



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

## **Energy Use for Residential Water Heating for Dishwashers and Clothes Washers**

**Ronggui Liu**

**April 2007**

**CBEEEDAC 2007–RP-02**

### **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 CBEEEDAC, including Natural Resources Canada.

## **Executive Summary**

EnerGuide is a Government of Canada initiative that rates energy consumption and efficiency of household appliances, heating and ventilation equipment, air conditioners, houses and vehicles. The annual energy consumption reported in the EnerGuide takes into account the energy required to heat water for appliances that utilize hot water – such as dishwashers and clothes washers. In this paper, energy consumption from domestic hot water usage in Canada is briefly reviewed, and information on dishwashers and clothes washers in use in Canada, obtained from the 2003 Survey of Household Energy Use, is summarized. Energy and water consumption for these two appliances is also evaluated using information from the United States Department of Energy.

## Table of Contents

Executive Summary .....	i
List of Figures .....	iii
List of Tables .....	iv
1. Introduction .....	1
2. Residential Water Heating in Canada .....	1
2.1 Water Heater Fuel Type Distribution .....	2
3. Water Heater Energy Efficiency .....	4
4. Dishwashers .....	6
4.1 Distribution Statistics .....	6
4.2 Energy and Water Consumption for Dishwashers .....	9
5. Clothes Washers .....	16
5.1 Distribution Statistics .....	16
5.2 Energy and Water Consumption for Clothes Washers .....	21
6. Energy Conservation Tips for Residential Hot Water Usage .....	25
7. Conclusions .....	28
References .....	29
Appendix: Figures .....	30

## List of Figures

Figure 1: Percentage Fuel Type Distribution .....	30
Figure 2: Type of Fuel Used to Heat the Running Water - Newfoundland and Labrador ....	30
Figure 3: Type of Fuel Used to Heat the Running Water – Prince Edward Island .....	30
Figure 4: Type of Fuel Used to Heat the Running Water – Nova Scotia .....	31
Figure 5: Type of Fuel Used to Heat the Running Water – New Brunswick .....	31
Figure 6: Type of Fuel Used to Heat the Running Water – Quebec .....	31
Figure 7: Type of Fuel Used to Heat the Running Water – Ontario .....	32
Figure 8: Type of Fuel Used to Heat the Running Water – Manitoba .....	32
Figure 9: Type of Fuel Used to Heat the Running Water – Saskatchewan .....	32
Figure 10: Type of Fuel Used to Heat the Running Water – Alberta .....	33
Figure 11: Type of Fuel Used to Heat the Running Water – British Columbia .....	33
Figure 12: Type of Clothes Washer - Newfoundland and Labrador .....	33
Figure 13: Type of Clothes Washer – Prince Edward Island .....	34
Figure 14: Type of Clothes Washer – Nova Scotia .....	34
Figure 15: Type of Clothes Washer – New Brunswick .....	34
Figure 16: Type of Clothes Washer – Quebec .....	34
Figure 17: Type of Clothes Washer – Ontario .....	35
Figure 18: Type of Clothes Washer – Manitoba .....	35
Figure 19: Type of Clothes Washer – Saskatchewan .....	35
Figure 20: Type of Clothes Washer – Alberta .....	35
Figure 21: Type of Clothes Washer – British Columbia .....	36
Figure 22: Type of Clothes Washer – Canada .....	36

## List of Tables

Table 1: Ownership of A Hot Water Tank .....	2
Table 2: Type of Fuel Used to Heat Running Water .....	3
Table 3: Water Heating Fuel Type Distribution .....	3
Table 4: Natural Gas and Electricity Prices .....	4
Table 5: Energy Factors for Different Water Heating Systems Defined by the HOT2000 Program .....	5
Table 6: Ownership of a Dishwasher .....	6
Table 7: Distribution of the Size of the Dishwasher .....	7
Table 8: Age Distribution of Dishwasher .....	8
Table 9: Percentage of Age Distribution for Dishwasher .....	8
Table 10: Dishwasher is an Energy Star Qualified Product .....	9
Table 11: Dishwasher Classification .....	10
Table 12: Energy and Water Usage per Cycle - Standard Dishwasher .....	12
Table 13: Energy and Water Usage per Cycle – Compact Dishwasher .....	12
Table 14: Energy Use per Cycle for Standard Dishwasher .....	13
Table 15: Energy Use per Cycle for Compact Dishwasher .....	13
Table 16: Energy Expenditure per Cycle for Standard Dishwasher .....	14
Table 17: Ownership of a Clothes Washer .....	17
Table 18: Distribution of the Size of the Clothes Washer .....	17
Table 19: Clothes Washer Type Distribution .....	18
Table 20: Loading Type of the Clothes Washer .....	19
Table 21: Age Distribution of Clothes Washer .....	19
Table 22: Percentage of Age Distribution for Clothes Washer .....	20
Table 23: Clothes Washer is an Energy Star Qualified Product .....	20
Table 24: Temperature of Water Used for Washing .....	21
Table 25: Temperature of Water Used for Rinsing .....	21
Table 26: CEE Tier Levels and Specifications for Clothes Washer (2002) .....	22
Table 27: Energy and Water Use per Cycle for Standard Clothes Washer .....	23
Table 28: Per Cycle Energy Expenditure – Electric Water Heater and Dryer .....	24
Table 29: Per Cycle Energy Expenditure – Electric Water Heater and Gas Dryer .....	24
Table 30: Per Cycle Energy Expenditure – Gas Water Heater and Electric Dryer .....	25
Table 31: Per Cycle Energy Expenditure – Gas Water Heater and Dryer .....	25
Table 32: Add-on Insulation around the Hot Water Tank –SHEU 2003 .....	26
Table 33: Add-on Insulation around the Hot Water Pipes .....	27

## **1. Introduction**

EnerGuide is a Government of Canada initiative that rates energy consumption and efficiency of household appliances, heating and ventilation equipment, air conditioners, houses, and vehicles. The EnerGuide Appliance Directory is published each year and provides the most up-to-date listing of more than 3300 new and currently available major electrical household appliances. Categorized by appliance type, the directory enables one to compare the energy performance and operating costs of similar models. The annual energy consumption reported in the EnerGuide Directory takes into account the energy required to heat water for appliances that utilize hot water – such as dishwashers and clothes washers.

The objective of this paper is to evaluate the differences in cost and energy consumption according to the type of energy source used to provide hot water to dishwashers and clothes washers. Suggestions are also provided on how to save energy and hot water usage with these appliances.

The analysis makes use of data from the 2003 Survey of Household Energy Use (SHEU03) and related engineering results on energy consumption and water usage for dishwashers and clothes washers from the U.S. Department of Energy (DOE) and other sources.

## **2. Residential Water Heating in Canada**

In general, water heating is the third largest residential energy expense, following behind space heating and total energy consumption from major appliances. It typically accounts for about 13% of utility expenditures. (U.S DOE). Hence, there is great potential to save energy through better control of hot water usage, or through more efficient heating of water.

Of the 4551 households surveyed in SHEU03, over 93% had a hot water tank at home, as shown in Table 1. However, the picture is a little different if we consider each province separately. In particular, the Atlantic Provinces (Newfoundland and Labrador, Prince Edward Island, Nova Scotia, and New Brunswick) had the lowest hot water tank saturation rate in 2003. In fact, only

64% of the surveyed households in Prince Edward Island owned a hot water tank. In contrast, the Prairies Provinces (Manitoba, Saskatchewan and Alberta) had the highest saturation rate, with over 97% of residences in Alberta having a hot water tank. This distribution difference may be attributed to the colder climate in the Prairies Provinces and the greater accessibility to certain fuel types such as natural gas in these provinces.

**Table 1: Ownership of A Hot Water Tank**

		Yes		No		Don't Know		Total	
<b>Province</b>	<b>NF</b>	174	90.63%	18	9.38%	0	0.00%	192	100.00%
	<b>PEI</b>	30	63.83%	16	34.04%	1	2.13%	47	100.00%
	<b>NS</b>	233	78.19%	64	21.48%	1	0.34%	298	100.00%
	<b>NB</b>	230	94.65%	13	5.35%	0	0.00%	243	100.00%
	<b>QB</b>	934	94.53%	54	5.47%	0	0.00%	988	100.00%
	<b>ON</b>	1001	96.90%	31	3.00%	1	0.10%	1033	100.00%
	<b>MB</b>	217	94.76%	12	5.24%	0	0.00%	229	100.00%
	<b>SK</b>	173	96.65%	6	3.35%	0	0.00%	179	100.00%
	<b>AB</b>	543	97.14%	16	2.86%	0	0.00%	559	100.00%
	<b>BC</b>	702	89.66%	81	10.34%	0	0.00%	783	100.00%
	<b>Canada</b>	4237	93.10%	311	6.83%	3	0.07%	4551	100.00%

## 2.1. Water Heater Fuel Type Distribution

The distribution of fuel types used to heat hot water in each province for households surveyed in SHEU03 is provided in Tables 2 and 3, with graphical representations available in Figures 1 to 11 in the Appendix. For Canada as a whole, about half of the households used electricity for water heating while natural gas was the second most used fuel type with a percentage of 42%. However, different regions had different a preferred water heating fuel. In Central Canada, the Prairies and the Western Provinces (Ontario, Saskatchewan, Alberta and British Columbia), natural gas was the preferred water heating fuel, while electricity was the preferred heating fuel in the Atlantic and Eastern provinces (Newfoundland and Labrador, Nova Scotia, New Brunswick and Québec). For example, almost 90% of the households used natural gas for water heating in Alberta and over 91% of the households used electricity for the same purpose in New

Brunswick and Québec. In Manitoba the preferred fuel type for water heating was electricity, while in Prince Edward Island it was oil.

**Table 2: Type of Fuel Used to Heat Running Water**

		Electricity	Oil	Natural Gas	Propane	Solar Pane	Other Fuel Type	No Hot Running Water	Total
<b>Province</b>	<b>NF</b>	163	25	0	1	0	2	1	192
	<b>PEI</b>	10	32	0	3	0	2	0	47
	<b>NS</b>	172	117	0	3	0	2	4	298
	<b>NB</b>	223	16	1	2	0	1	0	243
	<b>QB</b>	901	28	55	2	1	1	0	988
	<b>ON</b>	295	28	695	8	0	5	2	1033
	<b>MB</b>	130	1	94	2	0	1	1	229
	<b>SK</b>	44	0	133	2	0	0	0	179
	<b>AB</b>	49	0	501	4	0	0	5	559
	<b>BC</b>	309	5	459	4	0	5	1	783
	<b>Canada</b>	2296	252	1938	31	1	19	14	4551

**Table 3: Water Heating Fuel Type Distribution**

		Electricity	Oil	Natural Gas	Propane	Solar Pane	Other Fuel Type	No Hot Running Water
<b>Province</b>	<b>NF</b>	84.90%	13.02%	0.00%	0.52%	0.00%	1.04%	0.52%
	<b>PEI</b>	21.28%	68.09%	0.00%	6.38%	0.00%	4.26%	0.00%
	<b>NS</b>	57.72%	39.26%	0.00%	1.01%	0.00%	0.67%	1.34%
	<b>NB</b>	91.77%	6.58%	0.41%	0.82%	0.00%	0.41%	0.00%
	<b>QB</b>	91.19%	2.83%	5.57%	0.20%	0.10%	0.10%	0.00%
	<b>ON</b>	28.56%	2.71%	67.28%	0.77%	0.00%	0.48%	0.19%
	<b>MB</b>	56.77%	0.44%	41.05%	0.87%	0.00%	0.44%	0.44%
	<b>SK</b>	24.58%	0.00%	74.30%	1.12%	0.00%	0.00%	0.00%
	<b>AB</b>	8.77%	0.00%	89.62%	0.72%	0.00%	0.00%	0.89%
	<b>BC</b>	39.46%	0.64%	58.62%	0.51%	0.00%	0.64%	0.13%
	<b>Canada</b>	50.45%	5.54%	42.58%	0.68%	0.02%	0.42%	0.31%

The observed distribution pattern of preferred fuel type may be partly due to the regional availability of certain fuel types, and partly due to price. For example, natural gas was widely available in Central Canada, the Prairies and Western provinces, while it was not available or had only limited availability in the Atlantic region in 2003. Based on the pricing information

presented in Table 4, we can see that fuel costs may also have played an important role in determining this pattern. For instance, Albertans paid the second lowest price for its natural gas consumption in 2003 at \$11.87/GJ, but they were paying the highest electricity price in the nation at an average of about 10¢/kWh. In contrast, Manitoba had the lowest electricity price (less than 6¢/kWh) but the highest natural gas price (\$18.16/GJ). Hence, more households in Alberta used natural gas for water heating because it was cheaper and more households in Manitoba used electricity for the same reason.

**Table 4: Natural Gas and Electricity Prices**

		<b>Electricity</b>	<b>Natural Gas</b>
<b>Province</b>	<b>NF</b>	\$0.08	-
	<b>PEI</b>	\$0.10	-
	<b>NS</b>	\$0.10	-
	<b>NB</b>	\$0.08	\$14.55
	<b>QB</b>	\$0.07	\$11.99
	<b>ON</b>	\$0.09	\$15.44
	<b>MB</b>	\$0.06	\$18.16
	<b>SK</b>	\$0.09	\$10.00
	<b>AB</b>	\$0.10	\$11.87
	<b>BC</b>	\$0.06	\$13.77
		<b>Canada</b>	\$0.08

### 3. Water Heater Energy Efficiency

A water heater’s overall energy efficiency is indicated by its energy factor (EF). This measures the amount of hot water that can be produced per unit of fuel consumed. EF takes into account the following (U.S. DOE):

- Recovery efficiency – how efficiently the heat from the energy source is transferred to the water
- Standby losses – the percentage of heat loss per hour from the stored water compared to the heat content of the water (water heaters with storage tanks)
- Cycling losses – the loss of heat as the water circulates through a water heater tank, and/or inlet and outlet pipes.

The higher the energy factor, the more efficient the water heater. In general, an electric water heater is more efficient than a gas/propane water heater, while a heat pump water heater is even more efficient than the electric water heater. The U.S. DOE website provides a list of top-rated water heaters from different brands with their corresponding energy factor statistics ([http://www.aceee.org/consumerguide/topwater.htm#most\\_hpwh](http://www.aceee.org/consumerguide/topwater.htm#most_hpwh)). Table 5 shows the default energy factors defined by the HOT2000 V7.14 user manual (1996) for different water heating systems.

**Table 5: Energy Factors for Different Water Heating Systems Defined by the HOT2000 Program**

<b>Fuel Type</b>	<b>System</b>	<b>EF</b>
<b>Natural Gas/Propane</b>	Conventional Tank	0.554
	Conventional Tank (Pilot)	0.554
	Tankless Coil	0.480
	Instantaneous	0.830
	Instantaneous (Pilot)	0.800
	Induced Draft Fan	0.571
	Induced Draft Fan (Pilot)	0.571
	Direct Vent (Sealed)	0.575
	Direct Vent (Sealed and Pilot)	0.575
	Condensing	0.860
<b>Electricity</b>	Conventional Tank	0.824
	Conserved Tank	0.868
	Instantaneous	0.936
	Tankless Heat Pump	1.900
	Heat Pump	1.901
<b>Oil</b>	Conventional Tank	0.530
	Tankless Coil	0.400
<b>Wood</b>	Fireplace	0.300
	Wood Stove Water Coil	0.300

However, a higher energy factor value does not always mean lower operational costs and therefore does not necessarily define the preferred water heater. When consumers are making their purchase decisions, in addition to the purchase and installation price and the energy factors, they would presumably also consider the optimal size of the heater that suits their hot water needs, the fuel types available in their area and their corresponding prices, and other costs such as maintenance costs.

## 4. Dishwashers

It might often be assumed that washing dishes by hand reduces hot water usage and as a result saves energy. However, washing dishes by hand several times a day could be more expensive than using a dishwasher. If the dishwasher has a built-in booster heater, which increases the temperature of the water entering the dishwasher to the 60°C recommended for cleaning, the advantage of using a dishwasher is even greater because the household now can lower the water heating temperature for general usage on their water heater without impacting the operation of the dishwasher. According to the U.S. DOE, every 10°F (about 6°C) reduction in water temperature from the water heater corresponds to a 3%-5% saving in energy costs.

### 4.1. Distribution Statistics

Based on the data from SHEU03, about 56% of households in Canada owned a dishwasher. Overall, more households owned a dishwasher in the Western and Central Provinces than in the Atlantic Provinces. Specifically, British Columbia had the highest saturation rate of 63%, while Newfoundland and Labrador had the lowest ownership rate at 39%. The detailed ownership distribution is shown in Table 6.

**Table 6: Ownership of a Dishwasher**

		Yes		No		Total	
Province	<b>NF</b>	75	39.06%	117	60.94%	192	100.00%
	<b>PEI</b>	23	48.94%	24	51.06%	47	100.00%
	<b>NS</b>	126	42.28%	172	57.72%	298	100.00%
	<b>NB</b>	107	44.03%	136	55.97%	243	100.00%
	<b>QB</b>	536	54.25%	452	45.75%	988	100.00%
	<b>ON</b>	610	59.05%	423	40.95%	1033	100.00%
	<b>MB</b>	100	43.67%	129	56.33%	229	100.00%
	<b>SK</b>	89	49.72%	90	50.28%	179	100.00%
	<b>AB</b>	355	63.51%	204	36.49%	559	100.00%
	<b>BC</b>	514	65.64%	269	34.36%	783	100.00%
	<b>Canada</b>	2535	55.70%	2016	44.30%	4551	100.00%

In addition to determining whether households had a dishwasher, information collected in SHEU03 also included the size of the dishwasher that they owned and its relative age. Table 7 shows the size distribution of dishwashers. Of the 2,535 households that reported owning a dishwasher, over 96% had a standard/full size model.

In general, the older the dishwasher, the less energy efficient it is. About one-third of the dishwashers from SHEU03 were more than 10 years old, as shown in Table 8 and 9. Hence, it would be expected that these households have greater potential to save energy by replacing their old dishwashers.

**Table 7: Distribution of the Size of the Dishwasher**

		<b>Compact/Mini Size*</b>		<b>Standard/Full Size**</b>		<b>Total</b>	
<b>Province</b>	<b>NF</b>	3	4.00%	72	96.00%	75	100.00%
	<b>PEI</b>	1	4.35%	22	95.65%	23	100.00%
	<b>NS</b>	1	0.79%	125	99.21%	126	100.00%
	<b>NB</b>	7	6.54%	100	93.46%	107	100.00%
	<b>QB</b>	13	2.43%	523	97.57%	536	100.00%
	<b>ON</b>	18	2.95%	592	97.05%	610	100.00%
	<b>MB</b>	2	2.00%	98	98.00%	100	100.00%
	<b>SK</b>	1	1.12%	88	98.88%	89	100.00%
	<b>AB</b>	3	0.85%	352	99.15%	355	100.00%
	<b>BC</b>	34	6.61%	480	93.39%	514	100.00%
	<b>Canada</b>	83	3.27%	2452	96.73%	2535	100.00%

\* Compact/mini size- exterior width less than 56cm/22 in

\*\* Standard/full size-exterior width greater than or equal to 56cm/22 in

Table 8: Age Distribution of Dishwasher

		1-5 years	6-10 years	11-15 years	16-20 years	21-25 years	26+ years	Don't Know /Refusal	Total
Province	NF	35	24	9	6	1	0	0	75
	PEI	7	9	2	3	1	0	1	23
	NS	53	36	21	12	0	4	0	126
	NB	36	33	21	11	3	2	1	107
	QB	222	128	92	60	20	11	3	536
	ON	269	169	95	54	9	8	6	610
	MB	40	26	22	7	1	2	2	100
	SK	32	22	15	11	2	4	3	89
	AB	141	110	56	26	9	4	9	355
	BC	202	157	83	45	16	6	5	514
	Canada	1,037	714	416	235	62	41	30	2535

Table 9: Percentage of Age Distribution for Dishwasher

		1-5 years	6-10 years	11-15 years	16-20 years	21-25 years	26+ years	Don't Know /Refusal	Total
Province	NF	46.67%	32.00%	12.00%	8.00%	1.33%	0.00%	0.00%	100.00%
	PEI	30.43%	39.13%	8.70%	13.04%	4.35%	0.00%	4.35%	100.00%
	NS	42.06%	28.57%	16.67%	9.52%	0.00%	3.17%	0.00%	100.00%
	NB	33.64%	30.84%	19.63%	10.28%	2.80%	1.87%	0.93%	100.00%
	QB	41.42%	23.88%	17.16%	11.19%	3.73%	2.05%	0.56%	100.00%
	ON	44.10%	27.70%	15.57%	8.85%	1.48%	1.31%	0.98%	100.00%
	MB	40.00%	26.00%	22.00%	7.00%	1.00%	2.00%	2.00%	100.00%
	SK	35.96%	24.72%	16.85%	12.36%	2.25%	4.49%	3.37%	100.00%
	AB	39.72%	30.99%	15.77%	7.32%	2.54%	1.13%	2.54%	100.00%
	BC	39.30%	30.54%	16.15%	8.75%	3.11%	1.17%	0.97%	100.00%
	Canada	40.91%	28.17%	16.41%	9.27%	2.45%	1.62%	1.18%	100.00%

Table 10 displays the proportion of the dishwashers that were Energy Star qualified. Overall, less than 20% of the in-use dishwashers were Energy Star qualified products. This suggests that there is scope for making a greater effort in Canada to promote the use of energy-efficient dishwashers.

**Table 10: Is the Dishwasher an Energy Star Qualified Product?**

		<b>Yes</b>		<b>No</b>		<b>Total</b>	
<b>Province</b>	<b>NF</b>	21	28.00%	54	72.00%	75	100.00%
	<b>PEI</b>	3	13.04%	20	86.96%	23	100.00%
	<b>NS</b>	23	18.25%	103	81.75%	126	100.00%
	<b>NB</b>	13	12.15%	94	87.85%	107	100.00%
	<b>QB</b>	84	15.67%	452	84.33%	536	100.00%
	<b>ON</b>	108	17.70%	502	82.30%	610	100.00%
	<b>MB</b>	19	19.00%	81	81.00%	100	100.00%
	<b>SK</b>	12	13.48%	77	86.52%	89	100.00%
	<b>AB</b>	68	19.15%	287	80.85%	355	100.00%
	<b>BC</b>	91	17.70%	423	82.30%	514	100.00%
	<b>Canada</b>	442	17.44%	2093	82.56%	2535	100.00%

#### **4.2. Energy and Water Consumption for Dishwashers**

Since the U.S. and Canada have similar regulations regarding home appliances, and have similar products available in the market, the following energy and water consumption analysis is based on study results from the U.S. DOE.

The U.S. DOE has developed a Microsoft Excel spreadsheet to demonstrate the life-cycle costs and payback periods for different dishwashers (DOE website). The study has divided dishwashers into two major subgroups: standard dishwashers and compact dishwashers. Within each of these subgroups, dishwashers are further classified into 8 different efficiency levels. This detailed classification is indicated in Table 11.

**Table 11: Dishwasher Classification**

	<b>Subgroup</b>	<b>Efficiency Levels*</b>	<b>Efficiency Factor (EF) (cycles/kWh)</b>
<b>Dishwasher</b>	Standard Dishwasher	DOE Standard	0.46
		ENERGY STAR	0.58
		CEE Tier 1	0.62
		2007 ENERGY STAR	0.65
		CEE Tier 2	0.68
		Gap Fill	0.72
		Gap Fill	0.80
		Max Available	1.11
	Compact Dishwasher	DOE Standard	0.62
		ENERGY STAR	0.78
		CEE Tier 1	0.84
		2007 ENERGY STAR	0.88
		CEE Tier 2	0.92
		Gap Fill	1.01
		Gap Fill	1.08
Max Available	1.74		

\* where:

- DOE Standard refers to the U.S. Department of Energy baseline model;
- ENERGY STAR refers to the Minimum efficiency factor requirement to be qualified as an Energy Star dishwasher before January 1, 2007;
- CEE Tier 1 refers to the Consortium for Energy Efficiency (CEE) Tier 1 efficiency factor requirement for dishwashers;
- 2007 ENERGY STAR refers to the Minimum efficiency factor requirement to be qualified as an Energy Star dishwasher on and after January 1, 2007;
- CEE Tier 2 refers to the Consortium for Energy Efficiency (CEE) Tier 2 efficiency factor requirement for dishwashers;
- Gap Fill refers to Selected efficiency factor levels to fill up the large efficiency gap between CEE Tier 2 and the most efficient dishwasher;
- Max. Available refers to the most efficient dishwasher available on the market.

Based on the results from their engineering study and consumer energy consumption survey, the energy and water usage per cycle for dishwashers is shown in Table 12 and 13. The total energy usage is equal to the reciprocal of the efficiency factor (EF) value. In order to calculate the energy used for water heating, there are several assumptions that have been made. First of all, the temperature difference for water heating is set to be 70 degree Fahrenheit (21degree Celsius). Second, the energy (kWh) needed to heat water is 0.0024 kWh/gal/deg F. Third, the recovery efficiency of an electric water heater is 100%. Therefore, the energy required to heat the water for the DOE standard dishwasher is equal to 1.37 kWh/cyc(=8.16\*0.0024\*70/100%). The water usage figures are based on the historical relationship between total energy use (kWh/cyc) and total water use (gal/cyc). This relationship is derived from the Association of Home Appliance Manufacturers (AHAM) data.

It is obvious that as the efficiency increases, the total energy and water usage decrease. In particular, the energy saving largely comes from the energy used to heat the water. For example, the most efficient standard size dishwasher on the market uses almost 60% (1.27kWh/cyc) less energy than the DOE standard dishwasher. Of the 1.27kWh/cyc energy saving, almost 80% (0.99kWh/cyc) comes from water heating, and only 20% (0.28kWh/cyc) comes from the energy used to operate the dishwasher in general. In terms of water usage, the most efficient standard dishwasher uses 72% less water than the DOE standard model. For a compact size dishwasher, the energy saving is also very dramatic: the most efficient compact dishwasher uses 65% less energy than the standard model and the water saving is an amazing 86%!

**Table 12: Energy and Water Usage per Cycle-Standard Dishwasher**

Efficiency Level	Efficiency	Energy Usage			Machine**	Total Water Usage*	Standby Power
		Total	Water Heating				
	cycles/kWh	kWh/cyc	kWh/cyc	% WH of Total	kWh/cyc	gal/cyc	watt / h
DOE Standard	0.46	2.17	1.37	0.63	0.80	8.16	2
ENERGY STAR	0.58	1.72	1.02	0.59	0.70	6.07	2
CEE Tier 1	0.62	1.61	0.93	0.58	0.68	5.56	2
2007 ENERGY STAR	0.65	1.54	0.88	0.57	0.66	5.21	2
CEE Tier 2	0.68	1.47	0.82	0.56	0.65	4.90	2
Gap Fill	0.72	1.39	0.76	0.55	0.63	4.52	2
Gap Fill	0.8	1.25	0.65	0.52	0.60	3.87	2
Max Available	1.11	0.90	0.38	0.42	0.52	2.25	2

\* based on the Association of Home Appliance Manufacturers (AHAM) data showing historical relationship between Total Energy Use (kWh/cyc) and Total Water Use (gal/cyc)

\*\* includes motor energy, booster energy, and energy used to heat-dry dishes

**Table 13: Energy and Water Usage per Cycle-Compact Dishwasher**

Efficiency Level	Efficiency	Energy Usage			Machine**	Total Water Usage*	Standby Power
		Total	Water Heating				
	cycles/kWh	kWh/cyc	kWh/cyc	% WH of Total	kWh/cyc	gal/cyc	watt / h
DOE Standard	0.62	1.61	0.93	0.58	0.68	5.56	2
ENERGY STAR	0.78	1.28	0.68	0.53	0.61	4.02	2
CEE Tier 1	0.84	1.19	0.60	0.51	0.59	3.60	2
2007 ENERGY STAR	0.88	1.14	0.56	0.49	0.57	3.34	2
CEE Tier 2	0.92	1.09	0.52	0.48	0.56	3.12	2
Gap Fill	1.01	0.99	0.45	0.45	0.54	2.67	2
Gap Fill	1.08	0.93	0.40	0.43	0.53	2.37	2
Max Available	1.74	0.57	0.12	0.22	0.45	0.74	2

\* based on AHAM data showing historical relationship between Total Energy Use (kWh/cyc) and Total Water Use (gal/cyc)

\*\* includes motor energy, booster energy, and energy used to heat-dry dishes

If we assume the average recovery efficiency of a gas water heater to be 75% and the average recovery efficiency of an oil water heater to be 81% according to DOE's life-cycle cost

spreadsheet, then the total energy consumption per cycle under different fuel types for each model is presented in Table 14 and Table 15.

**Table 14: Energy Use per Cycle for Standard Dishwasher**

Efficiency Level	Machine kWh/cyc	Standby Power kW/h	Water Heating		
			(Elec) kWh	(Gas) GJ	(Oil) GJ
DOE Standard	0.80	0.002	1.37	0.0066	0.0061
ENERGY STAR	0.70	0.002	1.02	0.0049	0.0045
CEE Tier 1	0.68	0.002	0.93	0.0045	0.0041
2007 ENERGY STAR	0.66	0.002	0.88	0.0042	0.0039
CEE Tier 2	0.65	0.002	0.82	0.0039	0.0037
Gap Fill	0.63	0.002	0.76	0.0036	0.0034
Gap Fill	0.60	0.002	0.65	0.0031	0.0029
Max Available	0.52	0.002	0.38	0.0018	0.0017

**Table 15: Energy Use per Cycle for Compact Dishwasher**

Efficiency Level	Machine kWh/cyc	Standby Power kW/h	Water Heating		
			(Elec) kWh	(Gas) GJ	(Oil) GJ
DOE Standard	0.68	0.002	0.93	0.0045	0.0041
ENERGY STAR	0.61	0.002	0.68	0.0032	0.0030
CEE Tier 1	0.59	0.002	0.60	0.0029	0.0027
2007 ENERGY STAR	0.57	0.002	0.56	0.0027	0.0025
CEE Tier 2	0.56	0.002	0.52	0.0025	0.0023
Gap Fill	0.54	0.002	0.45	0.0021	0.0020
Gap Fill	0.53	0.002	0.40	0.0019	0.0018
Max Available	0.45	0.002	0.12	0.0006	0.0006

Ignoring the standby power energy consumption and using the pricing information from Table 4, we can approximate the energy expenditure per cycle for dishwasher using different fuel types and at different efficiency levels. The results for each province and for Canada as a whole are shown in Table 16.

**Table 16: Energy Expenditure per Cycle for Standard Dishwasher**

Province	Efficiency Level	Energy Expenditure per Cycle			
		Standard Dishwasher		Compact Dishwasher	
		Electricity	Gas	Electricity	Gas
NF	DOE Standard	\$0.17	-	\$0.13	-
	ENERGY STAR	\$0.14	-	\$0.10	-
	CEE Tier 1	\$0.13	-	\$0.10	-
	2007 ENERGY STAR	\$0.12	-	\$0.09	-
	CEE Tier 2	\$0.12	-	\$0.09	-
	Gap Fill	\$0.11	-	\$0.08	-
	Gap Fill	\$0.10	-	\$0.07	-
	Max Available	\$0.07	-	\$0.05	-
PEI	DOE Standard	\$0.22	-	\$0.16	-
	ENERGY STAR	\$0.17	-	\$0.13	-
	CEE Tier 1	\$0.16	-	\$0.12	-
	2007 ENERGY STAR	\$0.15	-	\$0.11	-
	CEE Tier 2	\$0.15	-	\$0.11	-
	Gap Fill	\$0.14	-	\$0.10	-
	Gap Fill	\$0.13	-	\$0.09	-
	Max Available	\$0.09	-	\$0.06	-
NS	DOE Standard	\$0.22	-	\$0.16	-
	ENERGY STAR	\$0.17	-	\$0.13	-
	CEE Tier 1	\$0.16	-	\$0.12	-
	2007 ENERGY STAR	\$0.15	-	\$0.11	-
	CEE Tier 2	\$0.15	-	\$0.11	-
	Gap Fill	\$0.14	-	\$0.10	-
	Gap Fill	\$0.13	-	\$0.09	-
	Max Available	\$0.09	-	\$0.06	-
NB	DOE Standard	\$0.17	\$0.16	\$0.13	\$0.12
	ENERGY STAR	\$0.14	\$0.13	\$0.10	\$0.10
	CEE Tier 1	\$0.13	\$0.12	\$0.10	\$0.09
	2007 ENERGY STAR	\$0.12	\$0.11	\$0.09	\$0.09
	CEE Tier 2	\$0.12	\$0.11	\$0.09	\$0.08
	Gap Fill	\$0.11	\$0.10	\$0.08	\$0.07
	Gap Fill	\$0.10	\$0.09	\$0.07	\$0.07
	Max Available	\$0.07	\$0.07	\$0.05	\$0.04
QB	DOE Standard	\$0.15	\$0.14	\$0.11	\$0.10
	ENERGY STAR	\$0.12	\$0.11	\$0.09	\$0.08
	CEE Tier 1	\$0.11	\$0.10	\$0.08	\$0.08
	2007 ENERGY STAR	\$0.11	\$0.10	\$0.08	\$0.07
	CEE Tier 2	\$0.10	\$0.09	\$0.08	\$0.07
	Gap Fill	\$0.10	\$0.09	\$0.07	\$0.06
	Gap Fill	\$0.09	\$0.08	\$0.06	\$0.06
	Max Available	\$0.06	\$0.06	\$0.04	\$0.04
ON	DOE Standard	\$0.20	\$0.17	\$0.15	\$0.13
	ENERGY STAR	\$0.16	\$0.14	\$0.12	\$0.10
	CEE Tier 1	\$0.15	\$0.13	\$0.11	\$0.10

**Table 16 (continued)**

Province	Efficiency Level	Standard		Compact	
		Electricity	Gas	Electricity	Gas
<b>ON (cont'd)</b>	2007 ENERGY STAR	\$0.14	\$0.12	\$0.10	\$0.09
	CEE Tier 2	\$0.13	\$0.12	\$0.10	\$0.09
	Gap Fill	\$0.13	\$0.11	\$0.09	\$0.08
	Gap Fill	\$0.11	\$0.10	\$0.08	\$0.08
	Max Available	\$0.08	\$0.08	\$0.05	\$0.05
<b>MB</b>	DOE Standard	\$0.13	\$0.17	\$0.10	\$0.12
	ENERGY STAR	\$0.10	\$0.13	\$0.08	\$0.10
	CEE Tier 1	\$0.10	\$0.12	\$0.07	\$0.09
	2007 ENERGY STAR	\$0.09	\$0.12	\$0.07	\$0.08
	CEE Tier 2	\$0.09	\$0.11	\$0.07	\$0.08
	Gap Fill	\$0.08	\$0.10	\$0.06	\$0.07
	Gap Fill	\$0.08	\$0.09	\$0.06	\$0.07
	Max Available	\$0.05	\$0.06	\$0.03	\$0.04
<b>SK</b>	DOE Standard	\$0.20	\$0.14	\$0.15	\$0.11
	ENERGY STAR	\$0.16	\$0.11	\$0.12	\$0.09
	CEE Tier 1	\$0.15	\$0.11	\$0.11	\$0.08
	2007 ENERGY STAR	\$0.14	\$0.10	\$0.10	\$0.08
	CEE Tier 2	\$0.13	\$0.10	\$0.10	\$0.08
	Gap Fill	\$0.13	\$0.09	\$0.09	\$0.07
	Gap Fill	\$0.11	\$0.09	\$0.08	\$0.07
	Max Available	\$0.08	\$0.07	\$0.05	\$0.05
<b>AB</b>	DOE Standard	\$0.22	\$0.16	\$0.16	\$0.12
	ENERGY STAR	\$0.17	\$0.13	\$0.13	\$0.10
	CEE Tier 1	\$0.16	\$0.12	\$0.12	\$0.09
	2007 ENERGY STAR	\$0.15	\$0.12	\$0.11	\$0.09
	CEE Tier 2	\$0.15	\$0.11	\$0.11	\$0.09
	Gap Fill	\$0.14	\$0.11	\$0.10	\$0.08
	Gap Fill	\$0.13	\$0.10	\$0.09	\$0.08
	Max Available	\$0.09	\$0.07	\$0.06	\$0.05
<b>BC</b>	DOE Standard	\$0.13	\$0.14	\$0.10	\$0.10
	ENERGY STAR	\$0.10	\$0.11	\$0.08	\$0.08
	CEE Tier 1	\$0.10	\$0.10	\$0.07	\$0.08
	2007 ENERGY STAR	\$0.09	\$0.10	\$0.07	\$0.07
	CEE Tier 2	\$0.09	\$0.09	\$0.07	\$0.07
	Gap Fill	\$0.08	\$0.09	\$0.06	\$0.06
	Gap Fill	\$0.08	\$0.08	\$0.06	\$0.06
	Max Available	\$0.05	\$0.06	\$0.03	\$0.04
<b>Canada</b>	DOE Standard	\$0.17	\$0.16	\$0.13	\$0.12
	ENERGY STAR	\$0.14	\$0.12	\$0.10	\$0.09
	CEE Tier 1	\$0.13	\$0.12	\$0.10	\$0.09
	2007 ENERGY STAR	\$0.12	\$0.11	\$0.09	\$0.08
	CEE Tier 2	\$0.12	\$0.11	\$0.09	\$0.08
	Gap Fill	\$0.11	\$0.10	\$0.08	\$0.07
	Gap Fill	\$0.10	\$0.09	\$0.07	\$0.07
	Max Available	\$0.07	\$0.07	\$0.05	\$0.04

The above per cycle expenditure figures indicates that it is cheaper to operate a more efficient dishwasher. A household using an electric water heater to supply hot water to the most efficient standard size dishwasher spends 59% less on its electricity bill than the one using the DOE standard model for all the provinces and for Canada as a whole. If the household uses a compact size dishwasher, then the electricity cost saving will increase to 64%. If the household uses a gas water heater to supply hot water, then the cost saving will range from 53% in Saskatchewan and Alberta to 62% in Manitoba in the case of a standard size dishwasher, and will range from 56% in Saskatchewan to 69% in Manitoba in the case of a compact dishwasher.

Furthermore, comparing the operation costs between using an electric water heater and a gas water heater to supply hot water to the dishwasher, it is cheaper to use an electric water heater in Manitoba and British Columbia, and it is cheaper to use a gas water heater in New Brunswick, Québec, Ontario, Saskatchewan, and Alberta. This finding is quite similar, although not exactly the same as the preferred fuel type distribution mentioned in Table 3 and Table 4. The reason for this difference is because when households are making their purchase choice among all the available water heaters, they not only compare the operation costs, which will depend on which fuel type is cheaper, but also they have to consider the upfront purchase price of the heater, its expected operational life and the related maintenance costs. For instance, the more efficient the water heater, the higher the retail price is likely to be. Hence, only by taking into account all of these costs can consumers determine which water heater is the best purchase.

## **5. Clothes Washers**

### **5.1. Distribution Statistics**

The clothes washer has one of the highest saturation rates among all appliances in Canada. In SHEU03, about 91% of the households stated that they owned a clothes washer. The saturation rate ranged from a low of 86% in New Brunswick and British Columbia to a high of 95% in Saskatchewan. This information is shown in Table 17.

**Table 17: Ownership of A Clothes Washer**

		Yes		No		Total	
Province	<b>NF</b>	181	94.27%	11	5.73%	192	100.00%
	<b>PEI</b>	42	89.36%	5	10.64%	47	100.00%
	<b>NS</b>	256	85.91%	42	14.09%	298	100.00%
	<b>NB</b>	227	93.42%	16	6.58%	243	100.00%
	<b>QB</b>	900	91.09%	88	8.91%	988	100.00%
	<b>ON</b>	964	93.32%	69	6.68%	1033	100.00%
	<b>MB</b>	200	87.34%	29	12.66%	229	100.00%
	<b>SK</b>	170	94.97%	9	5.03%	179	100.00%
	<b>AB</b>	519	92.84%	40	7.16%	559	100.00%
	<b>BC</b>	673	85.95%	110	14.05%	783	100.00%
	<b>Canada</b>	4132	90.79%	419	9.21%	4551	100.00%

In terms of size, as shown in Table 18, most (about 97%) of the clothes washers from SHEU03, were standard/full size washers. This means that Canadian consumers tend to purchase standard size clothes washers. This is not a problem as long as the washer is operated with a full load. However, if that is not the case, then using a compact washer may be more energy efficient. In contrast, if a household is large in size and needs to do a lot of laundry, then using a compact washer means more loads and the use of more energy. Therefore, choosing the right size clothes washer is very important in saving energy.

**Table 18: Distribution of the Size of the Clothes Washer**

		Compact/Mini Size*		Standard/Full Size**		Don't Know		Total	
Province	<b>NF</b>	14	7.73%	167	92.27%	0	0.00%	181	100.00%
	<b>PEI</b>	0	0.00%	42	100.00%	0	0.00%	42	100.00%
	<b>NS</b>	19	7.42%	237	92.58%	0	0.00%	256	100.00%
	<b>NB</b>	9	3.96%	218	96.04%	0	0.00%	227	100.00%
	<b>QB</b>	29	3.22%	871	96.78%	0	0.00%	900	100.00%
	<b>ON</b>	15	1.56%	948	98.34%	1	0.10%	964	100.00%
	<b>MB</b>	4	2.00%	196	98.00%	0	0.00%	200	100.00%
	<b>SK</b>	3	1.76%	167	98.24%	0	0.00%	170	100.00%
	<b>AB</b>	12	2.31%	507	97.69%	0	0.00%	519	100.00%
	<b>BC</b>	38	5.65%	635	94.35%	0	0.00%	673	100.00%
	<b>Canada</b>	143	3.46%	3988	96.52%	1	0.02%	4132	100.00%

\* Compact/mini size- less than 45 litres / 10 gallons

\*\* Standard/full size- greater than or equal to 45 litres / 10 gallons

In addition to being highly concentrated in terms of size of clothes washer, the actual type of clothes washer is also very concentrated in Canada. For those households in SHEU03 that owned a clothes washer, about 97% of them owned an automatic washer. Only a fraction of the households had a washer/dryer combination or other type of clothes washer. The detailed distribution is shown in Table 19, with graphical representations available in Figures 12 to 22 in the Appendix.

**Table 19: Clothes Washer Type Distribution**

		Automatic Washer		Washer/Dryer Combination		Other		Total	
<b>Province</b>	<b>NF</b>	166	91.71%	8	4.42%	7	3.87%	181	100.00%
	<b>PEI</b>	42	100.00%	0	0.00%	0	0.00%	42	100.00%
	<b>NS</b>	246	96.09%	10	3.91%	0	0.00%	256	100.00%
	<b>NB</b>	224	98.68%	2	0.88%	1	0.44%	227	100.00%
	<b>QB</b>	893	99.22%	7	0.78%	0	0.00%	900	100.00%
	<b>ON</b>	938	97.30%	22	2.28%	4	0.41%	964	100.00%
	<b>MB</b>	192	96.00%	4	2.00%	4	2.00%	200	100.00%
	<b>SK</b>	164	96.47%	3	1.76%	3	1.76%	170	100.00%
	<b>AB</b>	503	96.92%	12	2.31%	4	0.77%	519	100.00%
	<b>BC</b>	649	96.43%	24	3.57%	0	0.00%	673	100.00%
	<b>Canada</b>	4017	97.22%	92	2.23%	23	0.56%	4132	100.00%

As shown in Table 20, only about 10% of the clothes washers from SHEU03 were front-loading washers, the remaining 90% being top-loading washer. In general, a front-loading clothes washer is much more efficient than a top-loading one. According to the National Geographic website, a front-loading washer can easily reduce water and energy use by more than a half over a top-loading washer. Thus, a front-loading clothes washer should be encouraged for use in Canadian homes, although it is important to balance this recommendation with the observation that such clothes washers generally come with a higher price tag. From Tables 21 and 22, we see that about 30% of the existing clothes washers were more than 10 years old. Furthermore, only 16% of the clothes washers were Energy Star qualified products, as indicated in Table 23. Hence, Canadian households still have a lot of room to improve the efficiency of their clothes washers.

**Table 20: Loading Type of the Clothes Washer**

		Front loading		Top Loading		Total	
Province	<b>NF</b>	2	1.10%	179	98.90%	181	100.00%
	<b>PEI</b>	2	4.76%	40	95.24%	42	100.00%
	<b>NS</b>	9	3.52%	247	96.48%	256	100.00%
	<b>NB</b>	18	7.93%	209	92.07%	227	100.00%
	<b>QB</b>	140	15.56%	760	84.44%	900	100.00%
	<b>ON</b>	120	12.45%	844	87.55%	964	100.00%
	<b>MB</b>	18	9.00%	182	91.00%	200	100.00%
	<b>SK</b>	8	4.71%	162	95.29%	170	100.00%
	<b>AB</b>	60	11.56%	459	88.44%	519	100.00%
	<b>BC</b>	69	10.25%	604	89.75%	673	100.00%
	<b>Canada</b>	446	10.79%	3686	89.21%	4132	100.00%

**Table 21: Age Distribution of the Clothes Washer**

		1-5 years	6-10 years	11-15 years	16-20 years	21-25 years	26+ years	Don't Know /Refusal	Total
Province	<b>NF</b>	85	56	22	10	3	5	0	181
	<b>PEI</b>	18	11	9	3	0	0	1	42
	<b>NS</b>	87	85	43	29	7	5	0	256
	<b>NB</b>	77	72	43	23	4	6	2	227
	<b>QB</b>	345	262	153	85	24	26	5	900
	<b>ON</b>	405	271	153	74	24	28	9	964
	<b>MB</b>	73	52	38	17	11	6	3	200
	<b>SK</b>	45	52	31	22	9	8	3	170
	<b>AB</b>	202	165	74	43	14	12	9	519
	<b>BC</b>	246	220	122	50	16	13	6	673
	<b>Canada</b>	1,583	1,246	688	356	112	109	38	4132

**Table 22: Percentage Age Distribution for Clothes Washer**

		1-5 years	6-10 years	11-15 years	16-20 years	21-25 years	26+ years	Don't Know /Refusal	Total
<b>Province</b>	<b>NF</b>	46.96%	30.94%	12.15%	5.52%	1.66%	2.76%	0.00%	100.00%
	<b>PEI</b>	42.86%	26.19%	21.43%	7.14%	0.00%	0.00%	2.38%	100.00%
	<b>NS</b>	33.98%	33.20%	16.80%	11.33%	2.73%	1.95%	0.00%	100.00%
	<b>NB</b>	33.92%	31.72%	18.94%	10.13%	1.76%	2.64%	0.88%	100.00%
	<b>QB</b>	38.33%	29.11%	17.00%	9.44%	2.67%	2.89%	0.56%	100.00%
	<b>ON</b>	42.01%	28.11%	15.87%	7.68%	2.49%	2.90%	0.93%	100.00%
	<b>MB</b>	36.50%	26.00%	19.00%	8.50%	5.50%	3.00%	1.50%	100.00%
	<b>SK</b>	26.47%	30.59%	18.24%	12.94%	5.29%	4.71%	1.76%	100.00%
	<b>AB</b>	38.92%	31.79%	14.26%	8.29%	2.70%	2.31%	1.73%	100.00%
	<b>BC</b>	36.55%	32.69%	18.13%	7.43%	2.38%	1.93%	0.89%	100.00%
	<b>Canada</b>	38.31%	30.15%	16.65%	8.62%	2.71%	2.64%	0.92%	100.00%

**Table 23: Clothes Washer is an Energy Star Qualified Product?**

		Yes		No		Total	
<b>Province</b>	<b>NF</b>	36	19.89%	145	80.11%	181	100.00%
	<b>PEI</b>	5	11.90%	37	88.10%	42	100.00%
	<b>NS</b>	26	10.16%	230	89.84%	256	100.00%
	<b>NB</b>	24	10.57%	203	89.43%	227	100.00%
	<b>QB</b>	141	15.67%	759	84.33%	900	100.00%
	<b>ON</b>	194	20.12%	770	79.88%	964	100.00%
	<b>MB</b>	35	17.50%	165	82.50%	200	100.00%
	<b>SK</b>	14	8.24%	156	91.76%	170	100.00%
	<b>AB</b>	96	18.50%	423	81.50%	519	100.00%
	<b>BC</b>	114	16.94%	559	83.06%	673	100.00%
	<b>Canada</b>	685	16.58%	3447	83.42%	4132	100.00%

About 80% to 90% of the energy that a clothes washer consumes is used to heat the water. Hence, in order to save energy, it is recommended that households use cold water as much as possible. Based on the data collected in SHEU03, less than 40% of the contacted Canadian households used cold water for washing, but more than 80% of them used cold water for rinsing, as indicated in Tables 24 and 25. For individual provinces, Québec used more cold water in washing than any other provinces, with over half of its households doing so, while the Prairie provinces such as Manitoba, Saskatchewan and Alberta used less cold water in washing. For

rinsing, 88% of households in Nova Scotia used cold water, while fewer Albertan households (75%) tended to use cold water for this purpose.

**Table 24: Temperature of Water Used for Washing**

		Hot		Warm		Cold		Don't Know		Total	
Province	NF	7	3.87%	80	44.20%	93	51.38%	1	0.55%	181	100.00%
	PEI	3	7.14%	26	61.90%	13	30.95%	0	0.00%	42	100.00%
	NS	15	5.86%	116	45.31%	124	48.44%	1	0.39%	256	100.00%
	NB	8	3.52%	110	48.46%	109	48.02%	0	0.00%	227	100.00%
	QB	20	2.22%	392	43.56%	486	54.00%	2	0.22%	900	100.00%
	ON	39	4.05%	621	64.42%	297	30.81%	7	0.73%	964	100.00%
	MB	18	9.00%	140	70.00%	41	20.50%	1	0.50%	200	100.00%
	SK	14	8.24%	120	70.59%	35	20.59%	1	0.59%	170	100.00%
	AB	37	7.13%	344	66.28%	135	26.01%	3	0.58%	519	100.00%
	BC	24	3.57%	408	60.62%	240	35.66%	1	0.15%	673	100.00%
	<b>Canada</b>	185	4.48%	2357	57.04%	1573	38.07%	17	0.41%	4132	100.00%

**Table 25: Temperature of Water Used for Rinsing**

		Hot		Warm		Cold		Don't Know		Total	
Province	NF	1	0.55%	27	14.92%	151	83.43%	2	1.10%	181	100.00%
	PEI	0	0.00%	6	14.29%	36	85.71%	0	0.00%	42	100.00%
	NS	1	0.39%	26	10.16%	226	88.28%	3	1.17%	256	100.00%
	NB	1	0.44%	35	15.42%	191	84.14%	0	0.00%	227	100.00%
	QB	5	0.56%	137	15.22%	755	83.89%	3	0.33%	900	100.00%
	ON	9	0.93%	191	19.81%	756	78.42%	8	0.83%	964	100.00%
	MB	2	1.00%	44	22.00%	153	76.50%	1	0.50%	200	100.00%
	SK	1	0.59%	22	12.94%	146	85.88%	1	0.59%	170	100.00%
	AB	6	1.16%	120	23.12%	389	74.95%	4	0.77%	519	100.00%
	BC	6	0.89%	111	16.49%	553	82.17%	3	0.45%	673	100.00%
	<b>Canada</b>	32	0.77%	719	17.40%	3356	81.22%	25	0.61%	4132	100.00%

## 5.2. Energy and Water Consumption for Clothes Washers

There are two measures that are commonly used to evaluate the efficiency of a clothes washer: the Modified Energy Factor (MEF) and the Water Factor (WF). The MEF measures energy

consumption of the total laundry cycle, including washing and drying. It indicates how many cubic feet of laundry can be washed and dried with one kWh of electricity. Hence, the higher the number, the greater is the efficiency of the clothes washer. WF measures the total water consumption, both hot and cold, for each cubic foot of laundry. A lower number indicates lower consumption and more efficient use of water. The corresponding minimum MEF and WF requirements under the Consortium for Energy Efficiency (CEE) of North America Initiatives in 2002 are shown in Table 26.

**Table 26: CEE Tier Levels and Specifications for Clothes Washers (2002)**

<b>Level</b>	<b>Modified Energy Factor (MEF)*</b>	<b>Water Factor (WF)**</b>
Baseline *	0.817	13.3
Tier 1	1.260	11.0
Tier 2	1.420	9.5
Tier 3	1.600	8.5
Tier 4A	1.800	7.5
Tier 4B	1.800	5.5

\* MEF baseline determined from 2002 minimum U.S. federal efficiency standard

\*\* Water factor baseline determined from 1995 shipment weighted average water use data from AHAM

To analyze energy and water consumption, we have utilized the study results from the U.S. DOE on residential clothes washers. Since the MEF also takes into consideration the energy used to dry the laundry, then the following engineering data also includes the related information for the dryer as well. In its study, DOE focuses only on the standard clothes washer's MEF level. It uses 5% as the increment unit and examines how the energy and water usage changes as the MEF level increases. The study results are presented in Table 27.

**Table 27: Energy and Water Use per Cycle for Standard Clothes Washer \***

Efficiency Level	Energy Use per Cycle						Water Use per Cycle	
	Motor Energy	Water Heating Energy			Dryer Energy		Hot Water	Total Water
		Elec WH	Gas WH	Oil WH	Elec Dryer	Gas Dryer		
	(kWh)	(kWh)	(GJ)	(GJ)	(kWh)	(GJ)	(gal)	(gal)
Baseline (MEF=0.817)	0.209	1.587	0.0076	0.0071	1.430	0.0058	8.82	39.18
5% Impr. (MEF= 0.86)	0.209	1.543	0.0074	0.0069	1.413	0.0057	8.57	38.61
10% Impr. (MEF= 0.908)	0.209	1.408	0.0068	0.0063	1.400	0.0056	7.82	38.61
15% Impr. (MEF=0.961)	0.209	1.216	0.0058	0.0054	1.407	0.0057	6.76	38.62
20% Impr. (MEF=1.021)	0.218	1.113	0.0053	0.0049	1.408	0.0057	6.18	38.45
<b>MEF = 1.04</b>	0.242	1.002	0.0048	0.0045	1.370	0.0055	5.57	35.14
25% Impr. (MEF=1.089)	0.304	0.715	0.0034	0.0032	1.273	0.0051	3.97	26.60
35% Impr. (MEF=1.257)	0.133	0.462	0.0022	0.0021	1.270	0.0051	2.57	21.03
<b>MEF = 1.26</b>	0.133	0.462	0.0022	0.0021	1.270	0.0051	2.57	21.03
40% Impr. (MEF=1.362)	0.133	0.462	0.0022	0.0021	1.263	0.0051	2.57	21.03
45% Impr. (MEF=1.485)	0.114	0.429	0.0021	0.0019	1.107	0.0045	2.38	23.41
50% Impr. (MEF=1.634)	0.114	0.413	0.0020	0.0018	1.047	0.0042	2.29	23.41

\* Assumptions:

1. Recovery Efficiency of water heaters (WH) – Electric: 100%; Gas: 75%; Oil: 81%.
2. Temperature difference for water heating: 75 degree Fahrenheit or 24 degree Celsius
3. To heat 1 gallon of water requires 0.18 kWh of electricity

Based on the above results, as the clothes washer’s efficiency improves, it can save up to 45% of energy from operating the machine and save up to 74% of energy from heating the water. In terms of water usage, the most efficient model uses 40% less water in general and uses 74% less hot water.

Using the average pricing information for Canada from Table 4, we can calculate the per-cycle energy expenditure under different situations. The results are shown in Tables 28 to 31. According to the calculations, a household that uses a gas water heater and dryer to combine with the most efficient (MEF=1.634) clothes washer spends the least on energy (\$0.09/cycle). The most expensive scenario (\$0.26/cycle) is when the household uses an electric water heater to supply hot water to the baseline standard washer, and dries the laundry with an electric dryer. In all cases, the most efficient clothes washer realizes an energy saving of about 50% compared to the baseline model.

**Table 28: Per Cycle Energy Expenditure - Electric Water Heater and Dryer**

Efficiency Level	Motor Energy	Elec WH	Elec Dryer	Total Energy Expenditure	Cost Saving vs. Baseline
Baseline (MEF=0.817)	\$0.02	\$0.13	\$0.11	\$0.26	-
5% Impr. (MEF= 0.86)	\$0.02	\$0.12	\$0.11	\$0.25	1.9%
10% Impr. (MEF= 0.908)	\$0.02	\$0.11	\$0.11	\$0.24	6.5%
15% Impr. (MEF=0.961)	\$0.02	\$0.10	\$0.11	\$0.23	12.2%
20% Impr. (MEF=1.021)	\$0.02	\$0.09	\$0.11	\$0.22	15.1%
<b>MEF = 1.04</b>	\$0.02	\$0.08	\$0.11	\$0.21	19.0%
25% Impr. (MEF=1.089)	\$0.02	\$0.06	\$0.10	\$0.18	29.0%
35% Impr. (MEF=1.257)	\$0.01	\$0.04	\$0.10	\$0.15	42.2%
<b>MEF = 1.26</b>	\$0.01	\$0.04	\$0.10	\$0.15	42.2%
40% Impr. (MEF=1.362)	\$0.01	\$0.04	\$0.10	\$0.15	42.4%
45% Impr. (MEF=1.485)	\$0.01	\$0.03	\$0.09	\$0.13	48.9%
50% Impr. (MEF=1.634)	\$0.01	\$0.03	\$0.08	\$0.13	51.2%

**Table 29: Per Cycle Energy Expenditure - Electric Water Heater and Gas Dryer**

Efficiency Level	Motor Energy	Elec WH	Gas Dryer	Total Energy Expenditure	Cost Saving vs. Baseline
Baseline (MEF=0.817)	\$0.02	\$0.13	\$0.08	\$0.22	-
5% Impr. (MEF= 0.86)	\$0.02	\$0.12	\$0.08	\$0.22	2.0%
10% Impr. (MEF= 0.908)	\$0.02	\$0.11	\$0.08	\$0.21	7.2%
15% Impr. (MEF=0.961)	\$0.02	\$0.10	\$0.08	\$0.19	13.9%
20% Impr. (MEF=1.021)	\$0.02	\$0.09	\$0.08	\$0.18	17.2%
<b>MEF = 1.04</b>	\$0.02	\$0.08	\$0.08	\$0.18	21.3%
25% Impr. (MEF=1.089)	\$0.02	\$0.06	\$0.07	\$0.15	31.8%
35% Impr. (MEF=1.257)	\$0.01	\$0.04	\$0.07	\$0.12	47.0%
<b>MEF = 1.26</b>	\$0.01	\$0.04	\$0.07	\$0.12	47.0%
40% Impr. (MEF=1.362)	\$0.01	\$0.04	\$0.07	\$0.12	47.2%
45% Impr. (MEF=1.485)	\$0.01	\$0.03	\$0.06	\$0.11	53.0%
50% Impr. (MEF=1.634)	\$0.01	\$0.03	\$0.06	\$0.10	55.0%

**Table 30: Per Cycle Energy Expenditure - Gas Water Heater and Electric Dryer**

Efficiency Level	Motor Energy	Gas WH	Elec Dryer	Total Energy Expenditure	Cost Saving vs. Baseline
Baseline (MEF=0.817)	\$0.02	\$0.11	\$0.11	\$0.24	-
5% Impr. (MEF= 0.86)	\$0.02	\$0.10	\$0.11	\$0.23	1.8%
10% Impr. (MEF= 0.908)	\$0.02	\$0.09	\$0.11	\$0.22	6.0%
15% Impr. (MEF=0.961)	\$0.02	\$0.08	\$0.11	\$0.21	11.2%
20% Impr. (MEF=1.021)	\$0.02	\$0.07	\$0.11	\$0.20	13.7%
<b>MEF = 1.04</b>	\$0.02	\$0.07	\$0.11	\$0.20	17.3%
25% Impr. (MEF=1.089)	\$0.02	\$0.05	\$0.10	\$0.17	26.5%
35% Impr. (MEF=1.257)	\$0.01	\$0.03	\$0.10	\$0.14	39.5%
<b>MEF = 1.26</b>	\$0.01	\$0.03	\$0.10	\$0.14	39.5%
40% Impr. (MEF=1.362)	\$0.01	\$0.03	\$0.10	\$0.14	39.8%
45% Impr. (MEF=1.485)	\$0.01	\$0.03	\$0.09	\$0.13	46.6%
50% Impr. (MEF=1.634)	\$0.01	\$0.03	\$0.08	\$0.12	49.1%

**Table 31: Per Cycle Energy Expenditure - Gas Water Heater and Dryer**

Efficiency Level	Motor Energy	Gas WH	Gas Dryer	Total Energy Expenditure	Cost Saving vs. Baseline
Baseline (MEF=0.817)	\$0.02	\$0.11	\$0.08	\$0.20	-
5% Impr. (MEF= 0.86)	\$0.02	\$0.10	\$0.08	\$0.20	1.9%
10% Impr. (MEF= 0.908)	\$0.02	\$0.09	\$0.08	\$0.19	6.7%
15% Impr. (MEF=0.961)	\$0.02	\$0.08	\$0.08	\$0.18	12.8%
20% Impr. (MEF=1.021)	\$0.02	\$0.07	\$0.08	\$0.17	15.8%
<b>MEF = 1.04</b>	\$0.02	\$0.07	\$0.08	\$0.16	19.6%
25% Impr. (MEF=1.089)	\$0.02	\$0.05	\$0.07	\$0.14	29.2%
35% Impr. (MEF=1.257)	\$0.01	\$0.03	\$0.07	\$0.11	44.4%
<b>MEF = 1.26</b>	\$0.01	\$0.03	\$0.07	\$0.11	44.4%
40% Impr. (MEF=1.362)	\$0.01	\$0.03	\$0.07	\$0.11	44.6%
45% Impr. (MEF=1.485)	\$0.01	\$0.03	\$0.06	\$0.10	50.8%
50% Impr. (MEF=1.634)	\$0.01	\$0.03	\$0.06	\$0.09	53.0%

## 6. Energy Conservation Tips for Residential Hot Water Usage

Water heating is one of the largest residential energy expenses. A number of recommendations have been made that can help reduce the energy needed to heat water for daily activities. These

include: use less hot water, turn down the thermostat on the water heater, insulate the water heater and pipes, and/or buy some new, more efficient appliances that produce or use hot water.

### *Use Less Hot Water*

There are many ways to reduce hot water usage. Some of these include:

- Install low-flow faucets and showerheads. A low-flow showerhead can reduce water consumption by as much as 50%. A family of four each showering five minutes a day can use about 700 gallons of water per week. A low flow showerhead can save the family 14,000 gallons of water a year as well as the energy required to heat it.
- Take showers instead of baths because baths use more water.

### *Turn down the Thermostat on the Water Heater*

Lower the thermostat on the water heater to 54°C. At this temperature, water will be hot enough to prevent bacteria buildup and for most other uses.

### *Insulate the Water Heater and Water Pipes*

Putting an insulating blanket around the water heater or storage tank is one of the most effective energy saving methods, especially if the water heater is in an unheated basement or space. The insulating blanket will reduce standby heat loss by about 25% to 40%. According to data from SHEU03, as presented in Table 32, fewer than 12% of the households in Canada have put some add-on insulation around their hot water tanks.

**Table 32: Add-on Insulation around the Hot Water Tank - SHEU 2003**

		Yes		No		Don't Know		Refusal		Not Stated		Valid Skip		Total	
Province	NF	8	4.17%	164	85.42%	1	0.52%	0	0.00%	0	0.00%	19	9.90%	192	100.00%
	PEI	4	8.51%	20	42.55%	3	6.38%	0	0.00%	1	2.13%	19	40.43%	47	100.00%
	NS	50	16.78%	177	59.40%	3	1.01%	0	0.00%	1	0.34%	67	22.48%	298	100.00%
	NB	22	9.05%	204	83.95%	3	1.23%	0	0.00%	0	0.00%	14	5.76%	243	100.00%
	QB	226	22.87%	677	68.52%	9	0.91%	2	0.20%	0	0.00%	74	7.49%	988	100.00%
	ON	85	8.23%	239	23.14%	6	0.58%	0	0.00%	2	0.19%	701	67.86%	1033	100.00%
	MB	9	3.93%	124	54.15%	0	0.00%	0	0.00%	0	0.00%	96	41.92%	229	100.00%
	SK	6	3.35%	41	22.91%	0	0.00%	0	0.00%	0	0.00%	132	73.74%	179	100.00%
	AB	9	1.61%	59	10.55%	2	0.36%	0	0.00%	0	0.00%	489	87.48%	559	100.00%
	BC	109	13.92%	222	28.35%	6	0.77%	0	0.00%	1	0.13%	445	56.83%	783	100.00%
	<b>Canada</b>	<b>528</b>	<b>11.60%</b>	<b>1927</b>	<b>42.34%</b>	<b>33</b>	<b>0.73%</b>	<b>2</b>	<b>0.04%</b>	<b>5</b>	<b>0.11%</b>	<b>2056</b>	<b>45.18%</b>	<b>4551</b>	<b>100.00%</b>

Insulating hot water pipes will reduce heat losses when hot water flows through the pipes. Furthermore, it will reduce standby losses when the tap is turned off and then back on within a short time period because the water will stay warmer much longer than it would have if the pipes were not insulated. Based on the data from Table 33, less than one-third of Canadian households insulated their hot water pipes in 2003.

**Table 33: Add-on Insulation around the Hot Water Pipes**

		Yes		No		Don't Know		Refusal		Not Stated		Valid Skip		Total	
Province	NF	52	27.08%	119	61.98%	3	1.56%	0	0.00%	0	0.00%	18	9.38%	192	100.00%
	PEI	12	25.53%	16	34.04%	2	4.26%	0	0.00%	1	2.13%	16	34.04%	47	100.00%
	NS	76	25.50%	153	51.34%	4	1.34%	0	0.00%	1	0.34%	64	21.48%	298	100.00%
	NB	62	25.51%	161	66.26%	7	2.88%	0	0.00%	0	0.00%	13	5.35%	243	100.00%
	QB	259	26.21%	638	64.57%	35	3.54%	2	0.20%	0	0.00%	54	5.47%	988	100.00%
	ON	404	39.11%	561	54.31%	34	3.29%	1	0.10%	2	0.19%	31	3.00%	1033	100.00%
	MB	39	17.03%	172	75.11%	6	2.62%	0	0.00%	0	0.00%	12	5.24%	229	100.00%
	SK	31	17.32%	138	77.09%	4	2.23%	0	0.00%	0	0.00%	6	3.35%	179	100.00%
	AB	118	21.11%	407	72.81%	18	3.22%	0	0.00%	0	0.00%	16	2.86%	559	100.00%
	BC	207	26.44%	471	60.15%	24	3.07%	0	0.00%	1	0.13%	80	10.22%	783	100.00%
	<b>Canada</b>	1260	27.69%	2836	62.32%	137	3.01%	3	0.07%	5	0.11%	310	6.81%	4551	100.00%

### *Buy More Efficient Appliances*

If you are in the market for a new water heater, or other appliances that consume a lot of hot water such as a dishwasher or clothes washer, it pays off in the long run to choose a more energy efficient model. For example, researchers have found that an on-demand water heater can save up to 30% on a household's hot water bill. The saving from an efficient dishwasher or clothes washer has been detailed in the previous sections.

When using appliances such as dishwashers or clothes washers, there are additional methods that can be used to save energy and water usage.

### *Dishwasher*

- Run it with full load.
- If the dishwasher has a booster heater, turn down the water heater thermostat.
- Avoid pre-rinsing the dishes before putting them in the dishwasher. Scrape off large food pieces if necessary. If you must rinse dishes first, use cold water if possible.
- Air dry the dishes. If there is no air-dry feature, turn off the dishwasher after the final rinse and open the door to allow air drying.

### *Clothes Washer*

- Use cold or warm water for laundry as much as possible
- Wash full loads.

## **6. Conclusions**

In this paper we have examined the energy consumption from domestic hot water usage in Canada using data from SHEU03 and engineering results from the U.S. DOE and other sources. The paper has presented a general picture on hot water usage in Canada and has evaluated the differences in cost and energy consumption according to the energy source used to provide hot water to dishwashers and clothes washers. Suggestions are also provided on how to save energy on residential hot water usage in general and particularly with these appliances.

**References:**

2003 Survey of Household Energy Use, Statistics Canada

Clothes Washer Life-Cycle Cost and Payback Period Spreadsheet, U.S. Department of Energy

Consortium for Energy Efficiency Residential Clothes Washer Initiative Program Description,  
the Consortium for Energy Efficiency, 2002.

Dishwasher Life-Cycle Cost and Payback Period Spreadsheet, U.S. Department of  
Energy [http://www.eere.energy.gov/buildings/appliance\\_standards/residential/docs/lcc\\_dishwasher.xls](http://www.eere.energy.gov/buildings/appliance_standards/residential/docs/lcc_dishwasher.xls)

Hot2000 Interactive V7.14 User Manual, Natural Resources Canada, 1996

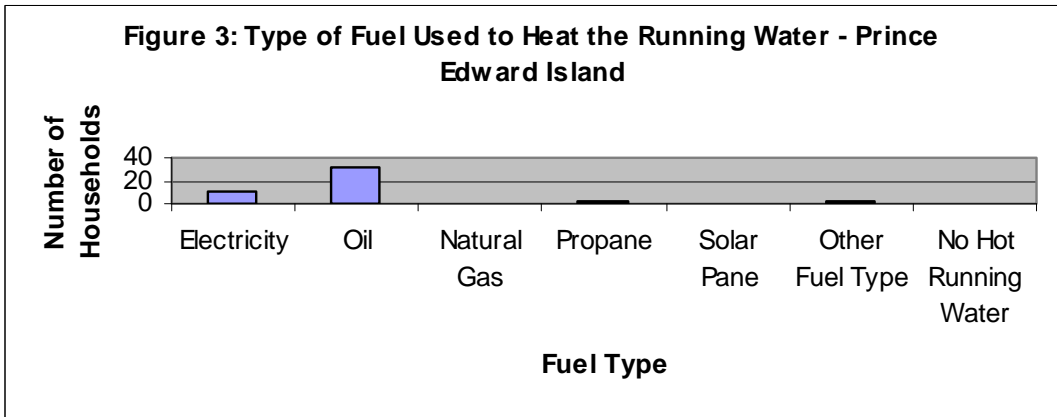
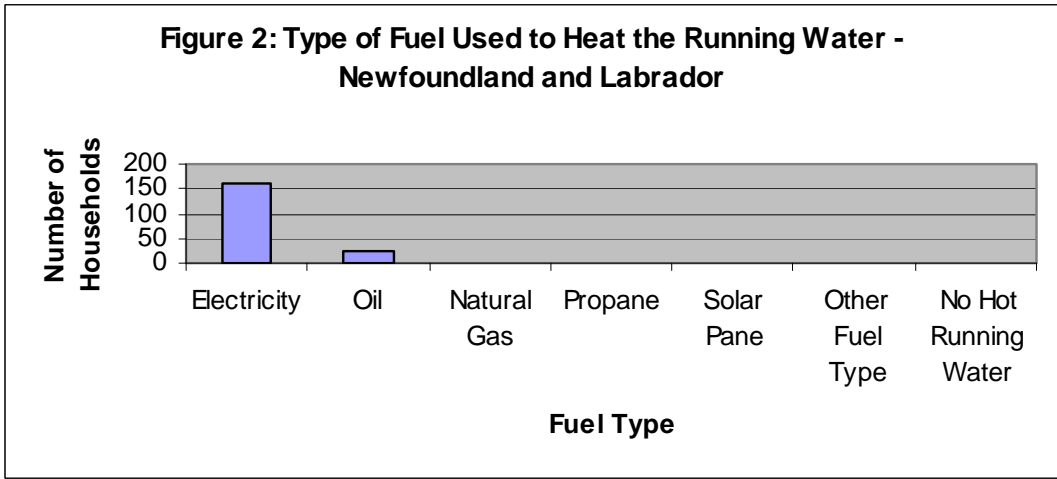
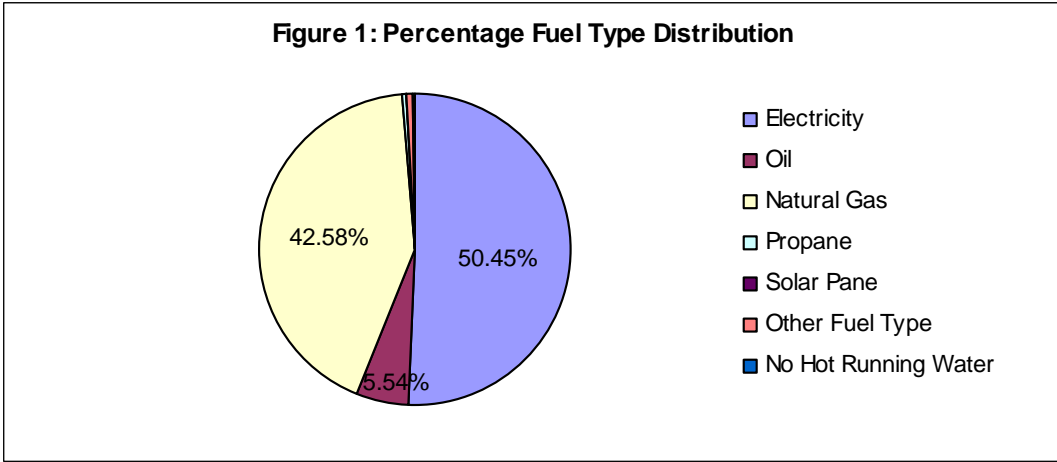
Rulemaking Framework for Commercial Clothes Washers and Residential Dishwashers,  
Dehumidifiers, and Cooking Products, U.S. Department of Energy, March  
2006 [http://www.eere.energy.gov/buildings/appliance\\_standards/pdfs/home\\_appl\\_framework\\_31506.pdf](http://www.eere.energy.gov/buildings/appliance_standards/pdfs/home_appl_framework_31506.pdf)

U.S. Department of Energy website

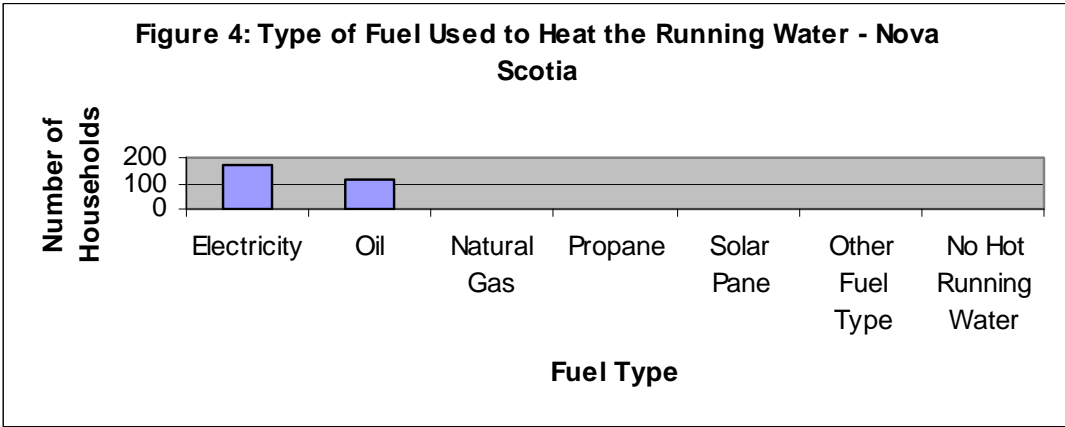
National Geographic (2007), “Is Your Home a “Green”

House?”, <http://www.nationalgeographic.com/everyday/greenhouse/tips.html>

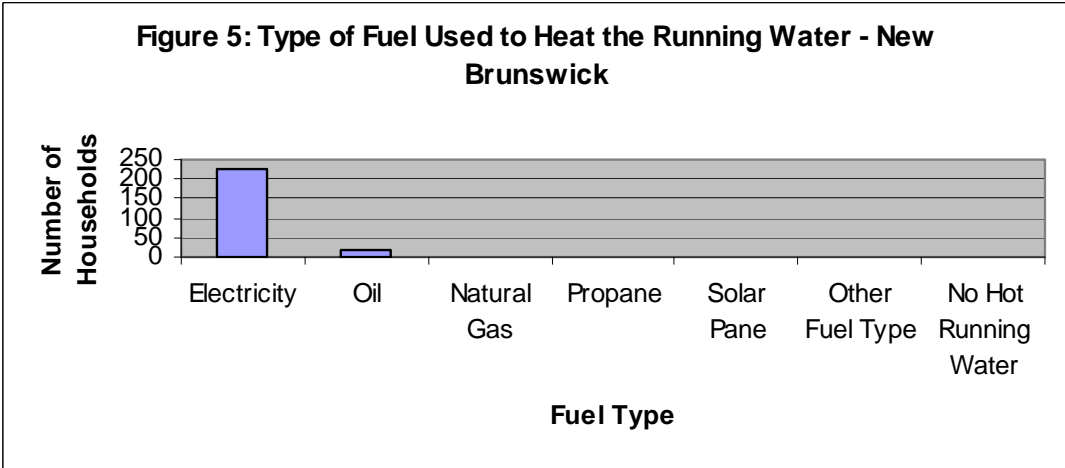
**APPENDIX: FIGURES**



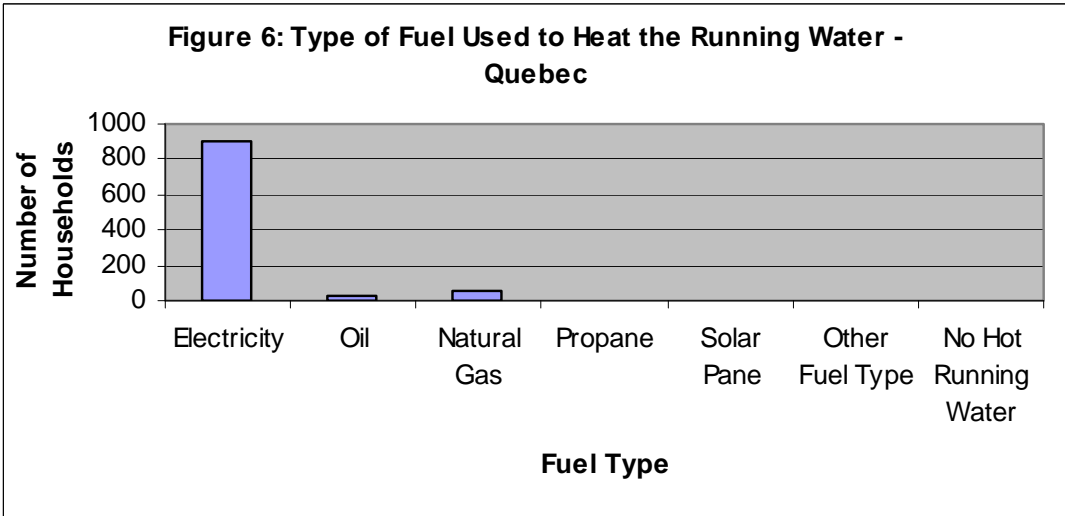
**Figure 4: Type of Fuel Used to Heat the Running Water - Nova Scotia**



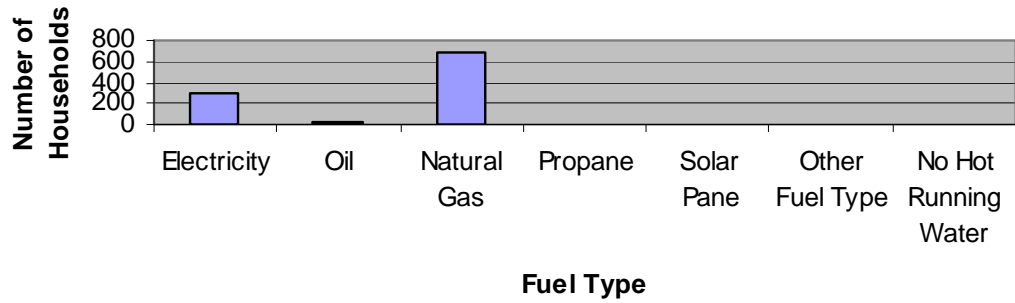
**Figure 5: Type of Fuel Used to Heat the Running Water - New Brunswick**



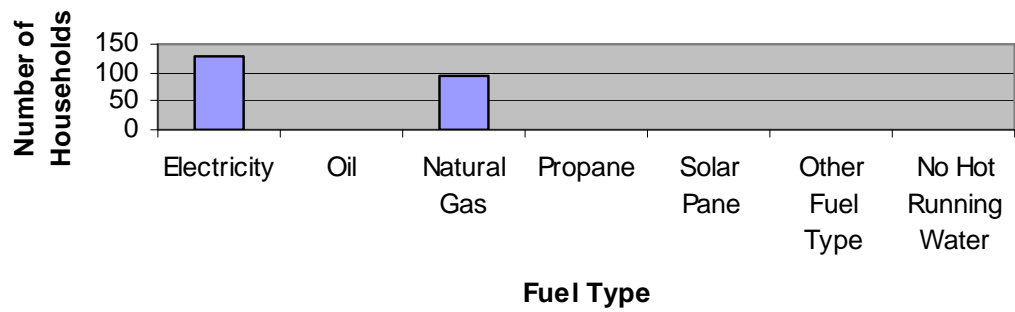
**Figure 6: Type of Fuel Used to Heat the Running Water - Quebec**



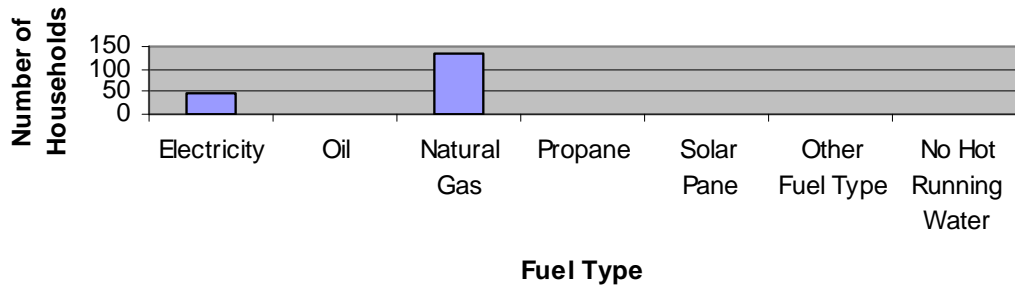
**Figure 7: Type of Fuel Used to Heat the Running Water - Ontario**



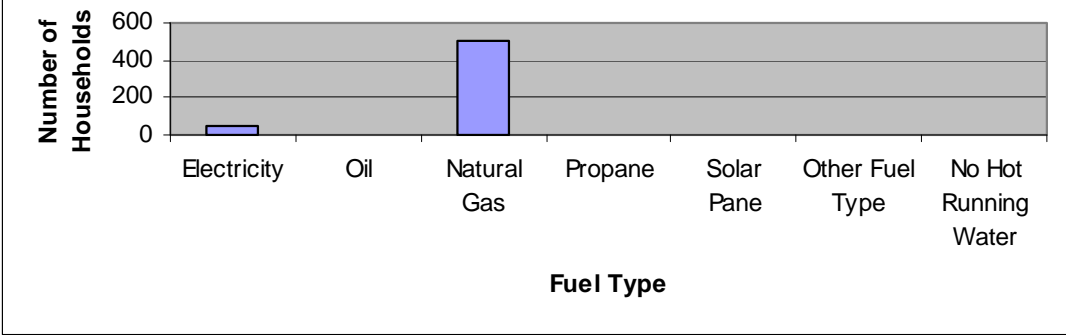
**Figure 8: Type of Fuel Used to Heat the Running Water - Manitoba**



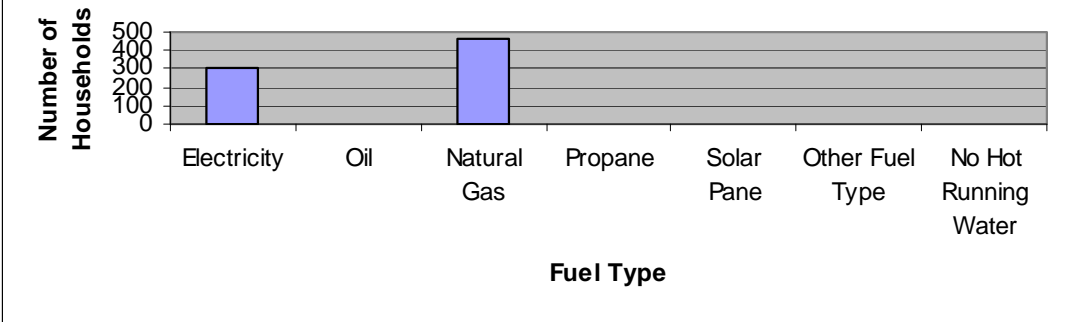
**Figure 9: Type of Fuel Used to Heat the Running Water - Saskatchewan**



**Figure 10: Type of Fuel Used to Heat the Running Water - Alberta**



**Figure 11: Type of Fuel Used to Heat the Running Water - British Columbia**



**Figure 12: Type of Clothes Washer - Newfoundland and Labrador**

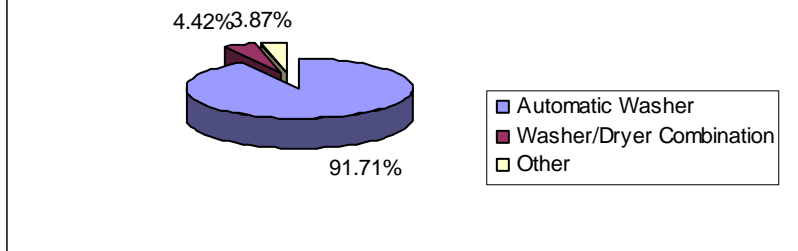


Figure 13: Type of Clothes Washer - Prince Edward Island

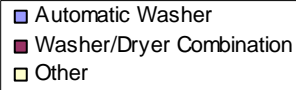
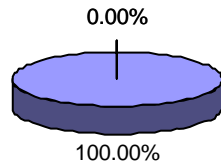


Figure 14: Type of Clothes Washer - Nova Scotia

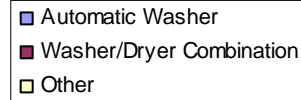
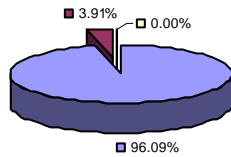


Figure 15: Type of Clothes Washer - New Brunswick

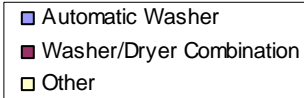
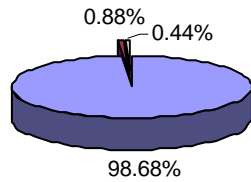
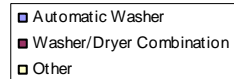
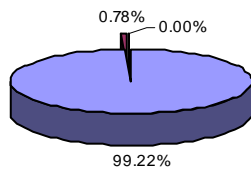
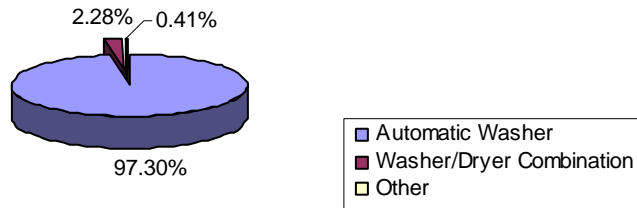


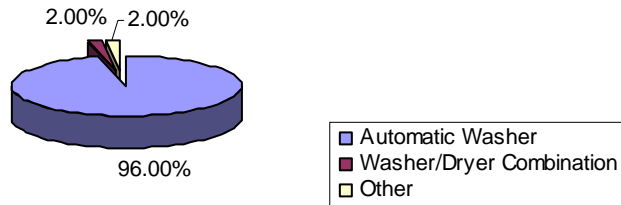
Figure 16: Type of Clothes Washer - Québec



**Figure 17: Type of Clothes Washer - Ontario**



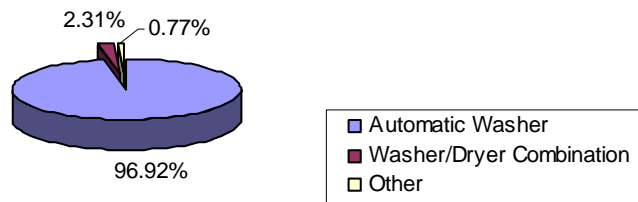
**Figure 18: Type of Clothes Washer - Manitoba**



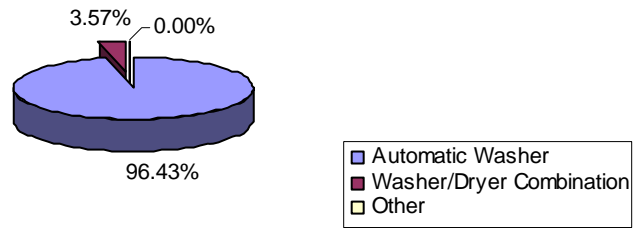
**Figure 19: Type of Clothes Washer - Saskatchewan**



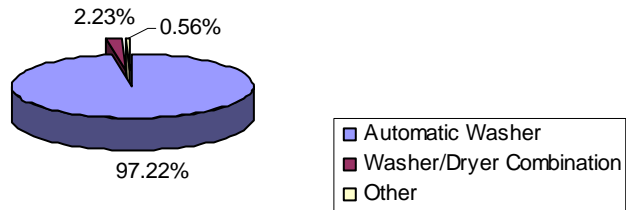
**Figure 20: Type of Clothes Washer - Alberta**



**Figure 21: Type of Clothes Washer - British Columbia**



**Figure 22: Type of Clothes Washer - Canada**



**CBEEDAC**  
Department of Economics  
University of Alberta  
8-14 Tory Building  
Edmonton, Alberta  
Canada  
T6G 2H4  
[cbeedac@ualberta.ca](mailto:cbeedac@ualberta.ca)

**COPYRIGHT © 2007**

**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 CBEEDAC is acknowledged as the source. All other rights are reserved. CBEEDAC 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.