in personal productivity.

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[6] "Excess winter deaths" are calculated by comparing the deaths in winter (November to March) with those in non-winter months (the preceding August to November and the following April to July).



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