

Country: Canada

Technology: Dishwashers

Sub Category: with a capacity of between six and sixteen place settings

## Introduction

The first stage in the Mapping and Benchmarking process is the definition of the products, i.e. clearly setting the boundaries that define the products for use in data collection and analysis. This ensures that comparison between the participating countries is done against a specific and consistent set of products.

The summary definition for this product is:

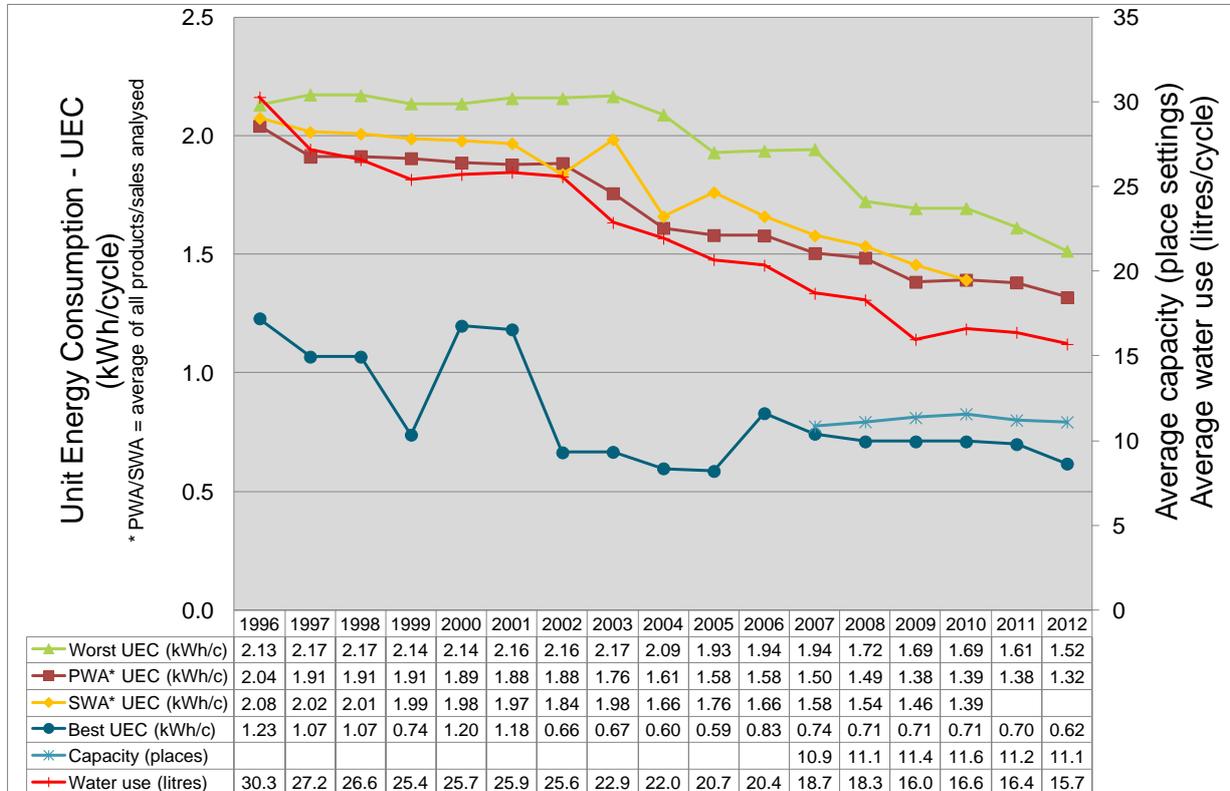
M&B Category	Description
<b>Definition and Scope</b>	<p><i>A machine which cleans, rinses, and dries dishware, glassware, cutlery, and, in some cases, cooking utensils by chemical, mechanical, thermal, and/or electric means, normally through the use of water and detergent. The machine may or may not have a specific drying operation at the end of the programme.</i></p> <p>The scope is to primarily include:</p> <ul style="list-style-type: none"> <li>• Single door built-in (this includes freestanding units in European definitions), portable and drawer-type dishwashers;</li> <li>• Both non-soil-sensing and soil-sensing unit.</li> </ul> <p>The scope will <i>exclude</i>:</p> <ul style="list-style-type: none"> <li>• Table top dishwashers (with fewer than 6 place settings)</li> </ul>
<b>Rated Capacity</b>	6-16 place settings
<b>Other Characteristics to be Noted</b>	<p>Wash Cycle Time</p> <p>Cleansing Performance</p> <p>Drying Performance</p> <p>Standby Functionality and Power Levels (Delayed Start, End of Cycle and Off)</p> <p>Load Type</p>

The detailed product definition can be found at the Annex website:

<http://mappingandbenchmarking.iea-4e.org/matrix?type=product&id=13>



## Unit Energy Consumption (UEC) of dishwashers in Canada

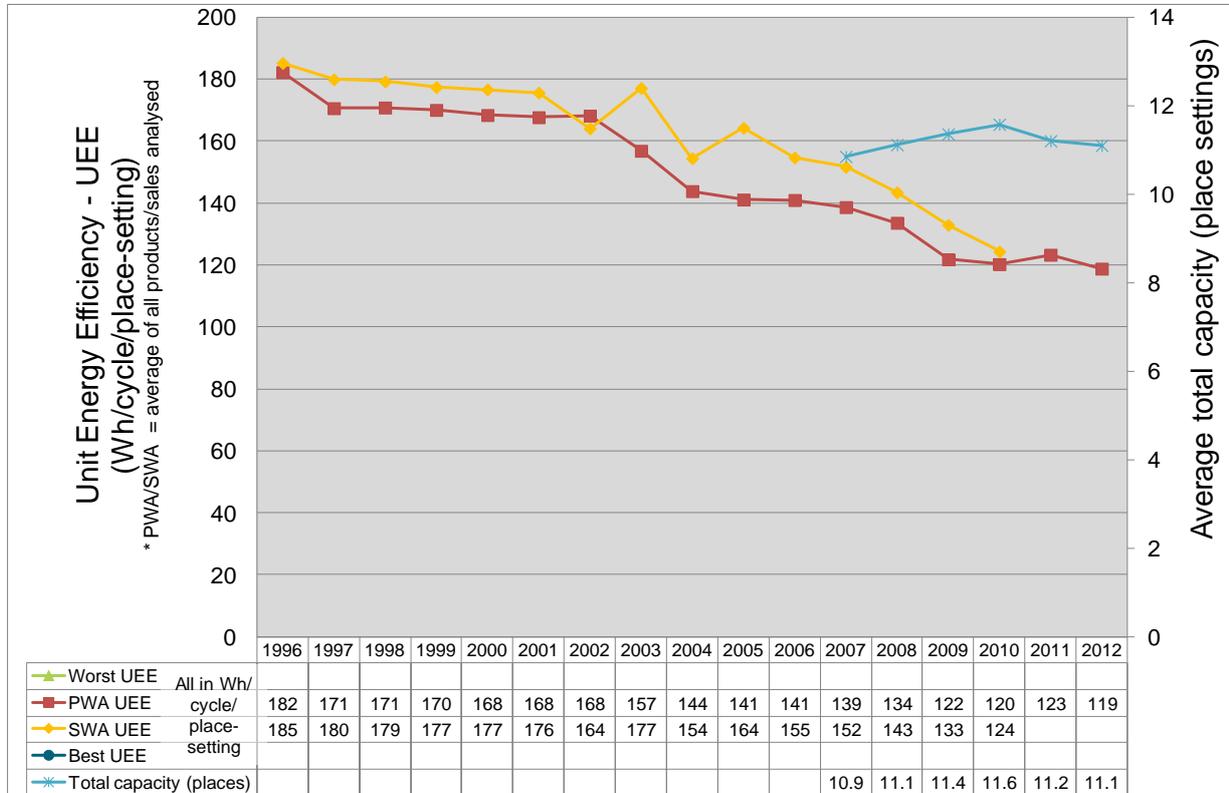


### Key notes on Graph (see notes section 1)

- Product and sales<sup>1</sup> weighted averages are from correlated data sets.
- No breakdown of dishwasher capacity was available in the data so **the average capacity presented is that of the products in the California Energy Commission database**. However, the Canadian and USA markets are believed to be very similar and this data is therefore a very good proxy for average Canadian capacities.
- Sales weighted average data is extracted from a declared value for total annual energy consumption (TAEC). The method for calculating TAEC was amended during both 2002 and 2005 (with a change to the number of cycles per annum) and in 2004 (with the inclusion of standby power). Without having access to the underlying data, it is assumed that these changes are responsible for the up-down-up trend in this data between 2002-2005, particularly because the declared TAEC plot does not show this pattern.
- The 'Worst UEC' is the UEC of the product at the 'worst 5%' point of a ranked list of products in the dataset.

<sup>1</sup> Sales weighted averages calculated based on *shipment weighted* data

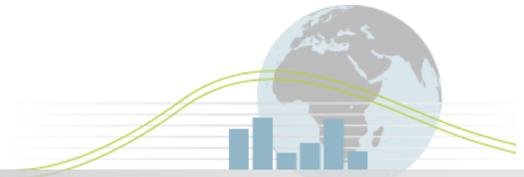
## Unit Energy Efficiency (UEE) of dishwashers in Canada



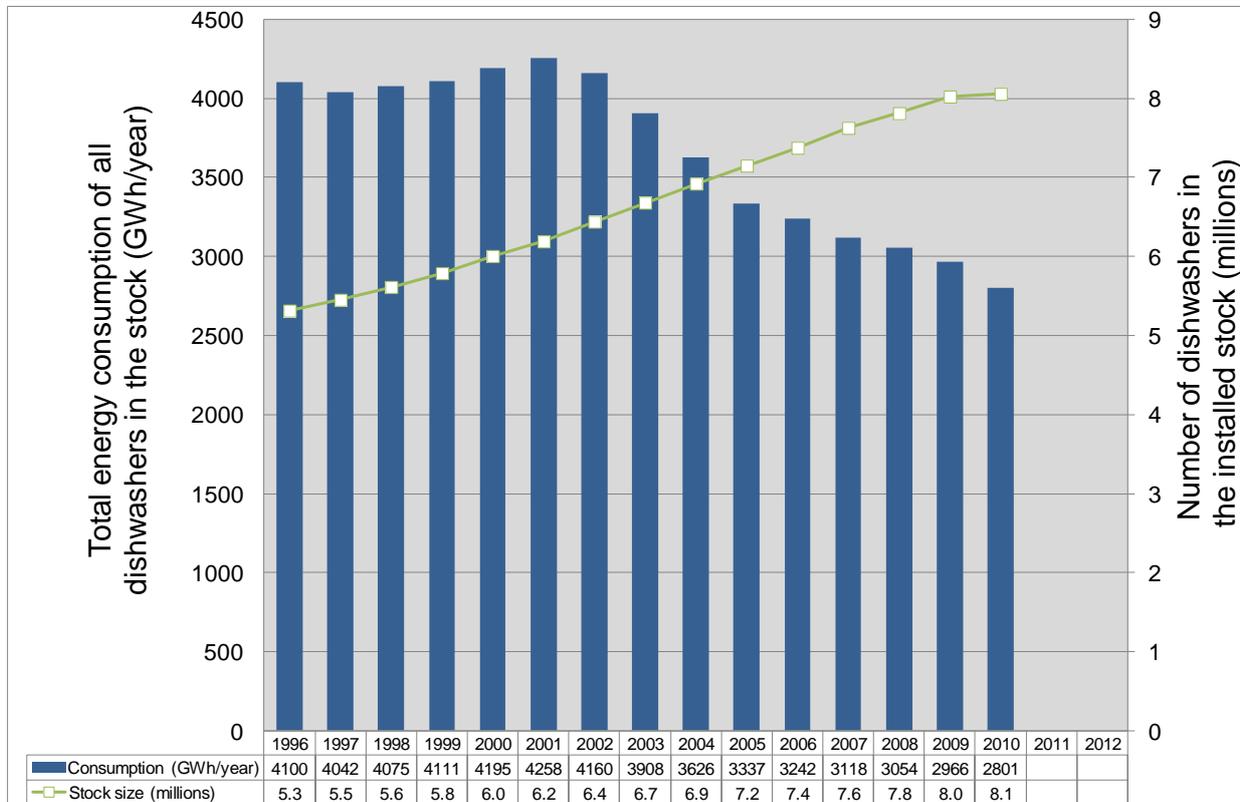
### Key notes on Graph (see notes section 1)

- Product and sales<sup>2</sup> weighted averages are from correlated data sets.
- No breakdown of dishwasher capacity was available in the data so **the average capacity presented is that of the products in the California Energy Commission database**. However, the Canadian and USA markets are believed to be very similar and this data is therefore a very good proxy for average Canadian capacities.
- All averages are derived using the annual averages of Canadian UEC and these USA capacities and should therefore be viewed with caution. Furthermore, UEEs prior to 2007 are based on the average USA capacity in all years and while capacity trends globally are relatively stable, this adds to the uncertainty of earlier values.
- Additionally, sales weighted average data is extracted from a declared value for total annual energy consumption (TAEC). The method for calculating TAEC was amended during both 2002 and 2005 (with a change to the number of cycles per annum) and in 2004 (with the inclusion of standby power). Without having access to the underlying data, it is assumed that these changes are responsible for the up-down-up trend in this data between 2002-2005, particularly because the declared TAEC plot does not show this pattern.
- The 'Worst UEC' is the UEC of the product at the 'worst 5%' point of a ranked list of products in the dataset.

<sup>2</sup> Sales weighted averages calculated based on *shipment weighted data*



## Energy Consumption of the installed stock of dishwashers in Canada



### Key notes on Graph (see notes section 2)

- Data is taken from the report Energy Consumption of Major Household Appliances Shipped in Canada - Trends for 1990-2010.



## Major Policy Interventions (see notes section 3)

Canada has three primary federal policy interventions related to the energy efficiency for dishwashers:

- **Minimum Energy Performance Standards (MEPS):** The *Energy Efficiency Act*, enacted in 1992, gives the Government of Canada the authority to make and enforce regulations on performance standards and labelling requirements for energy-using products that are imported into Canada or shipped across provincial and/or territorial borders for the purpose of sale or lease.

MEPS for dishwashers were first introduced in February 1995, with the registration of the *Energy Efficiency Regulations*. Since then, two amendments have been made to the *Regulations* concerning dishwashers. Amendment 8, published in September 2004, updated the reference for the test procedure for determining the minimum Energy Factor (EF) for dishwashers as well as introduced lower number of loads per year. Amendment 10, published in December 2008, increased the MEPS for dishwashers, replacing EF as a measure of energy performance with a total annual energy consumption which includes the calculation of a standby power. An amendment to further increase the stringency of MEPS for dishwashers has been announced in the regulatory plan for 2013-2015.

Generally, regulations and MEPS serve in transforming the Canadian marketplace by eliminating products with poor energy efficiency performance, while fostering a commitment to improving efficiency for energy-using equipment.

**Mandatory Labelling:** The EnerGuide label was introduced in 1978 under the Consumer Packaging and Labelling Act (1971), giving Canadians the opportunity to compare the energy consumption of major electrical household appliances, including dishwashers. With the enactment of the Energy Efficiency Regulations, placement of the EnerGuide label on major electrical household appliances and room/window air conditioners became mandatory. In addition to providing the average annual energy consumption of appliances, the EnerGuide label also includes a scale showing how the given appliance compares with other similar products in terms of annual energy consumption.

- **Voluntary Labelling:** In 2001, Canada officially introduced ENERGY STAR, the international symbol for energy efficiency. As of January 20, 2012, in order to be eligible for the ENERGY STAR label:
  - standard dishwashers that exceed the regulated performance standards by at least 17% and have a water factor of less than 16.09 L/cycle, and
  - compact dishwashers must exceed the regulated performance standards by at least 14% and have a water factor of less than 13.25 L/cycle.

ENERGY STAR has also been integrated with the EnerGuide label to further enable consumers to identify the most energy efficient products.





In addition the ENERGY STAR for new homes initiative encourages the use of energy efficient appliances, including dishwashers.

Conformity Assessment: Various monitoring activities are utilized to achieve a high level of compliance: self-monitoring by manufacturers and dealers; monitoring by regulatory authorities including NRCan designated inspectors, provincial partners, and Canada Customs and Border Services (CBSA); market surveys, product testing and electronic monitoring of energy efficiency reports and imports information to determine compliance; third-party verification mark issued by independent certification bodies accredited by the Standards Council of Canada; and finally with complaints and tips from dealers, manufacturers and consumers. Compliant product models are listed on Natural Resources Canada's website and in product directories for consumers, utilities, dealers, and the public.

In addition to these major policy interventions, federal, provincial and territorial governments have also introduced programs to encourage the purchase and use of energy efficient equipment, including grants, and rebate and incentives programs.



## Cultural Issues (see notes section 4)

- The Canadian market for dishwashers has remained relatively stable since 2007, ranging from a low of 706,000 in 2009 units to a high of 792,000 units in 2007. This has led to a moderate increase in the proportion of households in Canada with a dishwasher from 54% in 2002 to 60% in 2009;
- In 2002, 45% of new dishwasher models had an annual energy consumption of more than 600 kWh/year. Current federal regulations require that dishwashers imported into Canada for sale or lease have a total annual energy consumption of less than 355 kWh for standard size or 260 kWh for compact dishwashers.
- The average annual energy consumption of a dishwasher has decreased significantly in the last 30 years: the average annual energy consumption during the 1980s was 1400 kWh, decreasing to 1026 kWh in the 1990s and 298 kWh in 2011;<sup>3</sup>
- The popularity of dishwashers with stainless steel interior tubs has grown in recent years. In 2007, they represented 30% of market share; by 2011, 56% of new dishwasher models had stainless steel interior tubs;
- Tall tubs have also seen a significant growth in market share reaching 65% of all shipped units in 2011;
- Canadians continue to prefer built-in dishwashers, while market stock in portable models has declined. From 2002 to 2011, shipments of built-in models grew from 92.5% to slightly over 97% of market share, whereas shipments of portable dishwashers declined from 7.5% to just under 3%;
- Canadian consumers preferring dishwashers with features that help them to save energy and water such as: air dry vs. power dry, half-load option, delay start etc.
- The average useful life of a residential dishwasher is 13 years;
- Shipments to retail, building, and other consumers of ENERGY STAR dishwashers saw steady increases followed by significant drop offs in years where the ENERGY STAR standards were made more stringent. In 2011, the market share of ENERGY STAR dishwashers in Canada was 79%.

<sup>3</sup>A portion of this reduction is due to a change in the calculation methodology in 2004, lowering the number of loads used to calculate average energy consumption by 19% (from 264 to 215).



## Section 1. Unit Energy Consumption and Unit Energy Efficiency Graphics

### 1.1 Test methodologies

#### 1.1.1 Regulations

##### 1.1.1.1 Summary of Changes

The majority of the information in this section refers to:

*C373-04, Nov 2004: Energy consumption test methods and limits for household dishwashers (revised June 2005)*

This method was referred to in Canadian Minimum Performance Standards from 2004 onwards (including those introduced in 2010). However, the mapping and benchmarking process takes data from years preceding the introduction of this standard. During this period the following standard was in force

*C373-92, 1992*

This test method was referenced in the 1996 MEPS (enforced on February 3, 1995) until 2004 as noted above.

The primary differences relevant to the mapping and benchmarking process were:

- 1) The addition of a test methodology to measure standby power of the dishwasher and the addition of standby power to the annual total annual energy consumption calculation and associated declaration/ label information.
- 2) The switch in “standard” number of cycles performed per year from 264 to 215, again with the associated adjustments to the annual total annual energy consumption calculation and associated declaration/ label information.

Further, there are additional recent revised regulations for maximum energy consumption levels implemented from 1<sup>st</sup> January 2010 (Amendment 10 to the Energy Efficiency Regulations). Details of these revised requirements are included in the “Minimum Performance Requirements” section below.

##### 1.1.1.2 Test Methodology

Test methods referenced are primarily:

- C373-92; and
- C373-04.



### 1.1.1.3 Test Conditions:

**General approach:** The standard provides a methodology for testing the energy consumption based on a single unit. No comparative unit is required as the tests/regulations do not require declaration (or set a minimum) wash or dry performance.

**Rated Capacity:** The rated capacity of the dishwasher is defined as the whole number of complete place settings plus the corresponding serving pieces which can be cleaned and dried when loaded in accordance with the manufacturer's instructions.

A place setting (a set of crockery, glass and cutlery for use by one person) and the associated serving pieces are defined.

Type of unit (and associated load) is defined as follows:

- Standard dishwasher:  $\geq$  eight place settings and six serving pieces settings and six serving pieces
- Compact: < eight place settings and six serving pieces settings and six serving pieces

**Test load: CSA/C373-04.** Specified loads are of eight place settings and six serving pieces for standard machines and four place settings and six serving pieces for compact machines (unless the machine has a rated capacity lower than 6 place settings in which case the machine is loaded to rated capacity).

**Soiling Agent:** For models with soil sensing, soiling follows ANSI DW-1-1992 specification . The following soiling agents are required for both DOE and AHAM tests:

- Dinner plates: Quarter sections of egg yolk, mashed potatoes, ground beef/tomato paste mix, and red raspberry preserves with coffee grounds
- Bread and butter plates, dessert bowls: Half sections of oatmeal and creamed corn
- Coffee cups and saucers: Coffee
- Glasses: Tomato juice
- Serving bowls and spoons (AHAM only): 1 with creamed corn, 1 with mashed potatoes, or half sections if only 1 bowl used
- Knives and serving platter (AHAM only): Peanut butter (applied to knives)
- Spoons (AHAM only): Half with creamed corn, half with oatmeal
- Forks and serving fork (AHAM only): Egg yolk

Three tests are undertaken at different levels of soiling with a weighted average unit energy consumption being reported.

For models without soil sensing, a clean load used in energy consumption tests.

**Cycle, Programme and Time:** A cycle is defined as any complete sequence of operations capable of being pre-set before initiation of machine operation. A cycle can include variations in, or combinations of, the functions of washing, rinsing, and drying.



Normal cycle is defined as: the cycle recommended in the manufacturer's instructions for completely washing a full load of normally soiled dishes, including the powered-dry feature (if such a feature is provided).

Truncated normal cycle is defined as the normal cycle, interrupted to eliminate the powered-dry feature, after termination of the last rinse operation. (Note that this is relevant in the calculation of energy consumption)

The cycle time is not formally defined but it can be inferred to be the time measured from the initiation of the program (excluding any user programmed delay) until all activity ceases. Activity is considered to have ceased when the power consumption reverts to a steady state condition that persists indefinitely without user intervention. If there is no activity after the end of the program, the cycle time is equal to the program time (again adjustments are made for a truncated cycle).

**Cleansing Performance:** No mechanism is defined for the measurement of the dishwashers cleansing performance, nor are there any mandatory or voluntary limits or labelling requirements for cleansing performance.

**Drying Performance:** No test method prescribed to measure drying performance and no requirements to measure or disclose the information.

**Stand-by:** Standby mode is defined as the lowest power consumption mode that cannot be switched off or influenced by the user and can persist for an indefinite time when the dishwasher is connected to the main electrical supply and used in accordance with the manufacturer's instructions.

Standby power in Watts is measured to ensure a full "stand-by cycle" is captured.

This measured standby power is then used as part of the calculation of total annual energy consumption.

**Water consumption:** The water consumption is the total (hot and/or cold) water delivered to the machine during the entire test cycle.

Water heating type dishwasher can be connected to cold water or hot water. The manufacturer decides what water line should be connected. If they recommend cold water, the unit is connected to the 10°C supply water. If the manufacturer recommends 49°C, it is connected to a 49°C supply water. Thus, for water heating type dishwashers, tests can be done with cold or hot water depending on what manufacturer recommends in their owners guide.

Water consumption in soil sensing machines is measured appropriately based on empirically derived consumer usage patterns and the measurement can be considered equivalent to the water measurement in "normal" units.

**Embodied Water Energy/ Nominal Water Inlet Temperature:** Nominal water inlet temperature is 10°C. Adjustments for embodied energy in the water are made for supplies that vary from this temperature.

**Water Hardness:** Not controlled as “normal” water supplied to the test facility through mains is specified for use.

**Detergent/ Rinse Agent/Water Softener:** The quantity and formula of the detergent, rinse aid and (if required) water softening salt is prescribed in ANSI DW-1-1992.

**Noise:** Not measured in the test.

**Ambient Temperature:** 23.8°C +/- 3°C.

**Order of Tests:** A preconditioning operation is performed prior to all tests.

Energy, water and duration are recorded during a single full cycle, with the cycle repeated a sufficient number of times for the measurements to be considered statistically valid.

Measurement of standby consumption occurs after the main consumption test.

#### **Energy Consumption:**

##### **Energy Consumption Per Cycle ( $E_C$ )**

$$E_C = (\text{energy used in the wash and dry cycle normalised for embodied water temperature energy})^4$$

Where Energy used in the washing and dry function is adjusted for units with an option for truncated dry cycle such that:

$$\text{wash and dry cycle energy} = (\text{wash energy normalised for embodied water temperature energy}) + (\text{dry energy}/2)$$

(note that drying energy is given the name  $E_D$ )

##### **Annual Energy Consumption ( $E_A$ )**

$$E_A = E_C \times 215$$

Where 215 is the empirically derived number of washes per year.

##### **Annual Stand-by Energy Consumption ( $S$ )**

$$S = \text{hours per year in standby} \times \text{average measured standby power}$$

Where

$$\text{Hours per year in Standby} = 8766 - (\text{cycle time} * 215)$$

(8766 is the number of hours in year accounting for leap years and 215 is empirically derived number of wash cycles per year. Note that the drying time element is reduced by half for units with an option for truncated cycle).

##### **Total Annual Energy Consumption (TEAC)**

<sup>4</sup> There are several variations of this definition for specific functionality e.g. soil sensing, but this is the primary derivation.



$$TEAC = \text{Annual Energy Consumption } (E_A) + \text{Annual Stand-by Energy Consumption } (S)$$

## 1.2 Product Classifications

Standard for:

1. Measurement of energy consumption for household dishwasher
2. Energy consumption limits for household dishwashers

Includes the following definitions:

- Dishwasher — a machine for automatically washing dishes.
- Automatic dishwasher — a dishwasher that performs a complete cycle after one setting of the controls and stops without requiring further attention from the user.
- Built-in dishwasher — a dishwasher that is permanently installed.
- Non-soil-sensing dishwasher — a dishwasher that is unable to automatically adjust any energy-consuming aspect of a wash cycle based on the soil load of the dishes.
- Portable dishwasher — a dishwasher that is not permanently installed.
- Soil-sensing dishwasher — a dishwasher able to automatically adjust any energy-consuming aspect of a wash cycle in accordance with the soil load of the dishes.
- Water-heating dishwasher — a dishwasher that, as recommended by the manufacturer, is designed for heating cold inlet water (nominal 10 °C [50°F]) or water with a nominal inlet temperature of 49 °C (120°F) and provides internal water heating to above 49 °C (120°F) in at least one wash phase of the normal cycle).

## 1.3 Data sources

Sources:

1. Energy Consumption of Major Household Appliances Shipped in Canada, Trends for 1990-2010, Natural Resources Canada, December 2012
2. Major Appliance Industry Trends and Forecast, Canadian Appliance Manufacturers Association, 2008, 2009 and 2012
3. Energy Use Data Handbook tables 1990-2010.
4. All capacity data is based on the California Energy Commission database<sup>5</sup>.

<sup>5</sup> Current models taken from <http://www.appliances.energy.ca.gov/SearchResults.aspx> (advanced search)  
 Historical data from: [http://www.energy.ca.gov/appliances/database/historical\\_excel\\_files/Dishwashers/](http://www.energy.ca.gov/appliances/database/historical_excel_files/Dishwashers/)



The number of models analysed are presented in the tables below.

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Products in dataset	263	299	292	239	229	156	273	346	463	508	661	636	772	700	705	643	770
Products analysed	263	299	292	239	229	156	273	346	463	508	653	636	772	700	705	643	770
% products included	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	100%	100%	100%	100%	100%	100%

Sales weighted data is in fact based on shipment weighted data. The following information on total shipments gives an indication of the number of shipments included in the analysis:

**Based on CAMA 2012 report Major Appliance Industry Trends and Facts**

Unit shipments (000s)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Dishwashers	360*	415*	415*	470*	470*	480*	575*	590*	630*	670*	710	792	760	706	770	772

## 1.4 Data manipulations and specific limitations

### 1.4.1 Overview of the mapping and benchmarking process

There are essentially 4 stages to the mapping and benchmarking process for dishwashers as detailed below:

Stage:	Description
1. Data Cleaning and Pre-processing	<ul style="list-style-type: none"> <li>• Removal of duplicate entries</li> <li>• Pre-processing to align all terminology and reported test values to be consistent between countries</li> <li>• Assigning of local, mapping and benchmarking and EU categories</li> <li>• Etc</li> </ul>
2. Production of mapping outputs	<ul style="list-style-type: none"> <li>• Production of mapping outputs based on local test methodologies</li> </ul>
3. Normalisation of test data	<ul style="list-style-type: none"> <li>• Calculation of full cycle Unit Energy Consumptions</li> <li>• Normalisation for test temperature differentials</li> </ul>
4. Production of Benchmarking outputs	<ul style="list-style-type: none"> <li>• Post processing of benchmarking results</li> <li>• Production of benchmarking report</li> </ul>

The details of this process are described in two supporting documents that accompany this mapping report:

1. The **product definition** describes the exact characteristics of the product being analysed; the energy metrics that will be calculated; the technological, usage and other characteristics that will be considered; and any other policy or cultural information that will be collected
2. The **summary of approach** provides an overview of the mapping and benchmarking process for analyzing dishwashers for all countries and regions.

These documents can be found at the annex website:

<http://mappingandbenchmarking.iea-4e.org/matrix?type=product&id=11>

Aspects of the Canada analysis that are specific to the local dataset or regulations are described below.



## 1.4.2 Specific cautions for the Canada data

### 1.4.2.1 Data cleaning

The main steps for cleaning the product weighted data were as follows:

- The Canadian database has no capacity data (number of place settings). It has therefore been assumed that the average capacity of dishwashers in the USA data (California Energy Commission) is a suitable proxy for Canadian dishwashers. This data is shown below:

Year	2007	2008	2009	2010	2011	2012
USA average capacity (place settings)	10.9	11.1	11.4	11.6	11.2	11.1
Models analysed	297	530	805	1313	975	1028

It should be noted that as a result of the Canadian dataset having not information on the capacity, it is possible that models excluded from the analysis (i.e. those with either <6 or >16 place settings) may be included in Canada. It is, however, believed that there will be very few if any models of this capacity.

- Prior to 2008, data was provided in *(Total) Annual Energy Consumption (kWh)*. The equation to convert back to consumption per cycle is:

$$\text{Energy Consumption per cycle} = (\text{Total Annual Energy Consumption} - \text{Annual Standby Power consumption}) / \text{number of cycles per year}$$

The assumed number of cycles per annum is shown below:

Year	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
Cycles per year	322	322	322	322	322	322	322	264	264	215	215	215	215	215	215	215	215

From 2004 onwards Total Annual Energy consumption included a component for Annual Stand-by Energy Consumption (S) where:

$$S = \text{hours per year in standby} \times \text{average measured standby power}$$

and

$$\text{Hours per year in Standby} = 8766 - (\text{cycle time} \times 215).$$

Assumptions had to be made for the values of average cycle time (based on the Test methodology assumed "normal cycle time") and standby power (based on Australian data for the same period) as follows:

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
Cycle time	150	150	150	150	150	150	150	150	150
Ave. Standby Power	2.23	2.06	1.90	1.73	1.56	1.39	1.23	1.06	0.89

- Sales weighted average data was supplied as shipment weighted average and these are assumed to be equivalent. The data was also supplied as *Total Energy Efficiency of New dishwashers* (including electrical energy and the energy in the hot water). This data was assumed to be equivalent to *Total Annual Energy Consumption (kWh)* and converted to Unit Energy Consumption (kWh/cycle) using the same methodology as above.
- 1996-97 data sets include a tag from drying type as follows:





- Type A** No heat dry available
- Type B** Heat dry only
- Type C** Heat on / heat off option

### 1.4.2.2 Test methodology details used in the analysis

The specific aspects of the Canadian test methodology that were used in the benchmarking analysis are listed below:

- Ambient temperature is 75°F ± 5°F = 23.8 ± 3 °C. This is assumed to be the temperature of the load at the start of the cycle.
- Inlet water temperature is either 10°C or the energy consumption results is adjudged to a value equivalent to that if the inlet water temperature had been set at 10°C.
- The weight of the load by type is as follows:

Number of place settings	6	7	8	9	10	11	12	13	14	15	16
Mass of crockery in USA / Canada load (kg)	7.48	9.185	10.27	10.27	10.27	10.27	10.27	10.27	10.27	10.27	10.27
Mass of cutlery USA / Canada load (kg)	1.175	1.35	1.525	1.525	1.525	1.525	1.525	1.525	1.525	1.525	1.525

### 1.4.2.3 Canada specific normalisation steps

In order to make the Unit Energy Consumption data comparable with that in other markets, the full cycle consumption needs to be estimated as described in the *summary of approach* report. Some entries in the NR Canada (product weighted) dataset had no data on whether the model was tested with a truncated cycle. Where this data was not available, and for the sales weighted data, prior to the benchmarking analysis model Unit Energy Consumption (UEC) was adjusted to be equivalent to the full cycle consumption using the following formula:

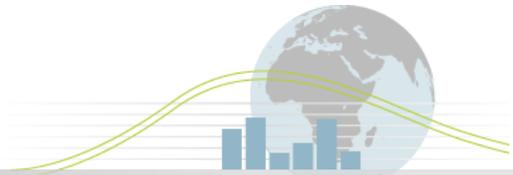
$$UEC \text{ per full cycle} = \text{listed UEC per cycle} * (1 + * 7\%^6 * 89\%^7)$$

As a result of no capacity data being available from the Canadian dataset, the normalisation for loading was undertaken using the average capacity of dishwashers in the USA dataset (California Energy Commission) for all models.

<sup>6</sup> Half the average % increase in Unit Energy Consumption of a full cycle compared to a truncated cycle. This average was based on a series of tests on 18 machines undertaken by CSA International during 2011-13.

<sup>7</sup> The average % of models in the Canadian dataset with powered drying functionality in years 2008-12 (those years with the most robust data). This may over estimate the number of models with powered drying in earlier years because the USA, which is a very similar market, shows a slightly decreasing prevalence of powered drying in earlier years. If there were fewer models having powered drying in earlier years, this assumption will overestimate UEC in those years (by a maximum of 4.9% if no models had powered drying).

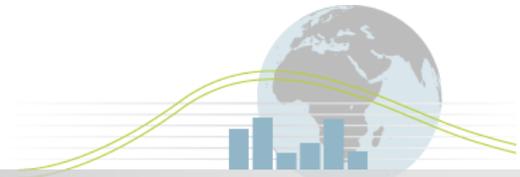




Sales weighted data was normalised using the same method as other data using the following additional assumptions:

1. in years for which data was available, the assumed average capacity for load normalisation was the average in the same year for models in the USA (California Energy Commission) dataset. For years in which USA data was not available (1996-2006), the average of all years in the USA dataset was used. While the load normalisation does not have a substantial effect on results, if this assumption is significantly wrong, the impact could be significant and therefore these results should be viewed with particular caution.
2. The average water consumption of all shipments was assumed to be the same as the average of models in the NRCAN database in each year.





## Section 2. Energy Consumption of the installed stock of dishwashers graphic

### 2.1 Data sources and limitations

#### Sources:

**Unit Energy Consumption (UEC) in stock:** Natural Resources Canada, Comprehensive Energy Use Database Tables, Table 38: Unit Energy Consumption (UEC) for Stock of Appliances and New Appliances<sup>8</sup>.

**Number of appliances (by type):** Natural Resources Canada, Comprehensive Energy Use Database Tables, Table 37: Appliance Stock by Appliance Type and Energy Source<sup>9</sup>.

#### Calculation methodology:

Stock consumption is the product of UEC and number of appliances.

<sup>8</sup> [http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends\\_res\\_ca.cfm?attr=0](http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_res_ca.cfm?attr=0)

<sup>9</sup> [http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends\\_res\\_ca.cfm?attr=0](http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_res_ca.cfm?attr=0)



## Section 3. Major Policy Interventions

### 3.1 Minimum Energy Performance Standards

From 1 January 2004 – 31 December 2009, the minimum performance standard (referred to as **Tier 1** limits) was set at a minimum performance **Energy Factor (EF)** of:

*Compact dishwasher 0.62 kWh/cycle*

*Standard dishwasher 0.46 kWh/cycle*

#### **Energy Consumption Factor (EF)**

$$EF = 1 / (\text{Total Energy Consumption Per Cycle } (E_C))$$

From 1 January 2010, the minimum energy performance standard was revised to become a **Maximum** Total Annual Energy Consumption (TEAC) value of:

*Compact dishwasher 260 kWh/year*

*Standard dishwasher 355 kWh/year*

*(this equates to and  $EF \geq 0.62$  (standard) and  $EF \geq 0.85$  (compact) and standby power of 1 watt)*

From 30 May 2013, the minimum energy performance standard **in the USA** were revised again to a **Maximum** Total Annual Energy Consumption (TEAC) value of:

*Compact dishwasher 222 kWh/year, Maximum Water Consumption 3.5 gallons/cycle*

*Standard dishwasher 307 kWh/year, Maximum Water Consumption 5.0 gallons/cycle*

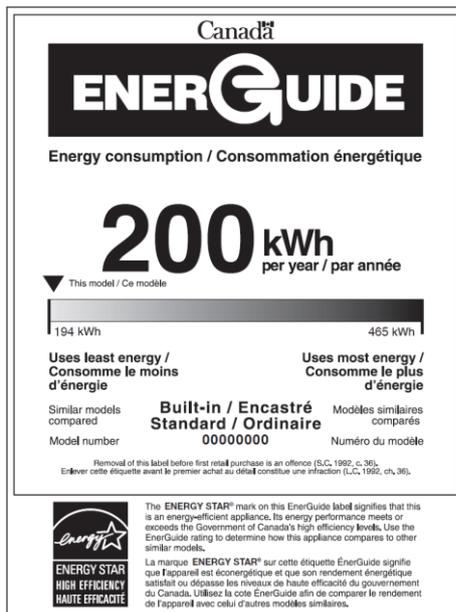
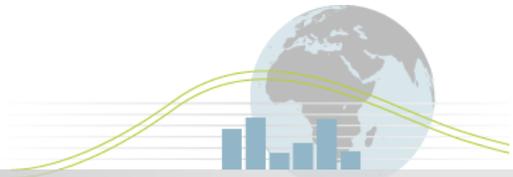
At the time of publication, Canada was in the process of harmonizing with these USA MEPS.

#### **Mandatory Labelling: EnergyGuide**

The EnerGuide label on dishwashers indicates how much electricity in kilowatt-hours (kWh) a particular model uses in one year.

The EnerGuide label also incorporates the ENERGY STAR Mark for qualified products.





### 3.2 Voluntary Labelling: ENERGY STAR

The required Energy Factor (EF) values to qualify for ENERGY STAR certification were (noting that other qualifying criteria needed also to be met):

*2004 – 2007 - Standard dishwasher 0.58*

*2007 – August 10, 2009 - Standard dishwasher 0.65*



In 2009 the minimum energy performance standard for ENERGY STAR was revised to become a **Maximum** Total Annual Energy Consumption (TEAC) value and a Water Factor Requirement was added. Maximum values were (from August 11 2009):

*Compact dishwasher 234 kWh/year, Water Factor changes to 4.0 gal/cyc*

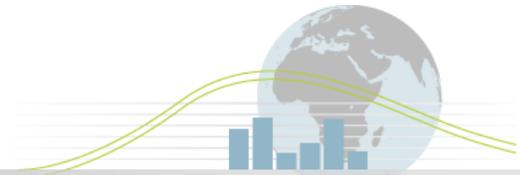
*Standard dishwasher 324 kWh/year, Water Factor changes to 5.8 gal/cyc*

From 20 January 2012, Version 5.0 of the minimum energy performance standard became compulsory with the following revisions:

*Compact dishwasher 222 kWh/year, Water Factor changes to 3.5 gallons/cycle*

*Standard dishwasher 295 kWh/year, Water Factor changes to 4.25 gallons/cycle*

Subsequently, the EPA plans to establish Tier 2 cleaning performance requirement and at the same time revise the energy and water criteria.



## Section 4. Cultural Issues

**Sources:** Cultural information was drawn from a range of sources listed below:

Energy Consumption of Major Household Appliances Shipped in Canada, Trends for 1990-2010, Natural Resources Canada,

Major Appliance Industry Trends and Forecast, Canadian Appliance Manufacturers Association, 2012

