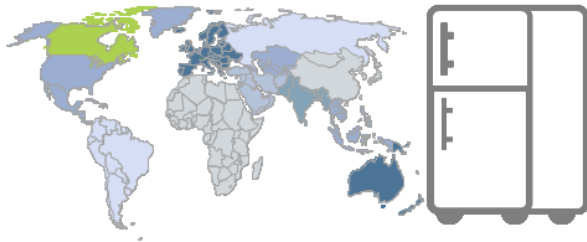
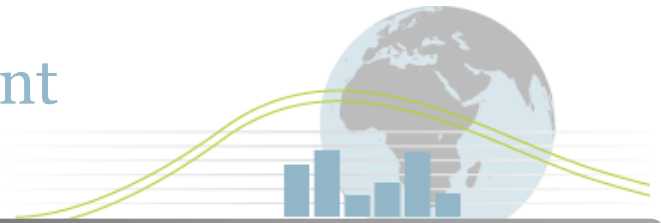


# 4E

## Mapping Document



Country: Canada

Technology: Domestic Cold Appliances

Sub Category: Freezers and Refrigerator/  
Freezers Combinations

### 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. Doing this ensures that comparison between the participating countries is done against a specific and consistent set of products.

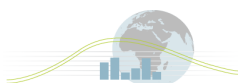
The summary definition for this product is:

<p>Under Counter/ upright Refrigerators</p> <p>(Single Grouping – collect data only)</p>	<p>Refrigerator with freezer (ice) compartment</p> <p>(Single grouping – collect data only)</p>	<p>Side-by-Side and Freezer top/ Refrigerator bottom and Refrigerator top/ Freezer bottom</p> <p>(Collect data on proportion of each type of unit in the market)</p>	<p>Chest/Under Counter/Upright Freezer</p> <p>(Collect data on proportion of each type of unit in the market)</p>
<p>Where units are:</p> <ul style="list-style-type: none"> <li>From all climate classes (but collect data on specific climate class that may be useful for later analysis)</li> <li>Have freezer compartments with rated temperatures below -12 (all temperature ratings to refrigerator with freezer (ice) compartment)</li> <li>Differentiated (if possible) between units with peripheral water coolers and ice makers</li> </ul>			
<p>Do not differentiate between</p> <ul style="list-style-type: none"> <li>Defrost Cycles including Manual/Cyclical/Automatic (although collect data in case normalisation is required)</li> <li>Controls mechanisms including manual, automatic and cyclical</li> <li>Built in and stand-alone units (but where differentiated in market, collect data to enable normalisation)</li> <li>Volume (but collect data on gross volumes as base metric)</li> <li>Climate class (but collect data on climate class in case future analysis required, plus data on related local test conditions for climate classes)</li> </ul>			

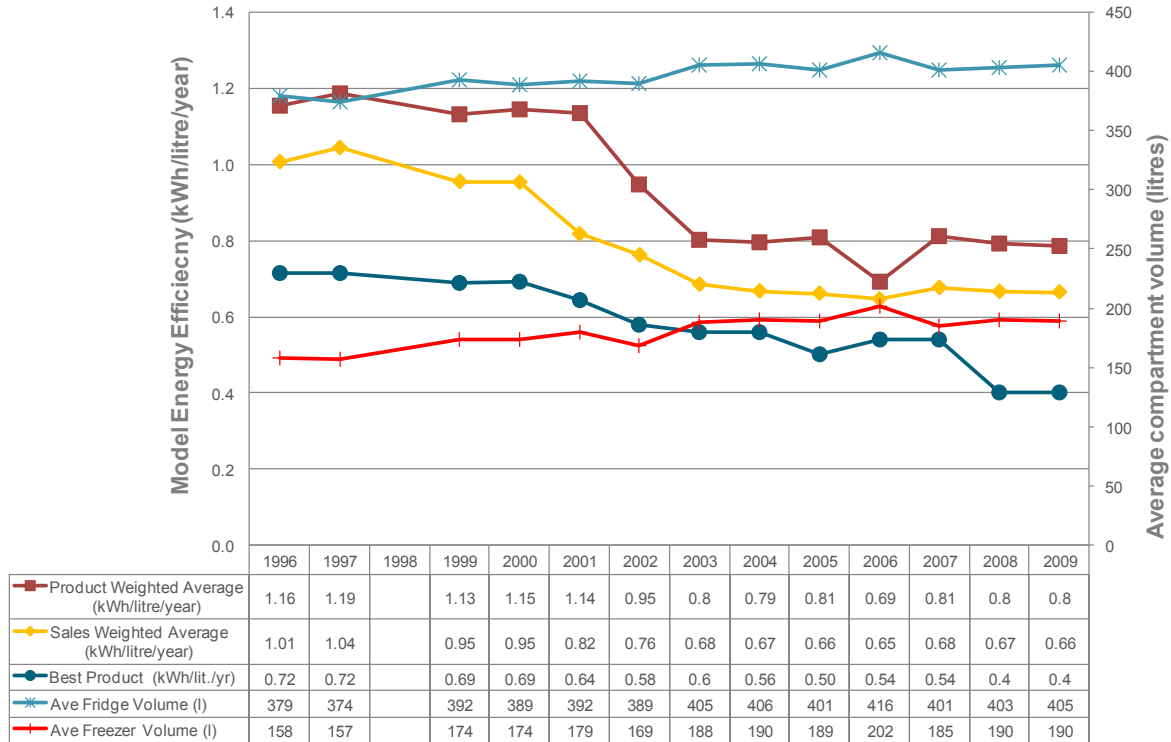
The detailed product definitions can be found at the Annex website:

<http://mappingandbenchmarking.iea-4e.org/>

Issue date: August 2010



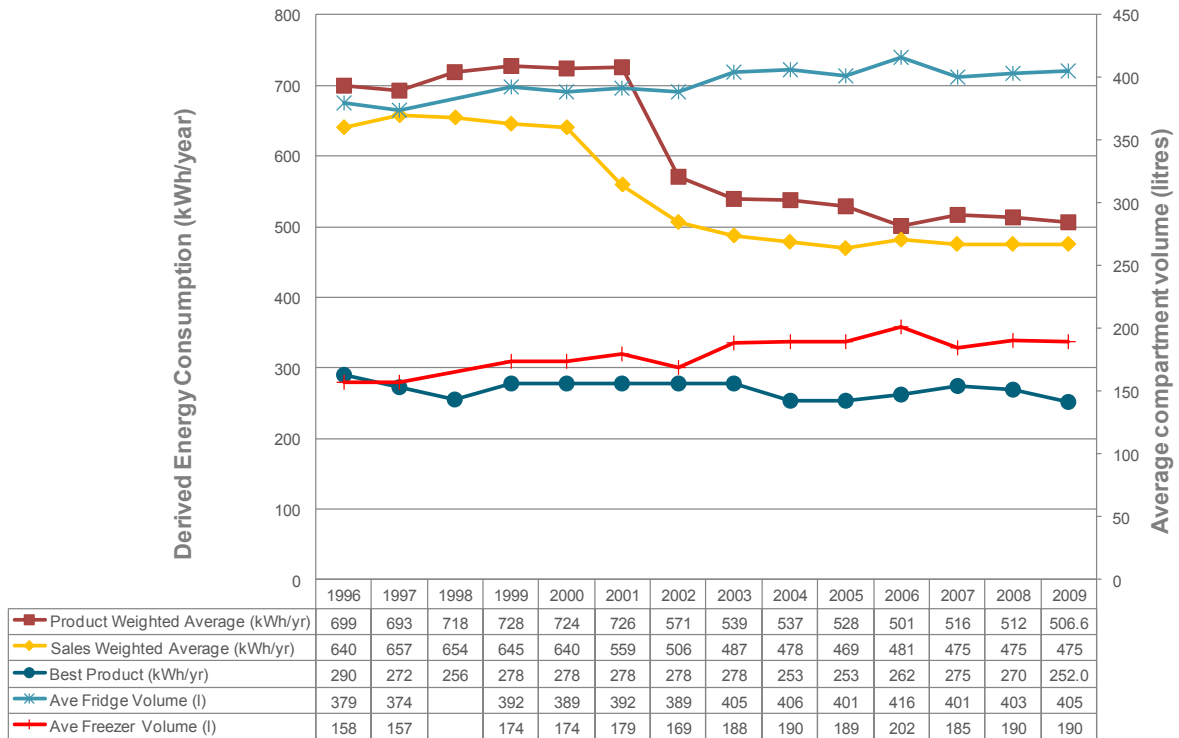
## Energy Efficiency of New Fridge-Freezers Canada



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

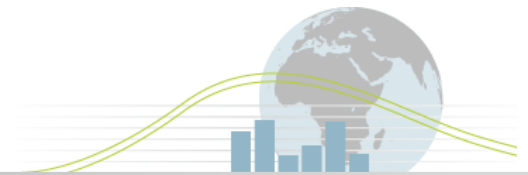
- Product and sales weighted averages are from correlated data sets.
- No breakdown of volumes was available in the sales data set, therefore average volumes are product weighted. Consequently, sales weighted average efficiency is calculated from two separate datasets and should be treated with caution.
- 1998 data with required volumes was not available and therefore efficiencies could not be calculated.
- Energy efficiency figures are based on actual product consumption under local test conditions and adjusted to account for two main differences in product technology/functionality:
  - adjusted fridge/freezer volume based on adjustment factors used in Canada
  - whether the model has a through the door ice making device
- Proximity between product weighted average, sales weighted average and best product plot lines shows that majority of market is in this area.

## Energy Consumption of New Fridge-Freezers Canada



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

- Product and sales weighted averages are from correlated data sets.
- No breakdown of volumes was available in the sales data set, therefore average volumes are product weighted.
- Derived energy consumption is based on actual product consumption under local test conditions and adjusted to account for whether the product has a through the door ice making device

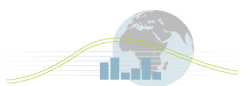


## Energy Efficiency in the Installed Fridge-Freezer Stock Canada

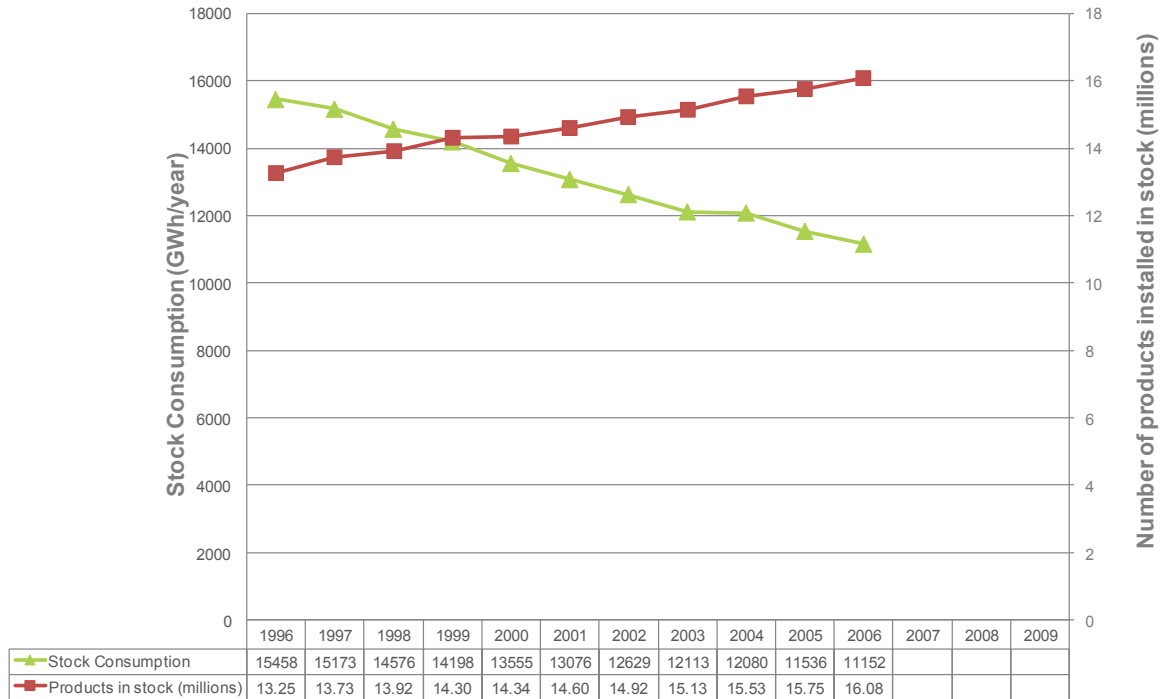


### Key notes on Graph (See notes section 3)

- Efficiency data is calculated from two Natural Resources Canada sources (unit energy consumption from a model and average compartment volumes from household survey).

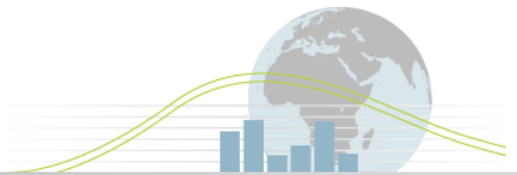


## Energy Consumption in the Installed Fridge-Freezer Stock Canada

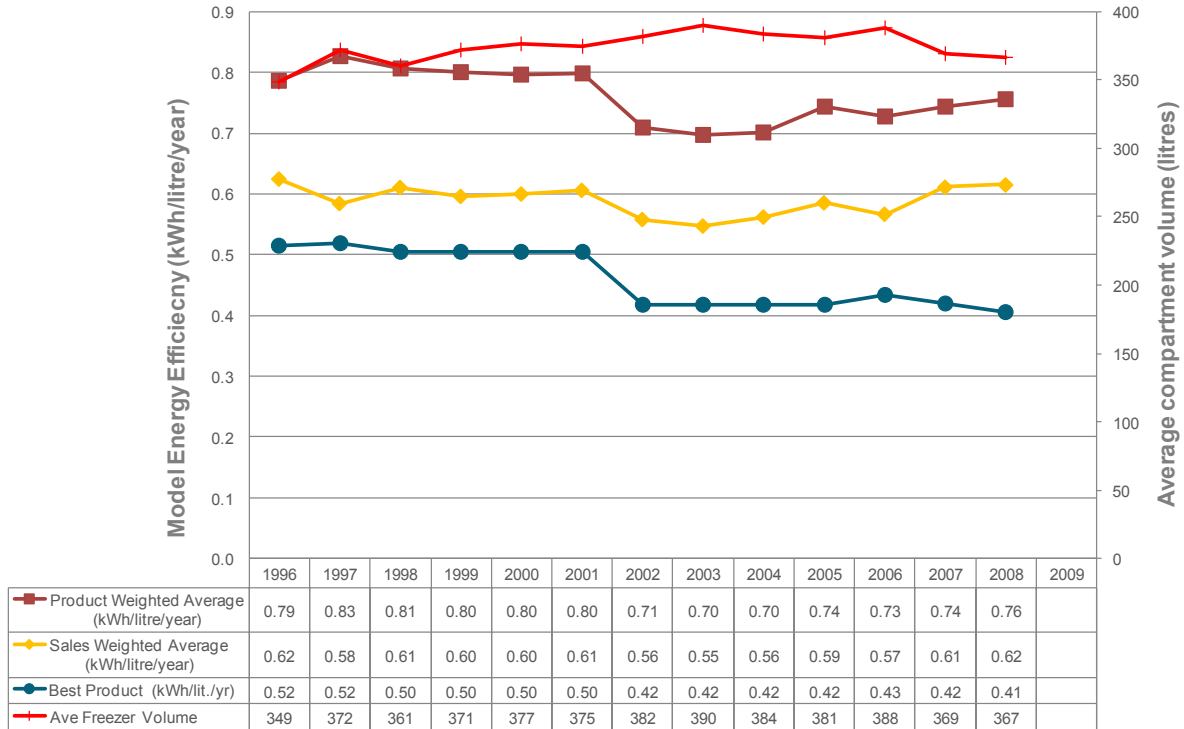


### Key notes on Graph (see Notes Section 4)

- **Stock average energy consumption is for all refrigerators, not just combination fridge/freezer units (data source does not differentiate).** Further, no corrections are made for ice-making facility as have been done with new product data above.
- Stock average consumption is based on rated efficiency under local test conditions.



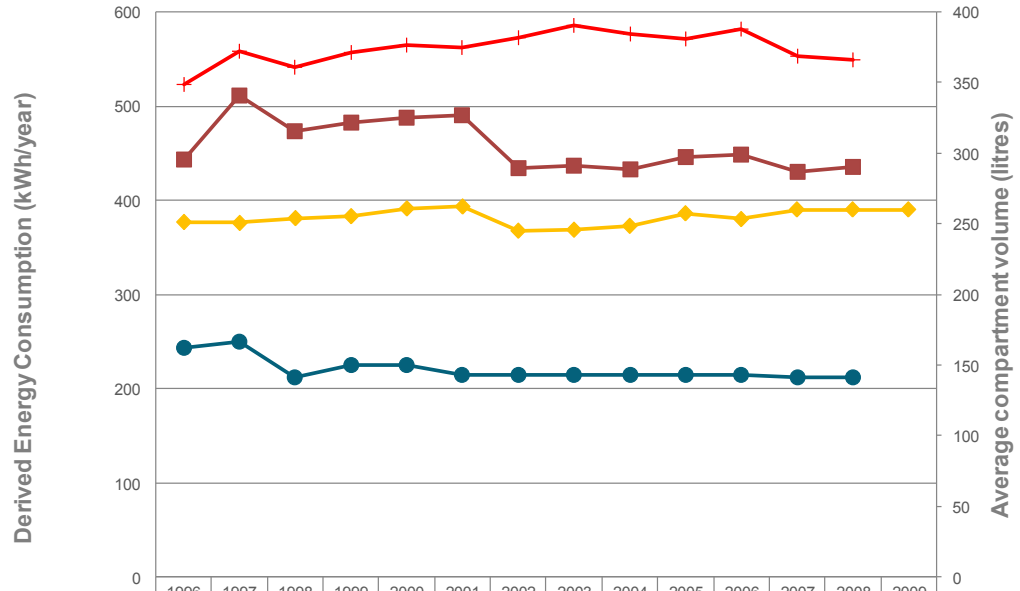
## Energy Efficiency of New Freezers Canada



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

- Product and sales weighted averages are from correlated data sets.
- No breakdown of volumes was available in the sales data set, therefore average volumes are product weighted.
- Energy efficiency figures are based on actual product consumption under local test conditions and are adjusted to a “standardised” refrigerator equivalence volume based on adjustment factors used in Canada.
- Proximity between product weighted average, sales weighted average and best product plot lines shows that majority of market is in this area.

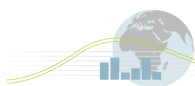
## Energy Consumption of New Freezers Canada

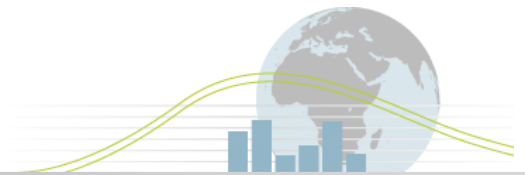


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Product Weighted Average (kWh/yr)	443	511	473	483	488	490	434	437	433	446	448	430	435	
Sales Weighted Average (kWh/yr)	377	376	381	383	391	393	368	369	373	386	380	390	390	390
Best Product (kWh/yr)	243	250	212	225	225	215	215	215	215	215	215	212	212	
Ave Freezer Volume	349	372	361	371	377	375	382	390	384	381	388	369	367	

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

- Product and sales weighted averages are from correlated data sets.
- No breakdown of volumes was available in the sales data set, therefore average volumes are product weighted.
- Derived energy consumption is based on actual product consumption under local test conditions



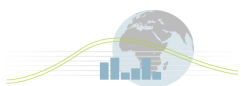


## Energy Efficiency in the Installed Freezer Stock Canada

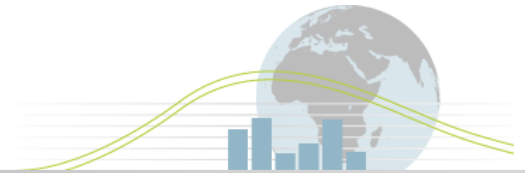


### Key notes on Graph (See notes section 3)

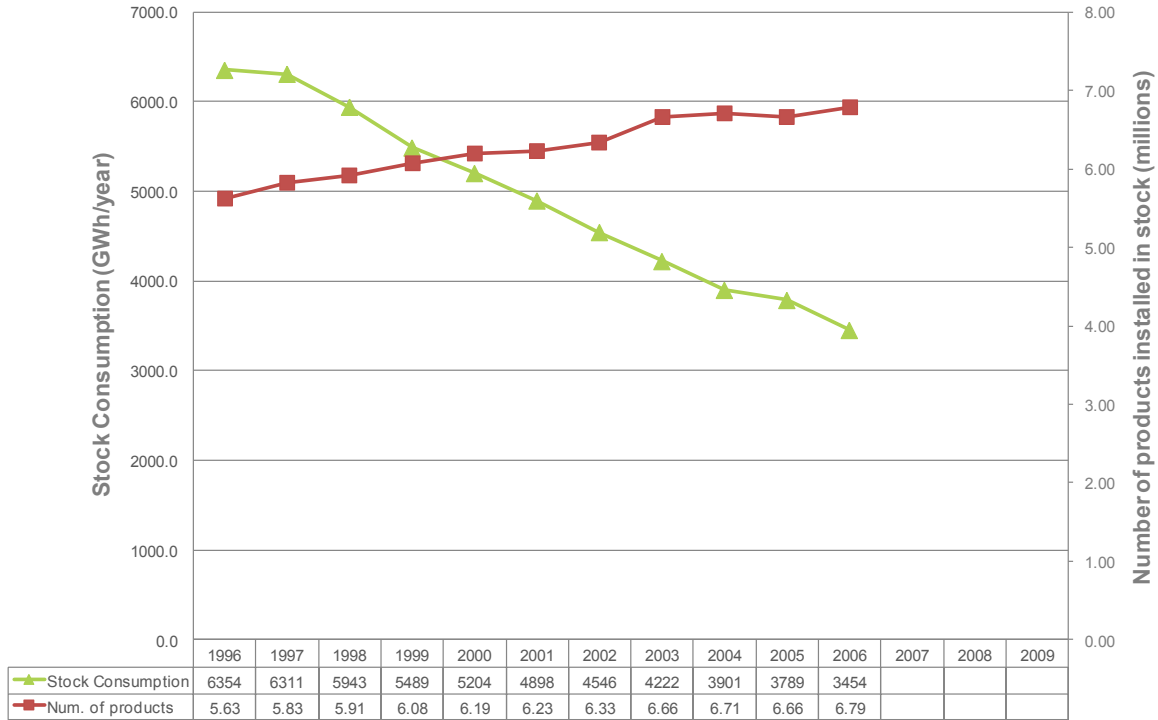
- Stock efficiency figures are calculated from the average energy consumption and the average volume of freezers in the stock. These values are taken from different sources.





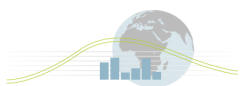


## Energy Consumption of the Installed Freezer Stock Canada



### Key notes on Graph (see Notes Section 4)

- Stock average consumption is based on rated efficiency under local test conditions.



## Major Policy Interventions (See notes Section 5)

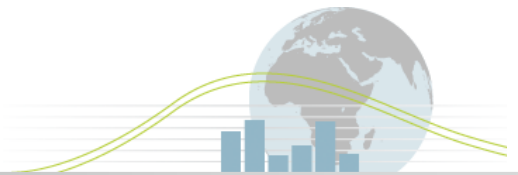
Canada has three primary federal policy interventions related to the energy efficiency of refrigerators, freezers and refrigerator-freezer combinations:

- **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 refrigerators and freezers were first introduced in February 1995 with the ratification of the Energy Efficiency Regulations. Since then a number of amendments have been made to the MEPS for refrigerators, freezers, refrigerator-freezer combinations and other variations on these products (i.e. wine chillers). Three amendments in particular (Amendments 5, 9 and 10, passed in 2001, 2006 and 2008, respectively) have introduced either a new product or greater stringency on existing regulations with respect to the refrigerator/freezer category. Proposals for Amendment 12 (2010/2011) include more stringent MEPS for refrigeration equipment.

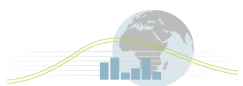
Generally, MEPS serve in transforming the Canadian marketplace by way of eliminating products with poor energy efficiency performance, while fostering a commitment to improving efficiency for energy-using equipment.

- **Mandatory Labelling:** Since its inception in 1978, the EnerGuide label has given Canadians the opportunity to compare the energy consumption of major electrical household appliances, including refrigerators and freezers. With the introduction of the Energy Efficiency Regulations (1995), 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 an appliance, 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. Refrigerators and freezers that exceed the regulated performance standards by 20% (or 10% for standard-sized freezers) are eligible for the ENERGY STAR label. ENERGY STAR has also been integrated with the EnerGuide label to further enable consumers to identify the best-performing products.
- **Conformity Assessment:** Various monitoring activities are utilized achieving 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; third-party verification mark issued by independent certification organizations accredited by the



Standards Council of Canada; and finally with complaints and tips from dealers, manufacturers and consumers. Compliant products are listed on NRCan's website and in product directories for consumers, utilities, dealers, and the public. The data is monitored electronically to detect non-compliant products.

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.



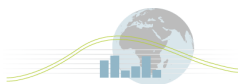
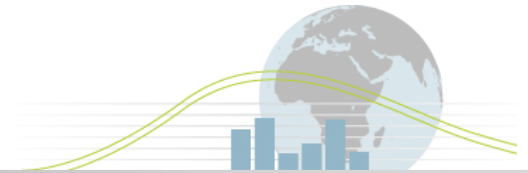
## Cultural Issues (See Notes Section 6)

### Refrigerator/Freezers

- The average annual energy consumption of a refrigerator/freezer in 2007 was 475 kWh, during the 1990s it was 956 kWh, and 1300 kWh during the 1980s;
- In 2006, nearly 89% of new refrigerator/freezer models used less than 30 kWh/ ft<sup>3</sup> per year – a significant improvement from 1990, when 60% of refrigerators on the market used 60 – 69.9 kWh/ft<sup>3</sup> per year, and all models used more than 30 kWh/ ft<sup>3</sup> per year;
- Since 1990, top-mounted freezer types have gradually declined in popularity, having dominated roughly 85% of the marketplace in 1990 to representing just under 55% of the market in 2008. Preference for bottom-mounted freezers has grown significantly during the same time period, from less than 1% of market stock in 1990 to nearly 35% in 2008. Distribution of side-by-side models has had a relatively flat growth rate, representing just under 11% of market stock;
- Canadians continue to prefer refrigerator/freezer models sized between 16.5 ft<sup>3</sup> and 19.4 ft<sup>3</sup> (40%), or between 19.5 ft<sup>3</sup> and 22.4 ft<sup>3</sup> (20%). These preferences have not changed significantly since 2000. There has been noticeable growth in the distribution and sales of compact refrigerators (under 6.5 ft<sup>3</sup>), which currently represent 15% of market stock;
- Canadian households with two or more refrigerators has increased from 24% in 2002 to nearly 27% in 2007;
- The average useful life of a refrigerator/freezer in Canada is 20 years;
- In 2008, the market share of ENERGY STAR refrigerators exceeded 50% for the first time (53%).

### Freezers

- During the 1980s the average annual energy consumption of a freezer was 960 kWh; by 1990 it had dropped to 714 kWh. From 1996 to present, due to marginal revisions of energy efficiency regulations and ENERGY STAR for freezers, the average annual consumption of a freezer in Canada has been around 390 kWh.
- In 2006, 40% of new freezer models used between 30 to 39.9 kWh/ft<sup>3</sup> per year, while nearly 35% of the freezer market used between 20 to 29.9 kWh/ft<sup>3</sup> per year. This is a dramatic improvement from 1990 when all freezers used more than 50 kWh/ ft<sup>3</sup> per year, the majority of which used between 70 to 79.9 kWh/ ft<sup>3</sup> per year;
- Chest freezers remain dominant in the market, having grown slightly in popularity from 65% in 1990 to 70% in 2008. Upright freezers represent 30% of market share;
- The average useful life of a freezer in Canada is 19 years.



## Notes on data

### Section 1: Notes on Product Efficiency

#### 1.1 Test methodologies, Performance Standards and Labelling Requirements

Test Standards in use by program:

- MEPS and EnerGuide (a mandatory labeling program): CSA/C300-08
- ENERGY STAR (a voluntary program): 10 CFR 430, Subpart B, Appendices A1 and B1

Specific information:

External Test Temperature: The energy test procedure simulates typical room conditions (approximately 21.1°C) with door openings, by testing at 32.2°C without door openings.

Internal Test Temperature: Varies but typically units tested at

- (a) all-refrigerator fresh food compartment temperature: 3.3 °C (38°F);
- (b) basic refrigerator-freezer compartment temperature: -9.4 °C (15°F) in the freezer compartment or 7.2 °C (45°F) in the fresh food compartment, whichever yields the higher energy consumption; and
- (c) refrigerator-freezer compartment temperature: -15.0 °C (5°F) in the freezer compartment or 7.2 °C (45°F) in the fresh food compartment, whichever yields the higher energy consumption.
- (d) Testing shall be performed at -17.8 °C (0°F), the standardized reference temperature for a freezer.

The freezer volume adjustment for freezers in refrigerator / Freezers is 1.63 to calculate total volume for all years. The freezer volume adjustment for basic refrigerators is 1.44 (these would be a subset of type 1 and type 11). The freezer volume adjustment for all freezers is 1.73.

#### 1.2 Product Efficiency Graphic

Sources:

1. Energy Consumption of Major Household Appliances Shipped in Canada, Trends for 1990-2006, Natural Resources Canada, December 2008
2. Major Appliance Industry Trends and Forecast, Canadian Appliance Manufacturers Association, 2008 and 2009
3. Energy Use Data Handbook tables 1990-2006, Natural Resources Canada, [http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tableshandbook2/res\\_00\\_16\\_e\\_3.cfm?atrr=0](http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tableshandbook2/res_00_16_e_3.cfm?atrr=0) on
4. Energy Use Data Handbook tables 1990-2007, Natural Resources Canada (publication in process at the time of benchmarking study)

### Key calculations undertaken:

**Derived Total Model Volume:** based on net volume (as defined in local regulations) with freezer compartment volume multiplied by a factor (in Canada, 1.63 for Refrigerator-Freezers, 1.44 for Refrigerator-Freezers of Type 1 and 11, and 1.73 for Freezers) to get equivalent fridge volume. Add this volume to the net fridge volume to establish the net total volume normalised to a refrigerator equivalent. This volume is the Derived Total Volume.

**Derived Model Energy Consumption:** based on total annual energy consumption under local test conditions, reducing consumption by 5% if the unit has an ice maker. This energy consumption is the Derived Unit Energy Consumption.

**Derived Model Energy Efficiency:** Equals Derived Model Energy Consumption divided by Derived Total Model Volume

**Sales Weighted Energy Efficiency of New Models:** (Sum of (Derived Model Energy Efficiency multiplied by sales volume of Model in year) for all Models) divided by (Sum of sales volume of all Models in year)

**Model Weighted Energy Efficiency of New Models (used where no sales data is available):** (Sum of Derived Model Energy Efficiency for all models sold in year) divided by (Number of Models sold in year).

## Section 2: Notes on Product Consumption

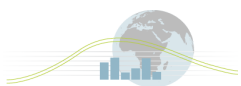
### 2.1 Test methodologies, Performance Standards and Labelling Requirements

Refer to section 1.2

### 2.2 Product Consumption Graphic

Sources:

1. Energy Use Data Handbook tables 1990-2006, Natural Resources Canada, [http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tableshandbook2/res\\_00\\_16\\_e\\_3.cfm?attr=0](http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tableshandbook2/res_00_16_e_3.cfm?attr=0) on
2. 2003 Survey of Household Energy Use (SHEU) Natural Resources Canada [http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data\\_e/sheu03/publication\\_en\\_022\\_1.cfm?attr=0](http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/sheu03/publication_en_022_1.cfm?attr=0)
3. 1997 Survey of Household Energy Use, Natural Resources Canada
4. 2007 Survey of Household Energy Use, Natural Resources Canada (publication in process at the time of benchmarking study)



### **Section 3: Notes on Efficiency of Stock**

**Unit Energy Consumption (UEC) in stock:** Natural Resources Canada, Residential End-Use Model, Ottawa, September 2008.

**Average volume of units in the stock:** Statistics Canada, Survey of Household Spending in 1997–2006, Ottawa, 2008 (Cat. No. 62F0041).

**Calculation methodology:** Stock efficiency is the average UEC divided by the adjusted total volume of the average unit.

### **Section 4: Notes on Consumption of Stock**

#### **Sources:**

**Unit Energy Consumption (UEC) in stock:** Natural Resources Canada, Residential End-Use Model, Ottawa, September 2008.

**Number of households and appliances (by type) per household:** Natural Resources Canada, Residential End-Use Model, Ottawa, September 2008 and Statistics Canada, Survey of Household Spending in 1997–2006, Ottawa, 2008 (Cat. No. 62F0041).

#### **Calculation methodology:**

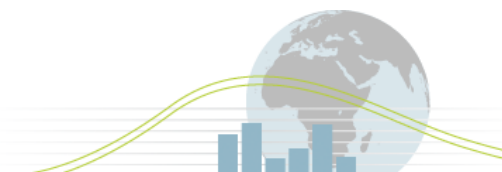
Stock consumption is the product of UEC, number of households and number of appliances per household.

Number of products in stock is the product of the number of households and the number of products by type per household.

### **Section 5: Notes on Policy Interventions**

**Minimum Standards** – The program covers refrigerators or refrigerators-freezers with a cabinet designed for the refrigerated storage of food at temperatures above 32° F., and having a source of refrigeration requiring single phase, alternating current electric energy input only. An electric refrigerator may include a compartment for the freezing and storage of food at temperatures below 32° F., but does not provide a separate low temperature compartment designed for the freezing and storage of food at temperatures below 8° F. An "all-refrigerator" is an electric refrigerator which does not include a compartment for the freezing and long time storage of food at temperatures below 32° F (0.0° C). An "all-refrigerator" may include a compartment of 0.50 cubic capacity (14.2 liters) or less for the freezing and storage of ice. NRCan recently introduced MEPS for wine coolers which are defined as a type of refrigerator.



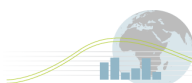


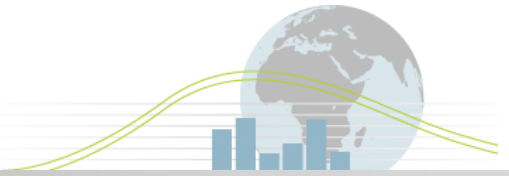
Types and minimum standards in Canada:

Refrigerators Product class	Type	Maximum annual energy consumption (kWh/year)
		July 1, 2001 *December 31, 2005
Refrigerators and refrigerator-freezers with semi-automatic or manual defrost	1	0.31 AV + 248.4
Refrigerator-freezers with partial automatic defrost	2	0.31 AV + 248.4
Refrigerator-freezers with automatic defrost with top-mounted freezer and without through-the-door ice service, and all-refrigerators with automatic defrost	3	0.35 AV + 276
Refrigerator-freezers with automatic defrost with side-mounted freezer and without through-the-door ice service	4	0.17 AV + 507.5
Refrigerator-freezers with automatic defrost with bottom-mounted freezer and without through-the-door ice service	5	0.16 AV + 459
Refrigerator-freezers with automatic defrost and bottom-mounted freezer with through-the-door ice service	5A*	0.18 AV + 539
Refrigerator-freezers with automatic defrost with top-mounted freezer and with through-the-door ice service	6	0.36 AV + 356
Refrigerator-freezers with automatic defrost with side-mounted freezer and with through-the-door ice service	7	0.36 AV + 406
<b>Compact models: refrigerated volume &lt; 219.5 L (7.75 ft<sup>3</sup>) and an overall height &lt; 91.4 cm (36 in)</b>		<b>July 1, 2001 (onward)</b>
Compact refrigerators and refrigerator-freezers with semi-automatic and manual defrost	11	0.38 AV + 299
Compact refrigerator-freezers with partial automatic defrost	12	0.25 AV + 398
Compact refrigerator-freezers with automatic defrost with top-mounted freezer and compact all-refrigerators with automatic defrost	13	0.38 AV + 355
Compact refrigerator-freezers with automatic defrost with side-mounted freezer	14	0.27 AV + 501
Compact refrigerator-freezers with automatic defrost with bottom-mounted freezer	15	0.46 AV + 367
<b>Wine chillers</b>		<b>January 1, 2008 (onward)</b>
Wine chillers with manual defrost	19	0.48 AV + 267
Wine chillers with automatic defrost	20	0.61 AV + 344

Notes:

- AV is the adjusted volume in litres





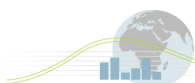
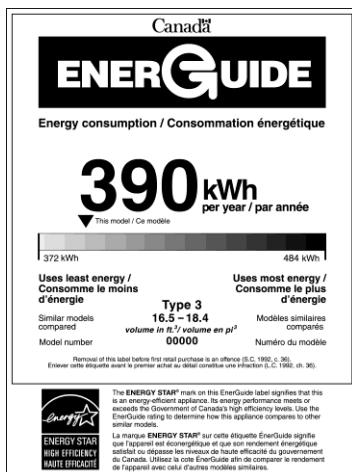
[Note: total or adjusted volume →  $AV = V_{\text{fresh food}} + (V_{\text{freezers}} * AF)$ ]

Freezers Product Class	Type	Maximum Annual Energy Consumption July 1, 2001 (kWh/year)  *December 31, 2005
Upright freezers with manual defrost	8	0.27 AV + 258.3
Upright freezers with automatic defrost	9	0.44 AV + 326.1
Chest freezers and all other freezers	10	0.35 AV + 143.7
Chest freezers with an automatic defrost system	10A*	0.52 AV + 211.5
<b>Product Class Compact:</b>		
Compact upright freezers with manual defrost	16	0.35 AV + 250.8
Compact upright freezers with automatic defrost	17	0.40 AV + 391.0
Compact chest and all other compact freezers	18	0.37 AV + 152.0
Compact = Refrigerated volume < 218.6 L (7.75 cu.ft.) and overall height < 90 cm (36 in.)		
Where AV = Adjusted volume of the freezer in litres = 1.73* Vfreezer		

### Mandatory Labelling: EnerGuide

The EnerGuide label on refrigerators 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.



## Voluntary Labelling: Energy Star

To qualify for ENERGY STAR, models must use 20% (standard and compact freezers and refrigerators, refrigerator-freezers) and 10% (standard freezers) less energy respectively than the current MEPS level or minimum federal standards for a refrigerator, refrigerator-freezers and freezers of that size and configuration.



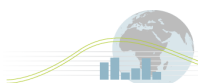
Energy Star sales penetration figures:

*Refrigerators (full size) '000s*

Year	2003	2004	2005	2006	2007
<i>Total</i>	1015	1028	1099	1159	1239
<i>Energy Star</i>	376	411	385	406	533
<i>%age</i>	37	40	35	35	43

Figures drawn from “The Canadian Appliance Manufacturers Association (CAMA): 2008 Major Appliance Industry Trends & Facts”

[http://www.electrofed.com/councils/CAMA/Industry\\_Trends/index.html](http://www.electrofed.com/councils/CAMA/Industry_Trends/index.html).



## **Section 6: Notes on Cultural**

### **Sources:**

1. *Energy Consumption of Major Household Appliances Shipped in Canada, Trends for 1990-2006*, Natural Resources Canada, December 2008

2. *Major Appliance Industry Trends and Forecast*, Canadian Appliance Manufacturers Association, 2008

3. *Major Appliance Industry Trends and Facts*, Canadian Appliance Manufacturers Association, 2009

4. *Data source for housing numbers and stock data:*

[http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tableshandbook2/res\\_00\\_15\\_e\\_3.cfm?attr=0](http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tableshandbook2/res_00_15_e_3.cfm?attr=0)

5. *Related information is also available at:*

[http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data\\_e/sheu03/publication\\_en\\_022\\_1.cfm?attr=0](http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/sheu03/publication_en_022_1.cfm?attr=0)

6. *Other cultural data supplied directly by Natural Resources Canada.*