

C A N A D I A N
Building Energy End-Use
DATA AND ANALYSIS CENTRE
commercial • residential • institutional

A Comparison of Energy-Related Characteristics of Residential Dwellings and Technologies across Canada and the US

Lucie Maruejols

Xuanye Lu

Denise Young

May 2011

CBEEDAC 2011-RP-05

*The financial support of Natural Resources Canada through the Canadian Building Energy End-Use Data and Analysis Centre (CBEEDAC) is gratefully acknowledged.

DISCLAIMER

The views and analysis contained in this paper are the sole responsibility of the authors, and should not be attributed to any agency associated with CBEEDAC, including Natural Resources Canada.

Executive Summary

Given the generally colder climate in Canada, it is not surprising that on average Canadian households consume more energy than their American counterparts. When compared to residential energy use in regions of the US with similar climatic conditions, however, households in many parts of Canada use less energy. In this project data from recent versions of Canada's Survey of Household Energy Use (SHEU) and the US Residential Energy Consumption Survey (RECS) are used to compare a variety of dwelling and household equipment characteristics that might be related to observed differences in residential energy use.

The survey information from the two countries indicates that a larger share of US than Canadian dwellings were built more than 40 years prior to the most recent respective surveys, resulting in an older and (possibly) less energy efficient housing stock in the US. Further, households in the US were more likely than Canadians to live in larger dwellings, more likely to live in single detached houses, and more likely to have single pane windows, all of which affect the amount of energy required for space heating (and cooling).

Heating preferences varied somewhat across the two countries. With the exception of (primarily) provinces on the west and east coasts, Canadians were less likely to choose relatively low indoor temperature settings than in the coldest US climate zone. The main heating equipment used by Canadian households was less likely to be of the most recent vintage (with the exception of homes in Alberta) than in the two coldest US climate zones. Households in the coldest US climate zones generally had higher ownership rates of air-conditioning equipment than in Canada.

In terms of other household technologies, Canadians tended to own more appliances than their American counterparts. Ownership rates were higher in Canada for stand-alone freezers, stoves and dishwashers, which may be related to a greater tendency for Canadian households to cook at home. Canadians were also more likely to own at least one computer, and to own DVD players and home theatre systems. Conversely, US households were more likely to own multiple TV sets and computers. Within Canada, Alberta's high rate of appliance and electronics use, along with its severe winter climate, may have played an important role in the high energy intensity of its households compared both to other Canadian households and to those in the US.

Table of Contents

Executive Summary	i
List of Figures	iii
List of Tables	iii
1. Introduction	1
2. Household Energy Use	3
3. Dwelling Features	4
a) Year of construction	4
b) Type and size	5
c) Windows	7
4. Heating and Cooling Technologies	9
a) Space Heating	9
b) Air Conditioning	12
5. Household Appliances and Home Electronics	14
a) Refrigerators and Freezers	14
b) Stoves and Microwaves	15
c) Dishwashers	16
d) Clothes Washers and Dryers	17
e) Personal Computers and Televisions	19
6. Concluding Remarks	21
References	23
Appendix 1: United States RECS Climate and Census Regions	24
Appendix 2: Definition of Climate Regions used in RECS-09, by <i>Building America</i>	25

List of Figures

Figure 1: Dwelling Vintages (year of construction), by Region.....	5
Figure 2: Dwelling Types, by Region.....	6
Figure 3: Dwellings by Size Category, by Region	7
Figure 4 : Window Types, by Region.....	8
Figure 5 : Source of Energy for Space and Water Heating.....	11
Figure 6 : Energy Sources for Main Heating Equipment, by Region.....	12
Figure 7 : Air-Conditioning Systems, by Region	13
Figure 8: Proportions of Energy Star® Refrigerators, by Country.....	15
Figure 9 : Cooking Equipment in Canada and the US.....	16
Figure 10 : Proportion of Households that use a Dishwasher, by Region	17
Figure 11 : Proportions of Households using Clothes Washers and Dryers, by Region	18
Figure 12 : Temperature used Most Often for Washing Clothes, by Region	19
Figure 13: Computers per Household.....	20

List of Tables

Table 1: Energy Use per Household in Canada (SHEU-2007) and in the US (RECS-2005).....	3
Table 2: Winter Temperature Settings in Canada (SHEU-2007) and the US (RECS-2005):	9

1. Introduction

The amount of energy consumed by a typical Canadian household has historically been, on average, higher than that of a typical American household. Aside from obvious differences in climate that impact heating and cooling needs, other factors, such as those associated with the energy-related features of the typical dwelling and its installed technologies, likely play important roles in observed residential energy-use differences between these two neighbouring countries. In this study we use data from Canada's 2007 Survey of Household Energy Use (SHEU-07) and the 2005 and 2009 editions of the US Residential Energy Consumption Survey (RECS-05 and RECS-09) to draw comparisons of basic dwelling characteristics, heating and cooling system technologies and their use, and the ownership and use of household appliances and home electronics.

Both SHEU and RECS are occasional surveys that focus on the quantities of various types of energy used in the residential sector and on the main factors influencing energy consumption including, among several other details regarding the residences and residents, type of dwelling, building characteristics, installed heating and cooling technologies, types and use of household appliances, and the types and use of home electronics. Data collection for the most recent SHEU survey, SHEU-07, aimed at providing a representative sample of households residing in a variety of dwelling types in the 10 Canadian provinces; i.e., residents of Canada's 3 territories are not included (Office of Energy Efficiency, 2010). Similarly, the RECS surveys in the US are designed to be representative of households in all 50 states and the District of Columbia (Energy Information Administration, 2011).

In terms of comparisons, it should be kept in mind that, aside from occasional differences in the wording and scope of the questions asked in the two surveys, the timing of the surveys does not coincide, with the most recent Canadian survey data occurring midway between the two most recent US surveys. Furthermore, only partial results from RECS-2009 have been published to date. As a result, we have chosen to use the most recent RECS-09 results in our comparisons to SHEU-07 whenever possible, and to use RECS-05 data in cases where more recent data are not yet available. Unless otherwise noted, comparisons are based on RECS-09.

Although national averages are often presented in our comparisons, given the differences in climate both within and between the two countries, these comparisons at a national level are sometimes of limited usefulness. When making comparisons to basic dwelling characteristics and heating / cooling technologies, features that are influenced by weather and climate, we focus on comparisons of Canadian provinces / regions to the US Cold/Very Cold climate zone when using RECS-09 data and to Climate Zones 1 (and 2) when using RECS-05 data.¹ For household appliances and home electronics, where climate is less likely to play a role, comparisons are made on a national basis and/or to US census regions. The geographical delineations of the RECS climate and census regions are provided in Figures A1 – A3 of Appendix 1.

The structure of the remainder of this report is as follows. In Section 2 we provide a comparison of residential energy use in Canada and the US. Section 3 focuses on a set of basic dwelling characteristics. This is followed in Section 4 by an examination of heating and cooling technologies. Section 5 considers household appliances and home electronics, while Section 6 provides concluding remarks.

¹ Definitions and delineations of climate zones differ for RECS-09 and RECS-05. See Appendix 2 for details.

2. Household Energy Use

A comparison at the national level, presented in Table 1, suggests that Canadian households used energy more intensely than their American counterparts². This national level comparison masks considerable differences within both countries. Notably, households in Quebec and British Columbia both exhibited energy use that was below the US average. While the climate in the most highly populated areas of British Columbia may be a major contributing factor to lower energy use there, the reasons for the low energy intensity for Quebec households is not obvious.

Table 1: Energy Use per Household in Canada (SHEU-2007) and in the US (RECS-2005)

Country	Region						
Canada	ALL	Atlantic Region	Quebec	Ontario	Manitoba /Saskatchewan	Alberta	British Columbia
	105.9	114.7	94.7	106.5	115.4	129.9	96.9
US	ALL	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	
	100.1	124.4	121.3	107.3	80.6	76.4	

Notes:^a Units of measurement are GJ/household

^b US data are from Energy Information Administration (2009), and are converted from millions of BTUs to GJs using a conversion rate of 1 million BTUs = 1.05506 GJ

^c The 2005 RECS climate zones are Zone 1: Less than 2,000 CDD and Greater than 7,000 HDD; Zone 2: 5,500 to 7,000 HDD; Zone 3: 4,000 to 5,499 HDD; Zone 4: Fewer than 4,000 HDD; and Zone 5: 2000 CDD or More and Less than 4,000 HDD. The locations of these zones can be seen in Figure A2 in Appendix 1.

A comparison of Canadian household energy use to energy use by households in US Climate Zones 1 and 2, regions of the US with somewhat similar climatic conditions to those found in Canada, suggests that, with the exception of Alberta, Canadians used energy less intensely than their American neighbours. Albertan households, at an average of 129.9 GJ per household in 2007, had the highest intensity of energy use of any of the regions / zones considered.

² Although this comparison is not contemporaneous, Office of Energy Efficiency (2001) annual estimates of energy use per household show virtually identical intensities of energy use by Canadian households for 2005 and 2007.

3. Dwelling Features

In this section we examine a set of basic dwelling characteristics in Canada and the US. There are many dwelling features that will have an impact on energy use. Several of these features, such as construction materials and the types / amounts of insulation, will depend to a great extent on when the dwelling was constructed. Some of these features change as buildings are renovated. Windows in older houses and apartment buildings, for example, are unlikely to be those that were installed at the original construction date. Other characteristics, such as building type and size, both of which affect energy consumption, are generally fixed at the time of construction. Given the wide variety of structural components in a typical dwelling, it is not feasible to compare all of these in this report. We therefore use year of construction as a rough proxy for basic structural features. We use windows as a measure of one commonly retrofitted aspect of residential dwellings.

a) Year of construction

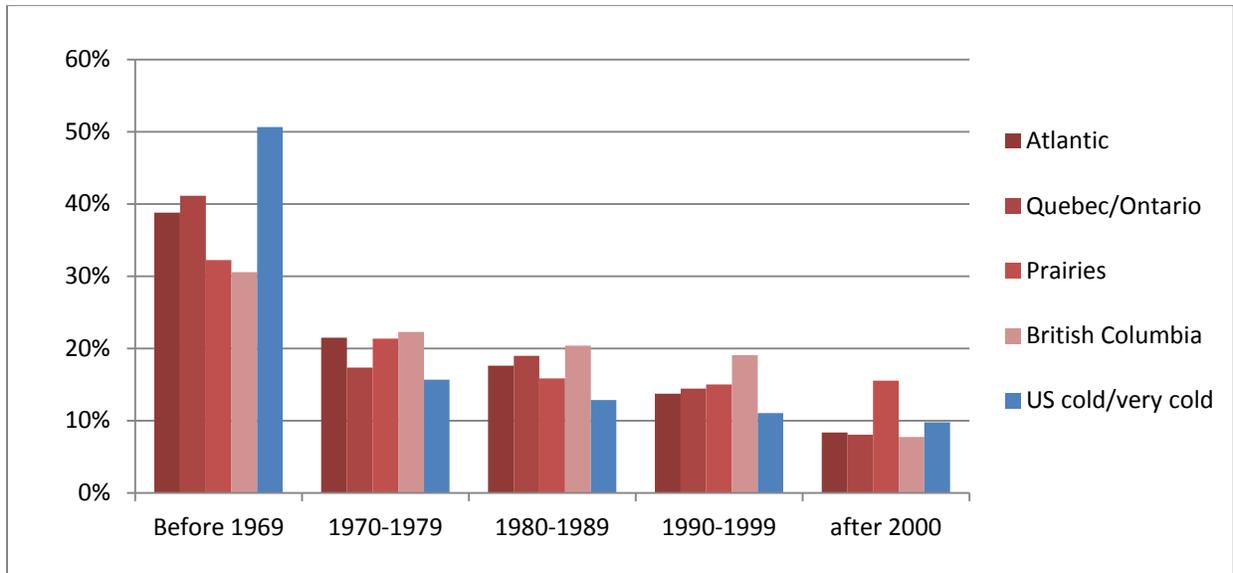
In the US, a somewhat larger proportion of dwellings (41%) than in Canada (38%), were built before 1970. Older vintage dwellings, unless they have been significantly upgraded, represent the least energy efficient portion of the housing stock, as they are more likely to embody outdated building and heating technologies and to be in a worse state of maintenance than their newer counterparts. On the other hand, the US also had a larger share of their housing stock that was constructed recently, and which is thus more likely to embody relatively more energy-efficient construction materials, as dwellings built during or after 1990 represented 28% of the 2009 US stock compared to 24% of the 2007 stock for Canada.³

A comparison across regions based on SHEU-07 and RECS-09, depicted in Figure 1, shows that Quebec and the Atlantic provinces had dwelling age distributions with relatively high proportions of older buildings, with approximately 40% of dwellings having been constructed prior to 1970. British Columbia and, to a much greater extent, Alberta had relatively high shares

³ Although the difference between Canada and the US is exaggerated here due to the different survey dates, the higher proportion of newer housing in the US is not completely attributable to this difference. According to the RECS-05 data, in 2005, 24% of the US housing stock had been constructed between 1990 and 2005. So, by 2007, the proportion built between 1990 and 2007 would be somewhat greater than 24%.

of newer buildings, with 27% and 40%, respectively, of households living in dwellings constructed during or after 1990. In the United States, the 2009 Cold/Very Cold region housing stock had an especially large share of dwellings built before 1970 (51%), and a relatively small share of more recent dwellings, with 21% built during or after 1990.⁴

Figure 1: Dwelling Vintages (year of construction), by Region



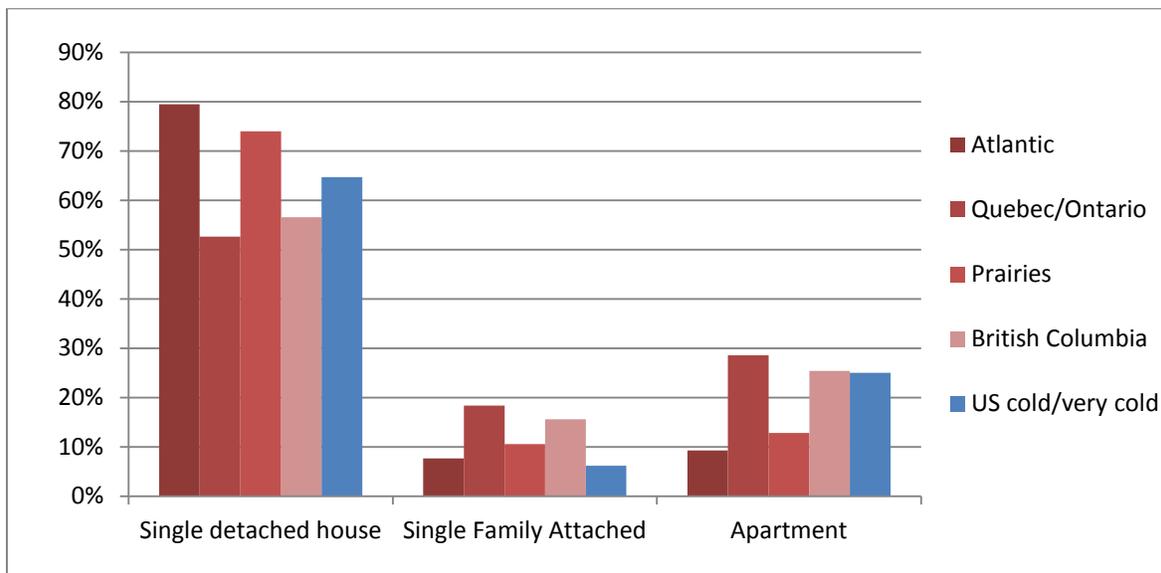
b) Type and size

Both the type and size of a dwelling impact household energy use, especially in cold climates where space heating constitutes a large proportion of energy use. Dwellings with shared walls will generally place less stress on heating systems due to the smaller number of outside walls per household. Office of Energy Efficiency (2011) data, for example, indicate that for Canada, in 2007, 66.5% of energy use in single detached houses was attributable to space heating, while for single attached houses this falls to 57.6%. This is partially due to the presence of shared walls in duplex style housing, and partially due to the generally larger living spaces in single detached homes, as larger dwellings will require more energy for heating purposes due to the increased amount of space that must be heated.

⁴ The RECS-05 data indicate that the proportions of pre-1970 dwellings in Zones 1 and 2 were 41 and 54%, respectively. The corresponding numbers for dwellings constructed during or after 1990 are 28 and 19%.

A larger percentage of US households lived in single family detached dwellings (63%) than in Canada (58%). There was significant variation within Canada, with more than 7 of 10 households in the Atlantic and Prairie regions living in single family dwellings. Not only were Canadian households more likely to live in a multifamily dwelling than those in the US, there were also differences in the composition of the multifamily subsector of the housing markets in the two countries. Duplex-type housing, also known as double, row or single family attached dwellings, constituted only 6% of US dwellings, compared to 16% of the Canadian housing stock. The proportions of households living in apartments were the same in both countries, at 25%.⁵ In general, as shown in Figure 2, the composition of the Canadian dwelling stock was quite similar to that found in the Cold/Very Cold US climate region.

Figure 2: Dwelling Types, by Region



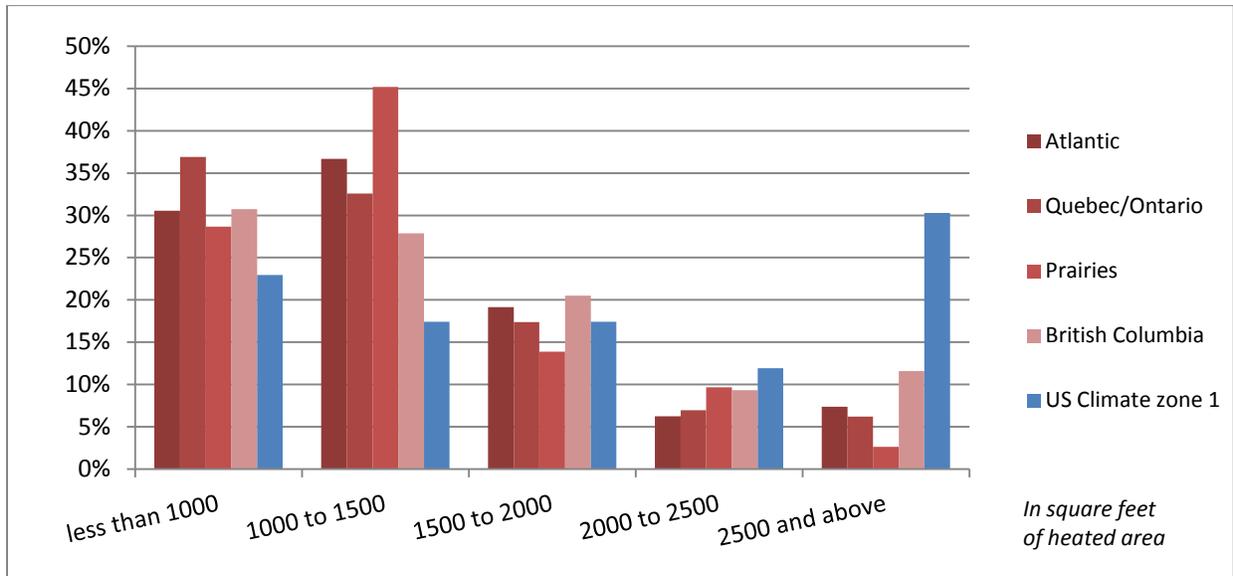
In both the SHEU and RECS surveys, information was gathered on dwelling size. In terms of heated area, US dwellings were larger on average than those in Canada.⁶ A higher proportion of Canadian dwellings had heated areas of less than 1500 sq ft than was the case in the US. There were also relatively more dwellings with at least 2000 sq ft heated areas in the US than in Canada. This pattern is especially evident when Canadian regions are compared with the US Climate Zone 1 (approximately the same as the Cold / Very Cold region), as shown in Figure 3,

⁵ Both surveys include low-rise and high-rise apartments.

⁶ RECS-05 data are used as the corresponding figures from RECS-09 were not available at the time of this report.

where 30% of dwellings had heated areas of at least 2500 sq ft. This is much higher than the highest Canadian rate, observed in British Columbia, where only 12% of the dwellings were this large. The proportions of smaller dwellings, under 1000 sq ft and between 1000 and 1500 sq ft, were smaller in US Climate Zone 1 than in any Canadian region.

Figure 3: Dwellings by Size Category, by Region



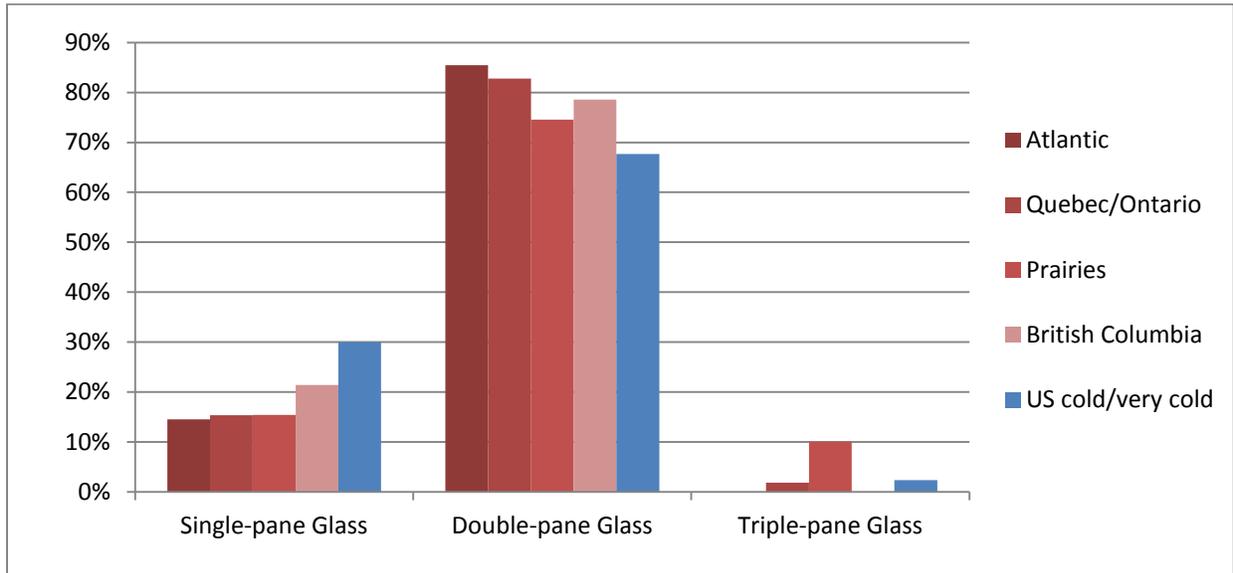
c) Windows

In Canada, most homes (80%) had double-pane windows in 2007, while 16% had single-pane glass.⁷ Only a small proportion of dwellings, 4%, used triple-pane glass. As seen in Figure 4, the percentage of households using double-pane glass windows did not vary much across regions, with the exception of Manitoba and Saskatchewan where a large number of households (26%) used triple-pane windows. In the US, double-pane windows were less commonly used, as only 57% of dwellings had double-pane windows while 42% used single-pane glass in 2009. The observed differences between Canada in the US are easily attributable to weather conditions, where Canadian dwellings typically need better insulation from cold temperatures than in the United States. In the US Cold/Very Cold climate region, almost 30% of households had single-

⁷ There is a high non-response rate for the window question in the SHEU-07 survey.

pane windows and two-thirds of dwellings had double-pane glass. This higher (lower) rate of use of single (double) pane windows in the coldest parts of the US indicates that window insulation was typically better in Canada.

Figure 4 : Window Types, by Region



4. Heating and Cooling Technologies

a) Space Heating

Space heating constitutes a major end-use of residential energy in Canada and in the colder regions of the US. There are many facets to space heating, including equipment type, equipment age, energy source and the extent to which the heating technologies are used (temperature settings). Here we present a few basic comparisons based on temperature settings, age of the main heating equipment, fuel choices, and the use of secondary heat sources.

Table 2: Winter Temperature Settings in Canada (SHEU-2007) and the US (RECS-2005): Proportion of households with temperature set below 21 C° by region / climate zone^a

Country	Region						
	Atlantic Region	Quebec	Ontario	Manitoba /Saskatchewan	Alberta	British Columbia	ALL
Canada	<i>Somebody at home and awake</i>						
	0.57	0.42	0.39	0.41	0.48	0.54	0.45
	<i>While sleeping</i>						
	0.87	0.71	0.72	0.76	0.87	0.88	0.76
US	Zone 1	Zone 2					
	<i>Daytime: somebody at home</i>						
	0.51	0.45					
	<i>Night time: while sleeping</i>						
	0.78	0.63					

NOTES:^a The 2005 RECS climate zones are Zone 1: Less than 2,000 CDD and Greater than 7,000 HDD; Zone 2: 5,500 to 7,000 HDD; Zone 3: 4,000 to 5,499 HDD; Zone 4: Fewer than 4,000 HDD; and Zone 5: 2000 CDD or More and Less than 4,000 HDD. The locations of these zones can be seen in Figure A2 in Appendix 1.

Information is available from SHEU-07 and RECS-05 on winter temperature settings both during the day (when somebody is at home) and at night while sleeping. Given the differences in temperature ranges in the questionnaires and the choice of measurement scale (Celsius for

Canada, Fahrenheit for the US), we compare the proportions of households who set temperatures above/below 21 C° (70 degrees F°). As shown in Table 2, about 45% of Canadians set temperatures below 21 C° when at home and awake. This proportion is slightly lower than settings observed for Americans in Climate Zone 1, and virtually identical to those in Climate Zone 2. There was significant variation across Canada though, with the highest proportions of households setting relatively low temperatures during the day found on the East and West coasts. Approximately 3 out of 4 Canadian households set temperatures below 21 C° while sleeping, which is comparable to the proportion in the coldest US Climate Zone. As with daytime temperature settings, the highest proportions of households within Canada that set relatively low sleeping temperatures were found on the two coasts.

In terms of age distributions of the main heating equipment used, households in the two coldest US climate zones tended to have newer main furnaces than in Canada, with almost 1 in 4 units bought within the 4 years prior to the RECS-05 survey. In comparison, about 1 in 5 furnaces was purchased within the 5 years previous to SHEU-07.⁸ There was significant variation across provinces though, with Quebec having the lowest rate of new furnace ownership (11%), and Alberta having the highest rate (29%).

Note that 43% of Canadian households had supplementary heating equipment (such as fireplaces, wood stoves, and portable heaters) that was used in conjunction with their main heating equipment. About 32% of U.S households used supplementary heating equipment in 2005. According to RECS-09, most secondary heating equipment was fuelled by electricity. Wood was also a frequently used fuel for secondary source space heating, likely used in fireplaces and wood-burning stoves.

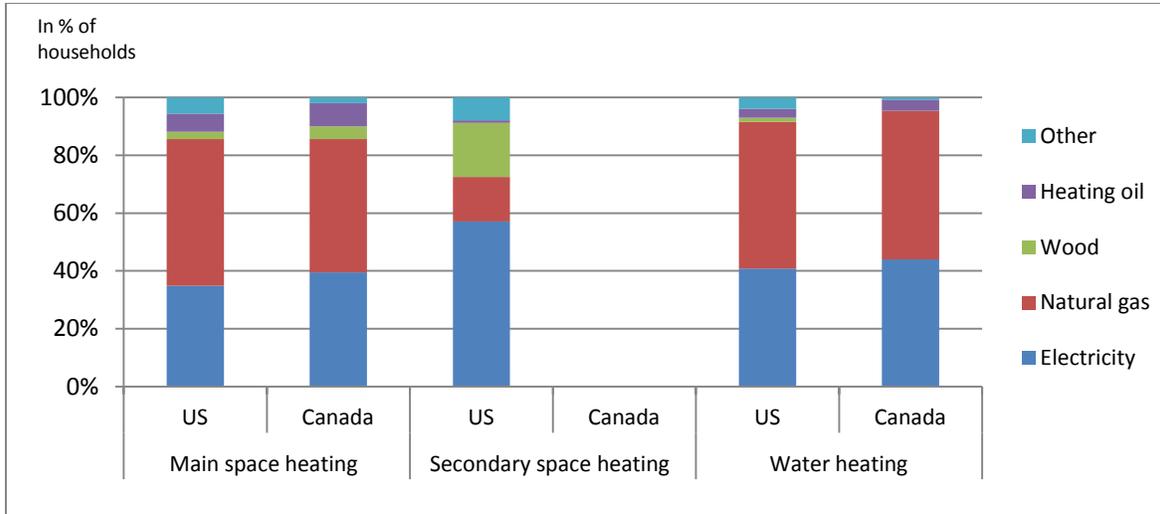
Regarding energy sources, illustrated in Figure 5, 40% of Canadian households used electricity as the main heating source for their dwellings according to SHEU-07.⁹ Another 46% of Canadian households used natural gas, 8% used heating oil and 4% used wood. A small

⁸ For approximately one quarter of Canadian households in SHEU-07, the age of the main heating equipment was either not known or not stated. Given that respondents are more likely to know the age of recently purchased items, it is assumed that the numbers in the 5 years or less age category are accurate.

⁹ Figure 5 also provides a comparison of fuels used for water heating. At the national level there are only minor differences between Canada and the US, with about 50% of households using natural gas and 40% using electricity. Regional differences also exist, given that natural gas was not available in all areas.

proportion (2%) used propane or another energy source. Compared to Canada, according to RECS-05, more US households used natural gas and other sources of energy to heat their dwellings and fewer used electricity.¹⁰ Natural gas was the main heating fuel for 49% of US households, while 34% used electricity. Heating oil was used by 6% of American households and wood by 2%.

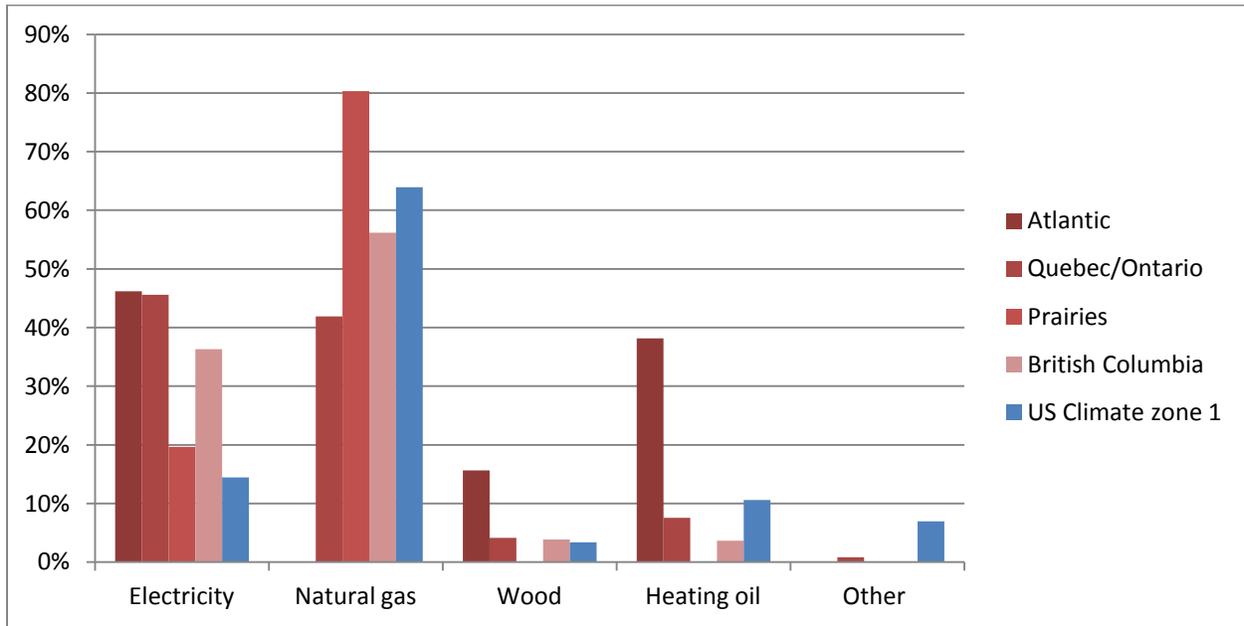
Figure 5 : Source of Energy for Space and Water Heating



Regional breakdowns of energy sources for main residential heating equipment are provided in Figure 6. In the Atlantic region, where natural gas has only recently begun to become available for residential heating, 46% of households used electricity, 38% of households used heating oil, and the rest used wood. Households in Manitoba, Saskatchewan and Alberta used either electric or natural gas heat, with the largest rate of natural gas use (88%) occurring in Alberta. In US Climate Zone 1, the use of natural gas predominated, providing heat for 64% of households. Electricity provided heat for 14% of households and heating oil for 11% in this region. Other sources of heating, primarily propane, are used by 7% of the households in the coldest (Climate Zone 1) region, whereas they are not often used in Canada.

¹⁰ RECS-05 data are used here as the corresponding figures for 2009 were not available at the time of this report.

Figure 6 : Energy Sources for Main Heating Equipment, by Region



b) Air Conditioning

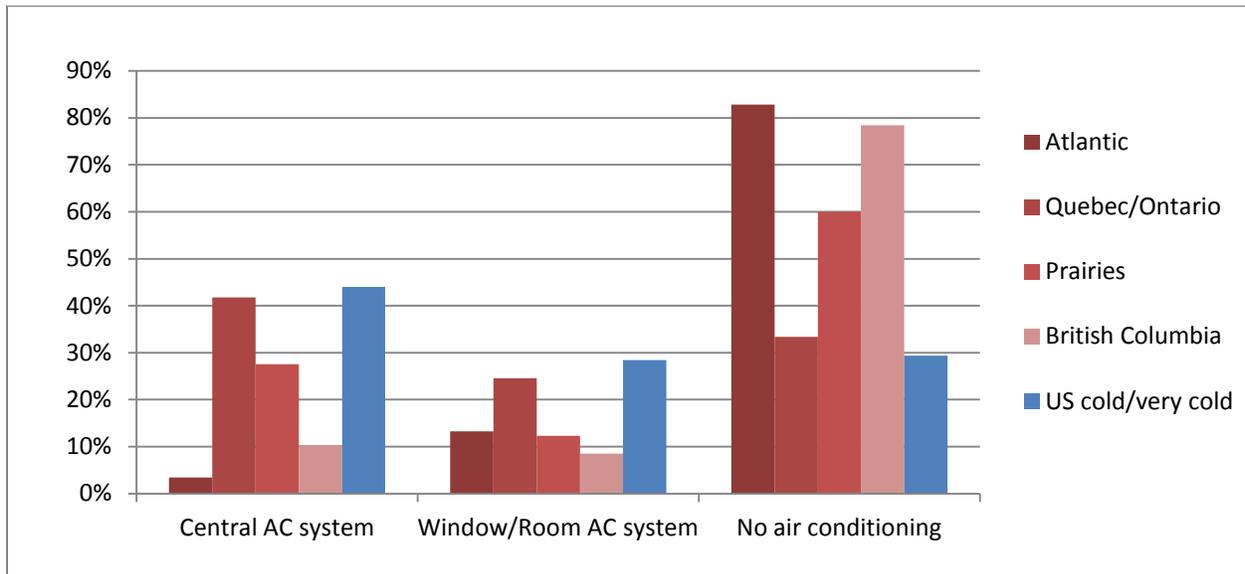
In Canada, 52% of households had an air-conditioning system in 2007, but there was considerable variation across regions, as depicted in Figure 7. The lowest rates of air-conditioning ownership were found in the Atlantic Provinces, British Columbia and Alberta, where only about 1 in 5 dwellings were equipped with air conditioning (17%, 19%, and 20% of households, respectively). The highest rate was in Ontario, with 4 out of 5 dwellings air-conditioned. About 70% of homes in Manitoba/Saskatchewan, and almost one-half of homes in Quebec, had air-conditioning. Nationwide, about 62% of the air-conditioning systems were central, with the highest proportions of central systems found in Ontario and Alberta (70%).

In the United States, with its generally warmer and more varied climate, 84% of households had an air-conditioning system in 2005, and almost all of these households actually used the system that was in place.¹¹ In Climate Zone 1, which corresponds approximately to the RECS-09

¹¹ Data from RECS-05 are used as the corresponding figures for 2009 were not available at the time of this report. Questions in the US Surveys separately identified ownership and use of an air conditioning system.

Cold/Very Cold region, the rate of air-conditioner use was much lower, at about 70%. Even this was higher than in Canada. Air-conditioning use in Ontario was about equal to that found the US Climate Zone 2, where 80% of households used air-conditioning. On average, about 70% of the U.S households with air-conditioning used a central system, which was slightly higher than in Canada. However, in Climate Zone 1, the percentage was 62%, matching up almost identically with the Canadian average.

Figure 7 : Air-Conditioning Systems, by Region



5. Household Appliances and Home Electronics

While many basic housing features, such as windows and heating systems, are greatly influenced by local climate weather conditions, the selection and use of most household appliances and home electronics components are less likely to be sensitive to outdoor temperatures. In this section, therefore, comparisons of Canada to the US are made at the national level and, when looking at regional differences, by Census regions.¹²

a) Refrigerators and Freezers

In both Canada and the US, refrigerators were present in almost all homes. Furthermore, a large percentage of refrigerators were of recent vintage at the time of the SHEU-07 and RECS-09 surveys. In Canada, 41% of refrigerators had been purchased within 5 years of the survey.¹³ In the US, 35% of the refrigerators had been bought within 4 years of the survey. In both countries, about 10% of main refrigerators had not been replaced within 15 years of the survey date. This proportion was slightly higher, at 12%, in the Midwest and Northeast regions of the US, as well as in Quebec and Manitoba/Saskatchewan. The rate of penetration of Energy Star® refrigerators was also comparable, with evidence of a slightly higher rate in Canada.¹⁴ As shown in Figure 8, about 39% of Canadian households were known to be using Energy Star® refrigerators in 2007, while the rate in RECS-09 was 37%.

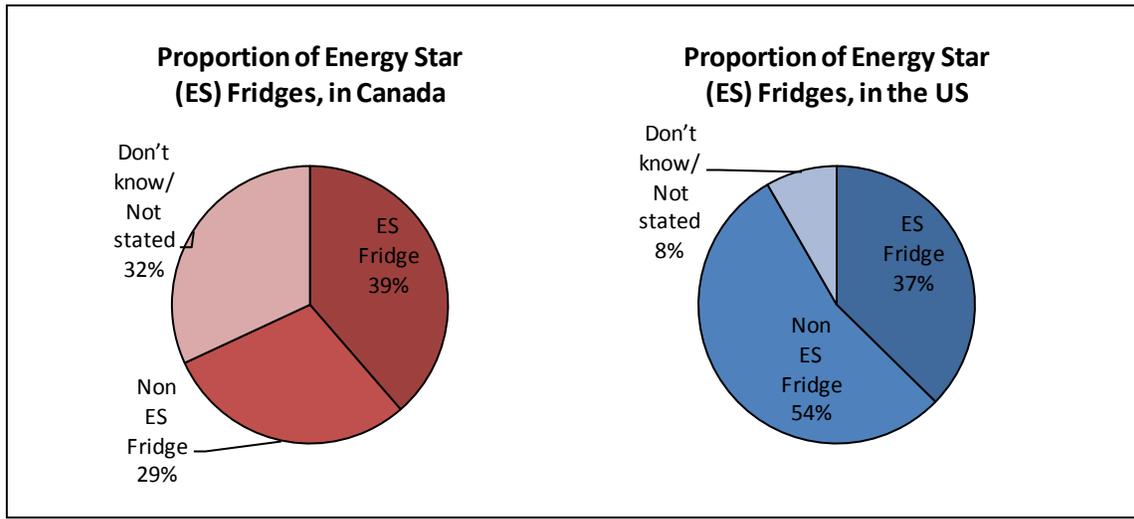
The use of separate stand-alone freezers appears to be more popular among Canadians than Americans. In Canada, 63% of household used separate freezers. In the US, the corresponding number was only 30%. In both countries, the age distributions were such that stand-alone freezers were on average older than refrigerators.

¹² For delineations of the US census zones, see Figure A3 in Appendix 1.

¹³ For approximately 10% of Canadian households, the refrigerator age was unknown or was not stated. Given that households are more likely to know the age of a recently acquired appliance, it is assumed that the number of refrigerators with ages of 5 years of less provides an accurate reflection of this age group.

¹⁴ The Energy Star status of the main refrigerator was either unknown or not stated for almost 1/3 of households in SHEU-07.

Figure 8: Proportions of Energy Star® Refrigerators, by Country



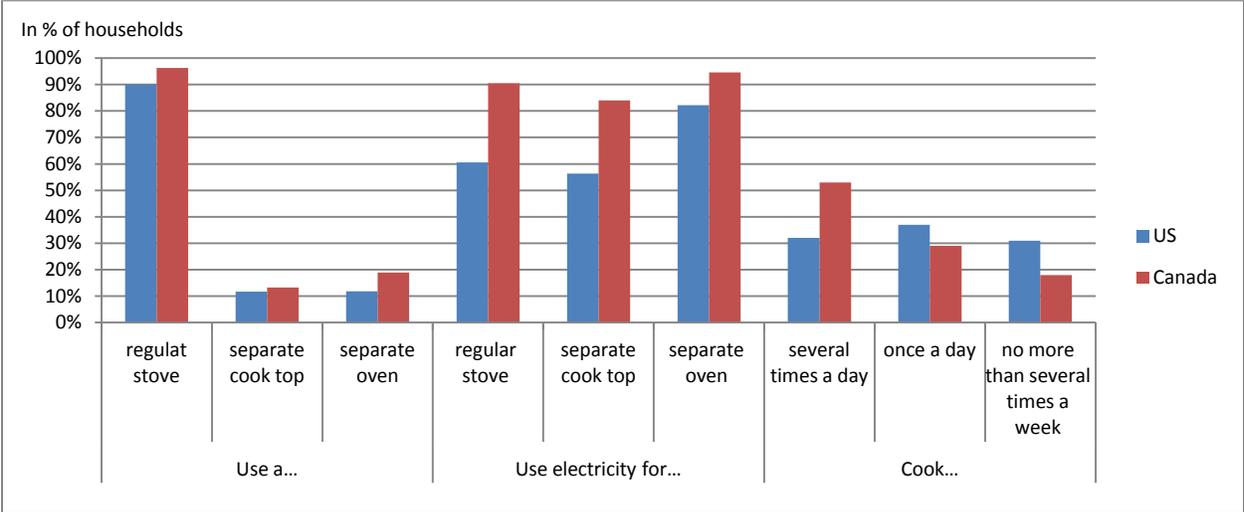
b) Stoves and Microwaves

In both Canada and the US, 95% of households used microwave ovens. More than 96% of Canadians owned a regular stove (defined as a unit with both an oven and a cook top). In the US, the percentage was slightly less, at 90%, although there were regional differences in ownership, with only 84% of households in the West census region using a stove. Several details regarding cooking equipment and use are provided in Figure 9.

At the national level, 90% of Canadian households had electric regular stoves, while 6% used natural gas, and 2% used both. A small number of households used propane. Users of separate cook tops used electricity in 84% of cases and users of built-in ovens used electricity in 94% of the cases. The remaining households used natural gas. In the US, electric stoves were less popular with only 60% of regular stoves fuelled by electricity. For other cooking equipment, 56% of separate cook tops and 82% of separate ovens used electricity. Regional differences were apparent in the US. In the Northeast and West census regions, natural gas use was about equal to electricity use for regular stoves and separate cook tops. Separate ovens are mainly powered by electricity in all four US census regions. The published SHEU-07 data on energy sources for cooking equipment is incomplete at the provincial level, with many missing values and/or values that are not deemed to be sufficiently reliable to be published.

In Canada, 32% of households cooked two times a day in 2007, and 21% did so more often. Cooking at home was less frequent for many households, with 29% of households cooking only once a day and 18% cooking no more than several times a week. In the US, patterns were different with more households cooking only once a day (37%) or only several times a week (32%). A smaller proportion of households cooked two times a day (24%) or more often (8%). When looking at provincial data, household cooking behaviour in Ontario was similar to that in the US, with more households cooking once a day than two times a day. For all other provinces, the proportions followed the same ordering as was observed at the national level. In the US, only the South census region exhibited a different ordering than at the national level, with more households cooking several times a week rather than two times a day.

Figure 9 : Cooking Equipment in Canada and the US



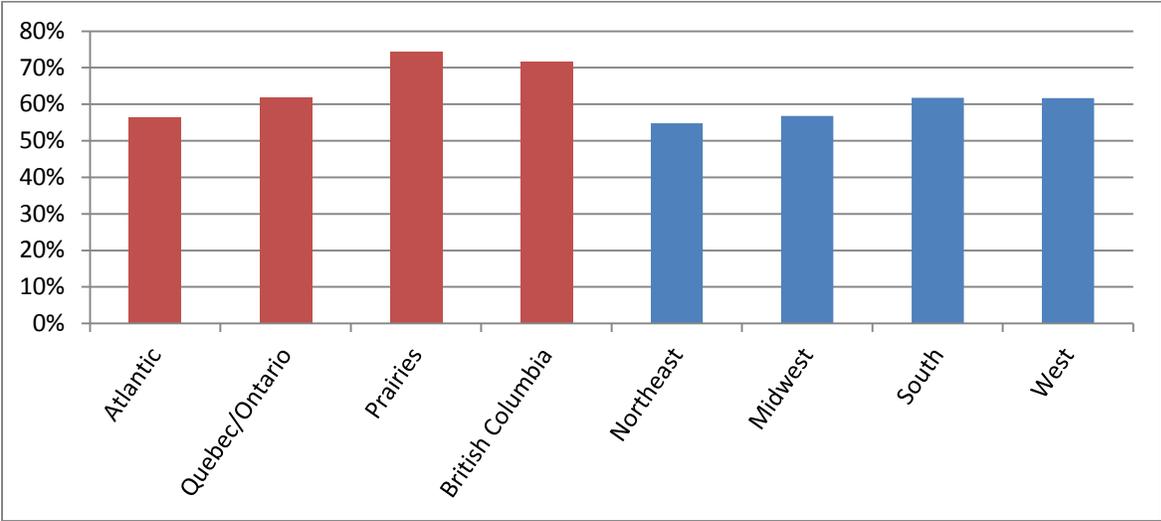
Overall, the results indicate that Canadian households owned more cooking equipment than their American counterparts. They also tended to use electricity as their main source of fuel whereas American households, though they predominately opted for electricity, did a larger share of their cooking with natural gas. Finally, Canadian households used their cooking appliances more frequently than American households.

c) Dishwashers

On average, 65% of Canadian household used dishwashers in 2007, with a much higher proportion in Alberta (81%) and a much lower proportion in the Atlantic region (57%). The rate

of dishwasher ownership in the Atlantic region is similar to that at the national level in the US, where about 59% of households owned a dishwasher. From Figure 10, it can be seen that there were smaller differences in dishwasher ownership rates across US census regions than across Canada. In both countries, more than 70% of dishwashers had been purchased within ten years of the respective surveys, with no large provincial/regional differences. In Canada, almost half of the dishwashers were bought during the 5 years preceding the survey, and in the US 37% of the dishwashers were purchased within 4 years of the survey. The penetration of Energy Star® dishwashers was virtually identical in Canada and the US at about 40% of dishwashers in use.¹⁵

Figure 10 : Proportion of Households that use a Dishwasher, by Region



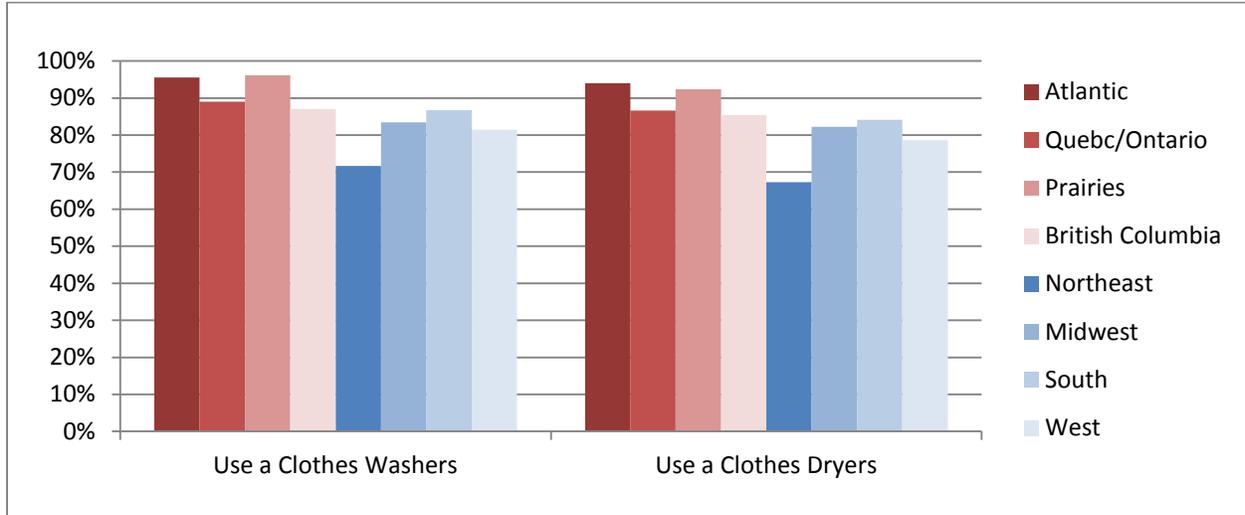
d) Clothes Washers and Dryers

The use of an in-home clothes washer was also more common among Canadian households than among their counterparts in the US. In Canada, as depicted in Figure 11, the rate of ownership was 90% at the national level and at least 87% in each province/region. In the US, 82% of households had a clothes washer, with the proportion falling to 72% in the Northeast census region. Over 80% of the clothes washers in both countries were bought within 15 years of the

¹⁵ Calculated as the ratio of dishwashers known to be Energy Star® units to the total number of dishwashers.

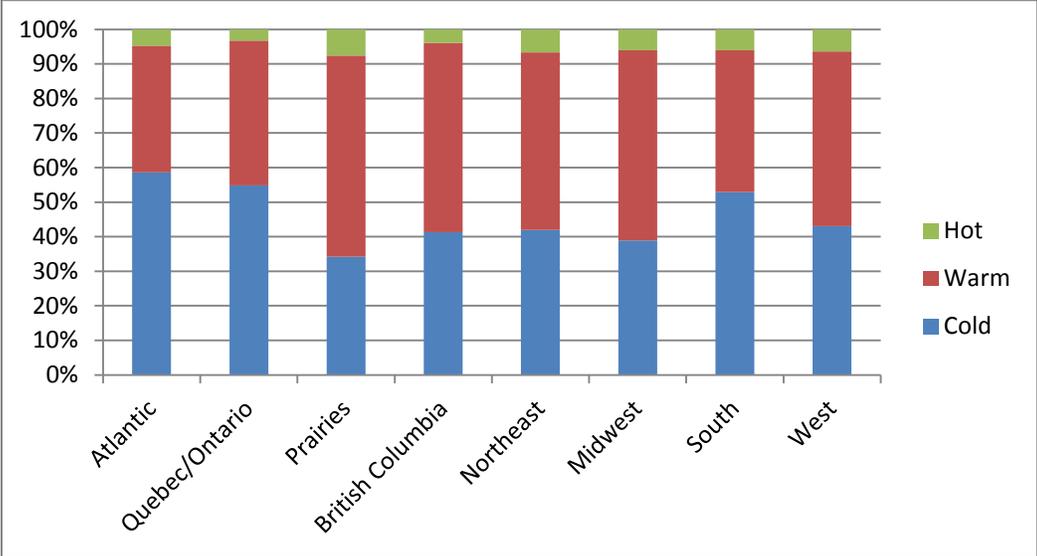
surveys, with about 70% of them purchased within 10 years. About 40% of the clothes washers in Canada in 2007 and 44% in the U.S in 2009 were declared to be Energy Star products.

Figure 11 : Proportions of Households using Clothes Washers and Dryers, by Region



How Canadian and American households operated their clothes washers, in terms of the choice of hot, warm or cold water, was fairly similar at the national levels. In Canada, 50% of households used cold water for most of their washing cycles while 46% used warm water, with the remaining households opting for hot water. Warm and hot water use in the US was slightly more common at 48% and 6% of households, respectively, while a smaller percentage of Americans (46%) than Canadians opted for cold water use. Regional differences existed within each country, as shown in Figure 12. In the Atlantic region and in Quebec, households used cold water more frequently than warm water, but in other provinces warm water was used more frequently than cold water. In the South census region, American households were the least likely to use cold rather than warm water. The highest rate of hot water use was found in the Canadian prairies and in the US Northeast.

Figure 12 : Temperature used Most Often for Washing Clothes, by Region



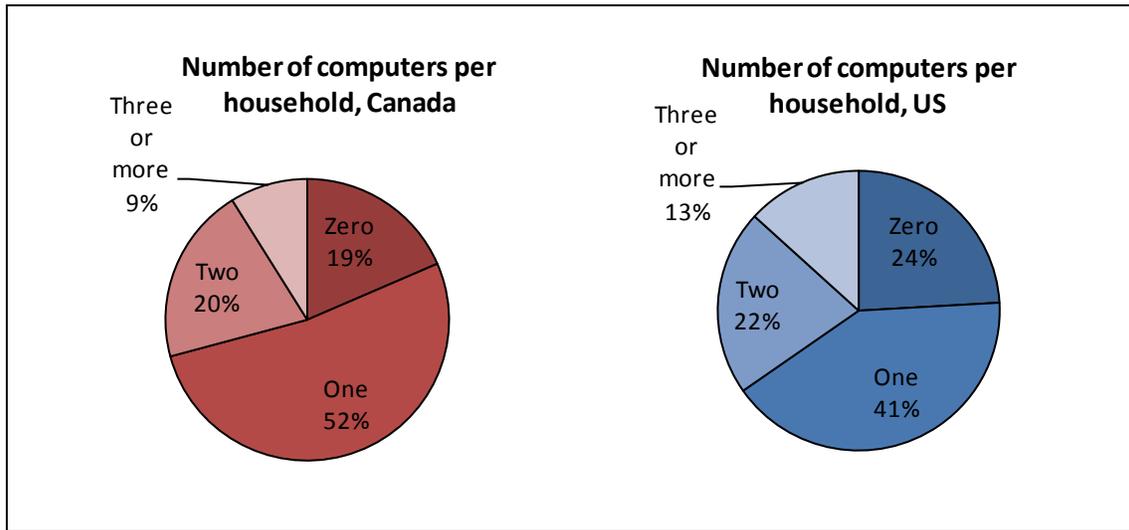
In Canada, approximately 9 out of 10 of households used in-home (not including those located in common areas of apartment buildings) clothes dryers, compared to about 4 out of 5 US households. Regional breakdowns are provided in Figure 11. Canadian households in British Columbia and Ontario were less likely to have an in-home dryer (85%), while the ownership rate was highest (more than 94%) among households in Alberta and the Atlantic region. In the US, the lowest proportion of households using a clothes dryer at home was found in the Northeast census region (67%) Although the use of an in-home clothes dryer could be thought to be related to weather conditions, as it is more difficult to dry clothes naturally in a colder environment, regional differences in the use of a dryer in Canada and especially in the US do not appear to support this hypothesis. The age distribution of clothes dryers was similar across the two countries, with about 40% of dryers purchased within the 5 (4 for the US) years preceding the survey. Approximately 10% of US and 12% of Canadian clothes washers had not been replaced during the 15 years preceding the respective surveys.

e) Personal Computers and Televisions

In Canada, more households were equipped with at least one computer than in the US (Figure 13). However, US households were more likely to own more than one computer. The highest rates of computer ownership in Canada were in Ontario (85%), Alberta (86%) and BC (87%). Alberta was the province with the highest proportion of households using two or more computers

(36%). In the U.S., the West census region had a significantly higher proportion of households with one computer (at 81%), while the South had the highest proportion of households with three computers or more.

Figure 13: Computers per Household



In both Canada and the US, almost all households had at least one television. In 2007, more than 3 of 5 Canadian households owned more than one TV: 36% of households had two TVs, and 27% had more than two. The presence of multiple televisions in a household was even more common in the US in 2009, at more than 7 out of 10 households, with 33% of residences having two televisions and 44% having three or more. The proportion of households using four or more TVs was 21% in the US, while only 9% in Canada.

The use of DVD players and home theatre systems was much higher in Canada than in the US. In 2007, 84% of Canadian households used a DVD player and 27% had a home theatre system. Alberta's proportion of households using a home theatre system, 32%, was larger than in any other region of Canada. Only about one half of US households had a DVD player in 2009, and less than 20% of residences were equipped with a home theatre system. The highest rates of ownership of these two devices in the US were in the West census region, but even these rates were not much different from the national averages at 53% and 21%, respectively.

6. Concluding Remarks

In this report, a variety of features of residential dwellings and installed technologies (heating and cooling equipment, household appliances, home electronics) that influence the consumption of energy at the household level are compared between the United States and Canada. Although the timing of the Canadian and American surveys does not coincide, and there are differences in the details of the questions asked of survey participants, this comparison provides some insight into observed differences in residential energy use in the two countries.

Even though energy use per household was higher in Canada than in the US, with the exception of Alberta it was lower than in the two coldest American climate zones. Part of these differences might be attributable to differences in the age distribution of dwellings. In the U.S, a larger share of dwellings were built more than 40 years prior to the most recent survey, resulting in proportionally more older (and probably less energy efficient) dwellings in the U.S. than in Canada. Furthermore, American households were more likely to live in single detached houses with single pane windows, and their residences were on average larger than those of the typical Canadian. Larger heated areas and fewer shared walls (leading to heat loss) lead to higher energy requirements, especially in cold regions.

A comparison of heating equipment characteristics between Canada and the climate zones in the US where space heating is a primary concern shows that, with the exception of (mainly) provinces on the west and east coasts, Canadians were less likely to choose relatively low indoor temperature settings than in the coldest US climate zone. Furthermore, the main heating equipment used by Canadian households was less likely to be of the most recent vintage (with the exception of homes in Alberta) than in the two coldest US climate zones. Households in both countries used electricity and natural gas as their main sources for space and water heating. Although space heating was primarily provided by natural gas in both countries, the share of households using electricity for their main heating equipment was far larger in Canada than in the US.

Given the more diverse climate in the US, American households were more likely to be equipped with air-conditioning systems than those in Canada, with a larger share of these systems being

central systems. Although households in the coldest US climate zones had higher ownership rates of air-conditioning equipment than in Canada, ownership rates in Manitoba/Saskatchewan and Ontario were found to be comparable to corresponding rates in these US climate zones.

In terms of other household technologies, Canadians tended to own more appliances than their American counterparts. Appliance ownership rates for some appliances, in particular microwaves and refrigerators, were similar in the US and Canada. However, ownership rates were higher in Canada for stand-alone freezers, stoves and dishwashers. The higher ownership rates for these particular appliances are likely related to the greater tendency of Canadian households to cook at home. Canadians were also more likely to own at least one computer, and to own DVD players and home theatre systems. On the other hand, American households were more likely to own multiple TV sets and computers. Within Canada, Alberta's high rate of appliance and electronics use, along with its severe winter climate, may have played an important role in the high energy intensity of its households compared both to other Canadian households and to those in the US.

References

Natural Resources Canada, Office of Energy Efficiency (2010), *Survey of Household Energy Use 2007: Detailed Statistical Report*, Ottawa: Natural Resources Canada.

Natural Resources Canada, Office of Energy Efficiency (2011), *Energy Efficiency Trends Analysis Tables*, Ottawa: Natural Resources Canada. Available at:
http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/analysis_ca.cfm

United States Energy Information Administration (2009), “2005 Residential Energy Consumption Survey: Summary Statistics”, Available at
<http://www.eia.doe.gov/emeu/recs/recs2005/c&e/summary/pdf/alltables1-15.pdf>

United States Energy Information Administration (2011), “How does EIA estimate energy consumption and end uses in US homes?”, Available at
<http://www.eia.doe.gov/consumption/residential/methodology/2009/brief.cfm>

Appendix 1: United States RECS Climate and Census Regions

Source: RECS Methodology, <http://www.eia.gov/consumption/residential/methodology/index.cfm>.

FIGURE A1: Building America Climate Regions -- RECS 2009

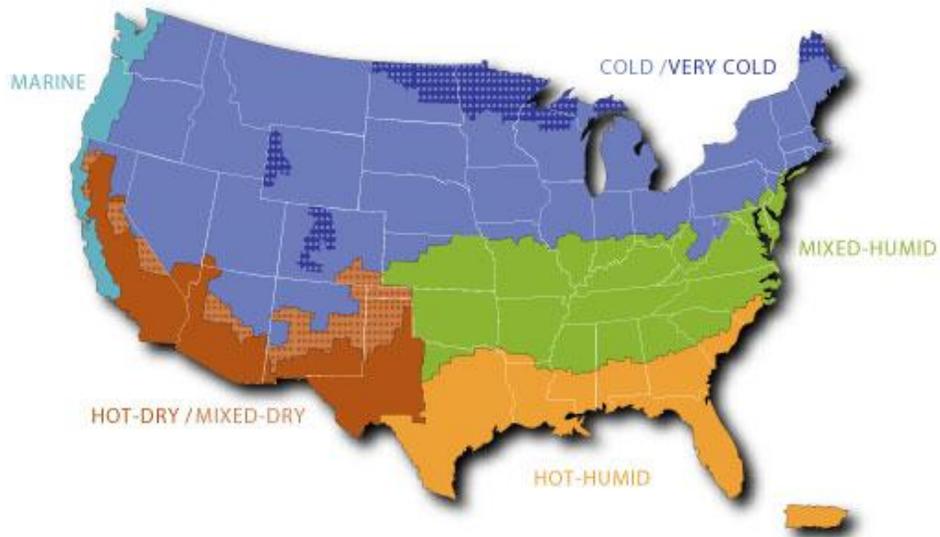


FIGURE A2: AIA Climate Zones -- RECS 1978-2005

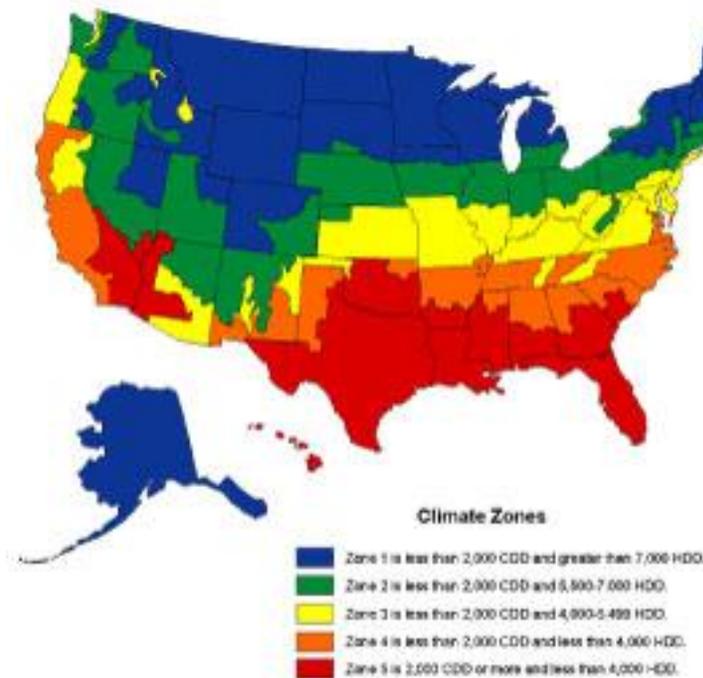
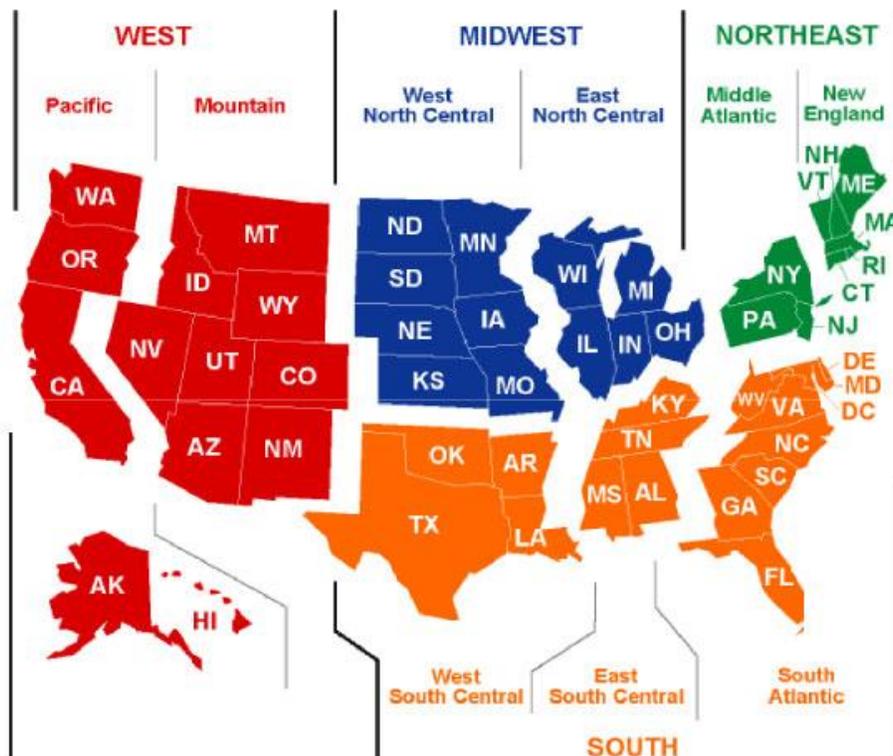


FIGURE A3 Census Regions & Divisions



Appendix 2: Definition of Climate Regions used in RECS-09, by *Building America*.

Source: Building America - Resources for Energy Efficient Homes, Climate Regions, http://www1.eere.energy.gov/buildings/building_america/climate_zones.html

Hot-Humid

A hot-humid climate is generally defined as a region that receives more than 20 in. (50 cm) of annual precipitation and where one or both of the following occur:

- A 67°F (19.5°C) or higher wet bulb temperature for 3,000 or more hours during the warmest 6 consecutive months of the year; or
- A 73°F (23°C) or higher wet bulb temperature for 1,500 or more hours during the warmest 6 consecutive months of the year.

Mixed-Humid

A mixed-humid climate is generally defined as a region that receives more than 20 in. (50 cm) of annual precipitation, has approximately 5,400 heating degree days (65°F basis) or fewer, and where the average monthly outdoor temperature drops below 45°F (7°C) during the winter months.

Hot-Dry

A hot-dry climate is generally defined as a region that receives less than 20 in. (50 cm) of annual precipitation and where the monthly average outdoor temperature remains above 45°F (7°C) throughout the year.

Mixed-Dry

A mixed-dry climate is generally defined as a region that receives less than 20 in. (50 cm) of annual precipitation, has approximately 5,400 heating degree days (65°F basis) or less, and where the average monthly outdoor temperature drops below 45°F (7°C) during the winter months.

Cold

A cold climate is generally defined as a region with approximately 5,400 heating degree days (65°F basis) or more and fewer than approximately 9,000 heating degree days (65°F basis).

Very-Cold

A very cold climate is generally defined as a region with approximately 9,000 heating degree days (65°F basis) or more and fewer than approximately 12,600 heating degree days (65°F basis).

Marine

A marine climate is generally defined as a region that meets all of the following criteria:

- A mean temperature of coldest month between 27°F (-3°C) and 65°F (18°C)
- A warmest month mean of less than 72°F (22°C)
- At least 4 months with mean temperatures more than 50°F (10°C)
- A dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.

CBEEEDAC

Department of Economics

University of Alberta

8-14 Tory Building

Edmonton, Alberta

Canada

T6G 2H4

COPYRIGHT © 2011

Use of materials and information

This publication is protected by copyright; it may be reproduced in unaltered form for personal, non-commercial use. Selected passages and other extracts from this publication may also be reproduced, as long as appropriate credit is granted and CBEEEDAC is acknowledged as the source. All other rights are reserved. CBEEEDAC will not be liable for any loss, damage, cost or expense incurred in or arising by reason of any person relying on the information in this publication.