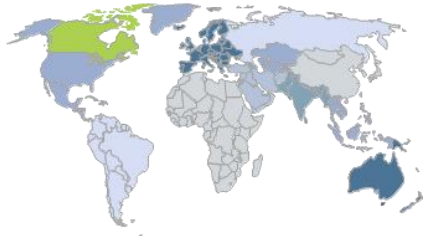
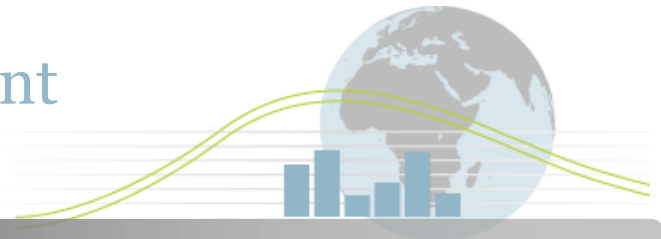


4E

Mapping Document



Country:	Canada
Technology:	Air Conditioners
Sub Category:	Residential, Packaged/Unitary, Split and Multi-split

Introduction

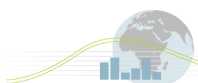
The first stage in the Mapping and Benchmarking process is the definition of the products, i.e. clearly setting the boundaries that define the products for use in data collection and analysis. Doing this ensures that comparison between the participating countries is done against a specific and consistent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

Definition & scope	<p><i>'Air conditioners used in dwellings and designed to maintain the temperature of indoor air at a given temperature level for a given heat load to be extracted.'</i></p> <p>Including only:</p> <ul style="list-style-type: none"> • Products of up to 14 kW cooling capacity (indicative, to exclude products used only in commercial premises) • Electrically driven vapour compression (Absorption units excluded) • Cooling only units, and cooling function of reverse cycle units. (Data for heating cycle / heat pumps to be invited but not analysed). • Air cooled condensers, and water/condensate spray assisted (water cooled units excluded) • Only air to air units (water chillers excluded) 		
Type	Unitary ('packaged', in single mounting, including double duct units)	Split units, (single room unit and single condenser linked by pipe-work)	Multi-split (two or more room units and single condenser linked by pipe-work)
Other variables invited (but not analysed)	<ul style="list-style-type: none"> • Mounting (Window / thru-wall; Other fixed mounting; Mobile) • Variable speed drive / multi-speed compressor (yes / no) • Refrigerant (designated according to ASHRAE refrigerant numbering system) • Standby consumption 		

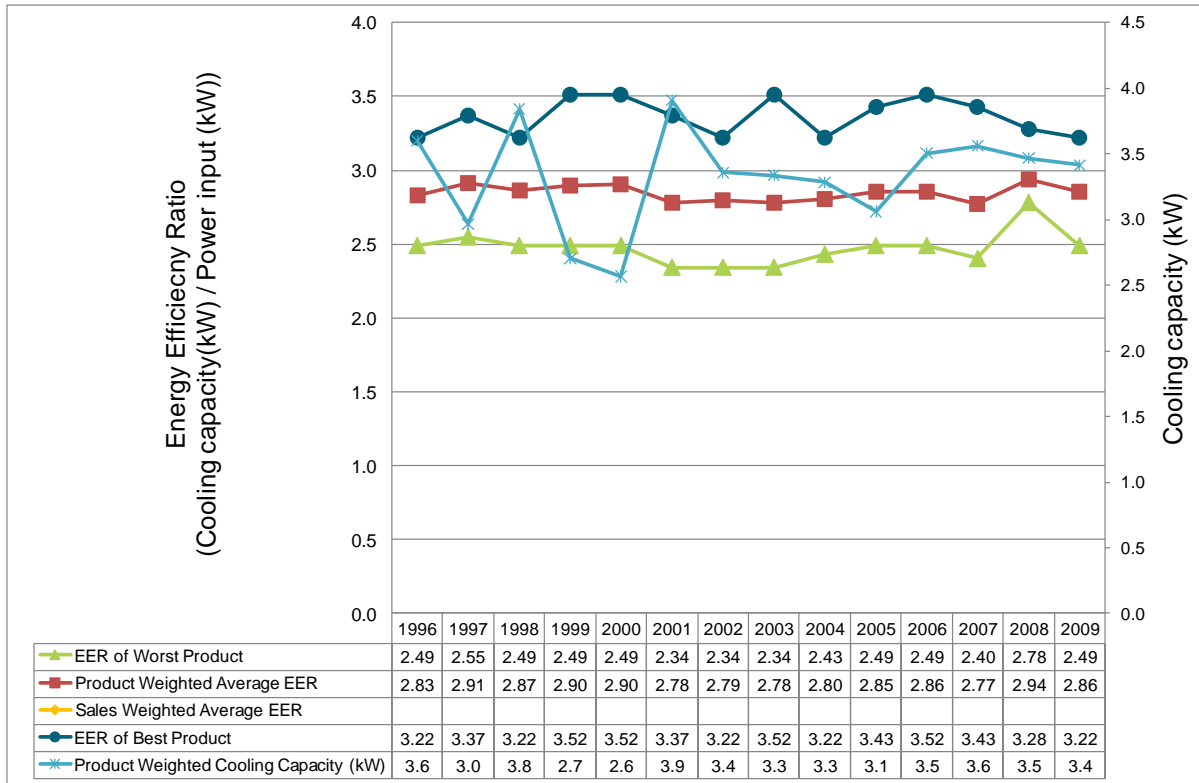
Important note: Ducted air conditioners (central) are excluded from this analysis as they are not generally used outside of the USA and Canada.

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

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

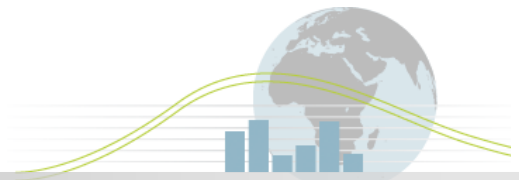


Energy Efficiency Ratio of New Unitary Air Conditioners Canada

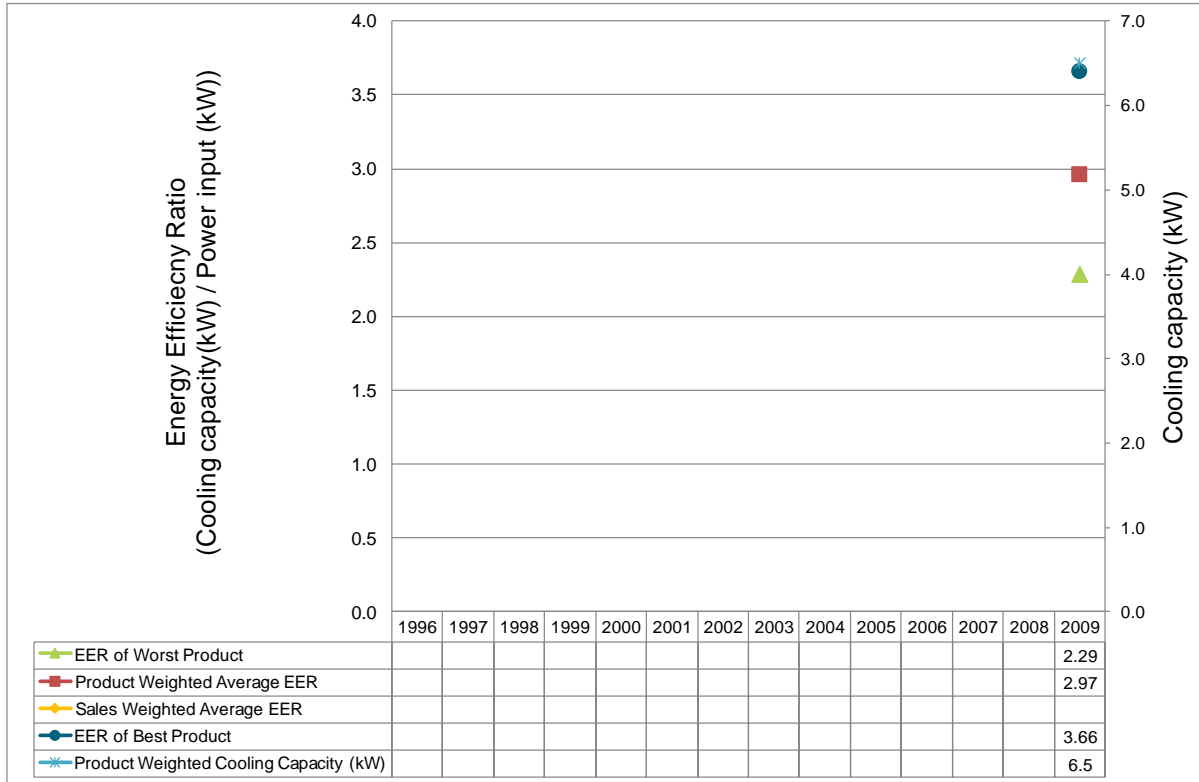


Key notes on Graph (see notes section 1)

- This graph includes unitary (packaged) products that are all under 14kW cooling capacity. Packaged Terminal Air Conditioners (PTACs) have not been included as they are primarily for commercial use in Canada.
- The EER units are kW per kW (calculated from the Btu/hr/kW more common in Canada and the USA by multiplying by 0.293).
- The data is derived from a Federal regulation database of products. Manufacturers are obliged to report models that are subject to energy efficiency regulations, although the data appear to represent a changing proportion of the market from year to year (giving the highly variable average cooling capacity in the graph above). No sales weighted data was available.
- Data was provided for each year separately.

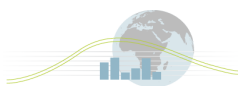


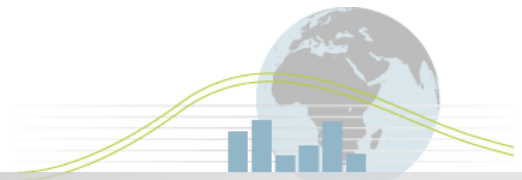
Energy Efficiency Ratio of New Split Air Conditioners Canada



Key notes on Graph (see notes section 1)

- Data was available for 52 split products for 2009. No data was available on split air conditioner products prior to 2009.
- This graph includes split air conditioners with cooling capacity under 14kW. The EER units are kW per kW.
- The data is derived from a Federal regulation database of products. Manufacturers are obliged to report models that are subject to energy efficiency regulations, although the data appear to represent a changing proportion of the market from year to year.
- Data was provided for each year separately.

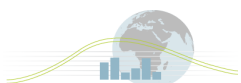


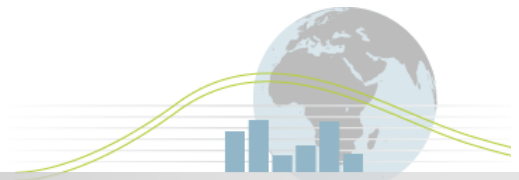


Energy Efficiency Ratio of New Multi-split Air Conditioners Canada

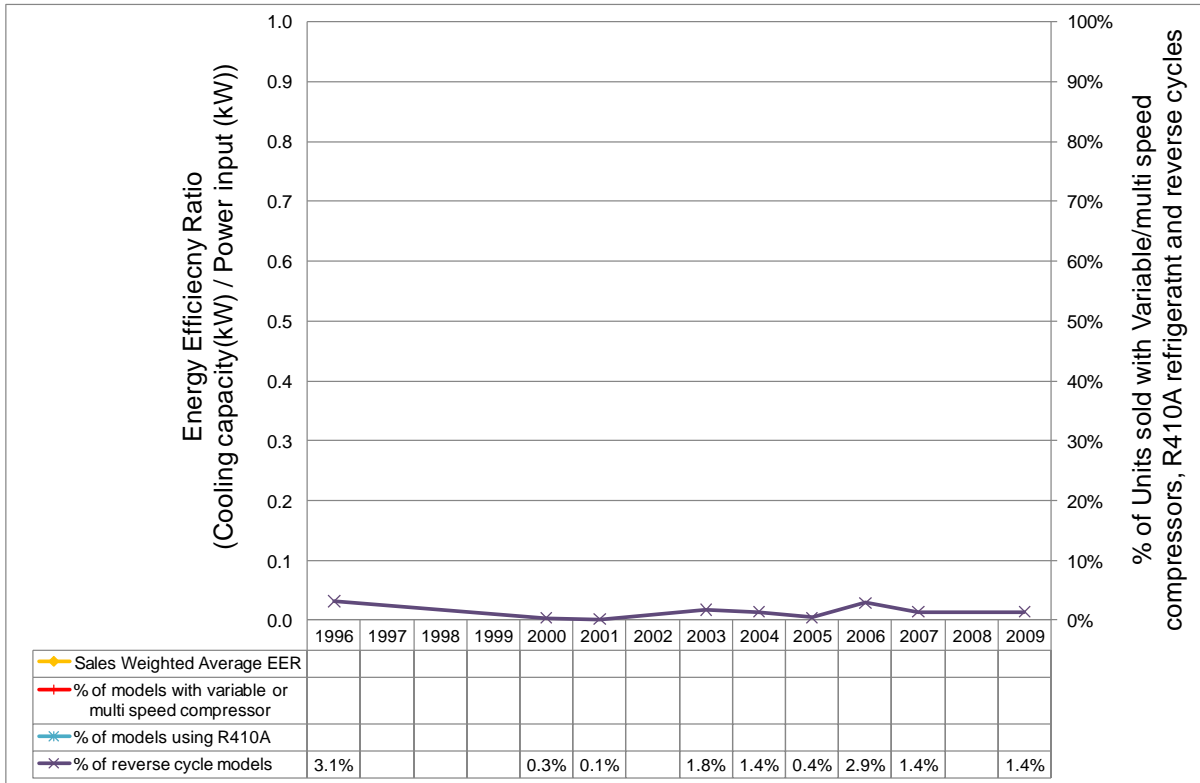
Key notes on Graph (See notes section 1)

- Few, if any, multi-split products are sold into the residential market in Canada and no data was available on these.



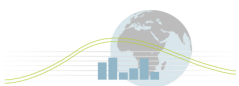


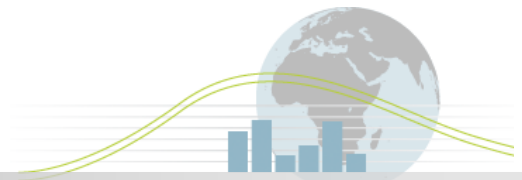
Other Characteristics of New Residential Air Conditioners Canada



Key notes on Graph (See notes section 2)

- No data available on refrigerants used, but a regulation effective January 1, 2010 phases out all HCFC refrigerants from the supply chain;
- A very low proportion of Canadian sales are of reverse cycle type - perhaps only 1% to 2% (with the vast majority clearly without reverse cycle, and a significant minority not known).
- No data available on the proportion of the market with variable or multi-speed compressors.





Seasonal Energy Efficiency Ratio of New Residential Air Conditioners - Canada

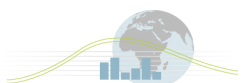
Key notes on Graph (See notes section 3)

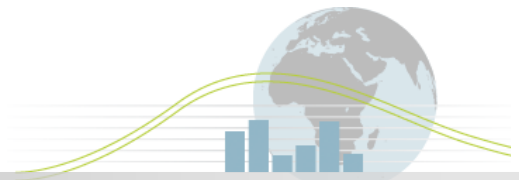
- No data available on Seasonal Energy Efficiency Ratios.

Energy Efficiency Ratio's in the Installed Residential Air Conditioner Stock - Canada

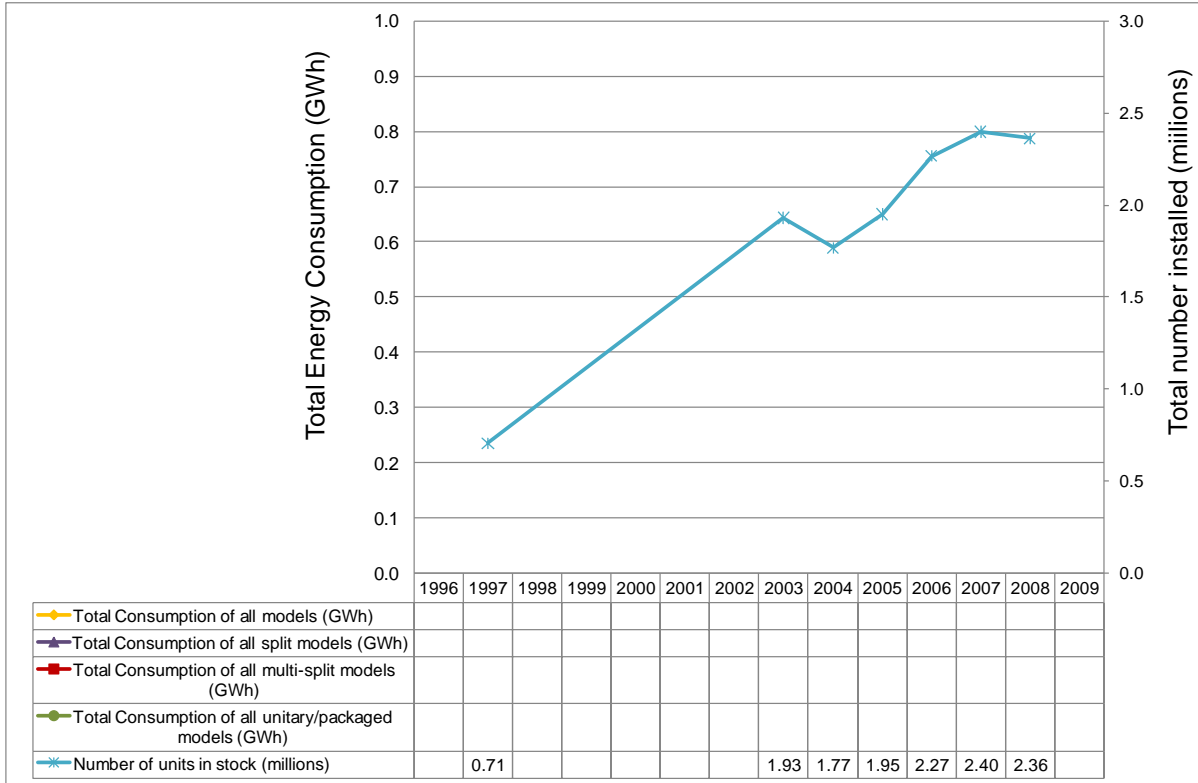
Key notes on Graph (See notes section 4)

- No data available on the efficiency of installed stock.



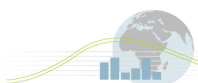


Energy Consumption in the installed Residential Air Conditioner Stock - Canada



Key notes on Graph (See notes section 5)

- No data available on the consumption of installed stock, but the above graph shows the growth in the number of households reporting having at least one room air conditioner.



Major Policy Interventions (See notes Section 6)

Canada has three primary federal policy interventions related to the energy efficiency of air conditioners:

- **Minimum Energy Performance Standards (MEPS)** for room air conditioners, single-phase single-package and single-phase split-system central air conditioners and heat pumps were first introduced in 1995. Amendments in 1998 raised MEP levels and expanded the scope to cover larger (commercial) air conditioners. More demanding MEPS for room air conditioners came into effect in January 2003. MEPS levels for all other regulated air conditioning products were raised in November 2006 and from this date have focused on SEER requirements rather than EER. A forthcoming amendment in 2011 will raise MEPS for room air conditioners, and introduce MEPS for portable air conditioners and single package vertical air conditioners and heat pumps (all based upon EER requirements).
- **Mandatory Labelling:** The EnerGuide energy label on room air conditioners became mandatory in 1995, and provides the EER for the product and a scale showing how the product compares with other similar models in terms of EER.
- **Voluntary Labelling:** Voluntary EnerGuide labels showing SEER may be found on central air conditioners and heat pumps (single-phase and three-phase single-package or split-system air conditioners and heat pumps). Also, in 2001 Canada introduced an ENERGY STAR label for room air conditioners and central air conditioners that exceed conventional energy efficiency performance standards by 10% and 8%. ENERGY STAR has also been integrated with the EnerGuide label to further enable consumers to identify best-performing products.
- **Manufacturers or dealers are obliged to register all air conditioners in Canada that are subject to energy efficiency regulation in a federal database.**

In addition, compliant products can be listed on NRCan's website in their EnerGuide Directory. There are EnerGuide Directories for many types of product, aimed at consumers, utilities, dealers and the public. The data is monitored electronically to detect non-compliant products.

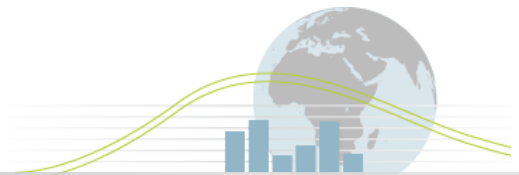
Various monitoring activities help achieve a high level of compliance: Self-monitoring by manufacturers and dealers, monitoring by regulatory authorities including NRCan designated inspectors, provincial partners, and Canada Customs and Border Services (CBSA); market surveys, product testing and electronic monitoring of energy efficiency reports and imports; 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.

There are also federal, provincial and territorial government programs to encourage the purchase and use of energy efficiency equipment, including grants, and rebate and incentives programs. Some of these apply to air conditioners.

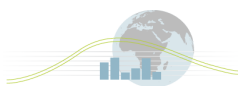
Cultural Issues (See Notes Section 7)

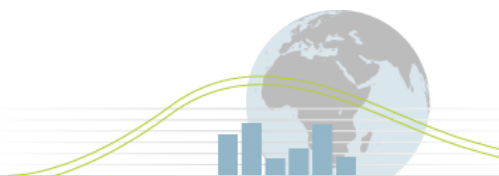
- Residential air conditioning in Canada is dominated by central air conditioning and room air conditioning. Central air conditioners account for some 40% of unit sales and over 50% of annual capacity of sales¹, with sales varying significantly between provinces;
- Of the types included in this analysis, products within the scope of this study on sale in the market in the dataset (i.e. product weighted, not sales weighted) were in the following proportions in 2009:
Unitary (packaged): 84.5% Split: 15.5% Multi-split: 0%
- Sales of air conditioning equipment, particularly room air conditioners, are largely determined by (unpredictable) summer temperatures and hot spells. During an unseasonably warm summer in 2006, for example, sales of room air conditioners reached 650,000 units – a significant increase from previous years (see note below);
- 27% of Canadian households reported having central air conditioning in 2003, rising to 32% in 2007. While the proportion of Canadian households having room air conditioners rose from 15% in 2003 to 20% in 2007;
- Canadians have shown a preference for central air conditioning in large part due to existing ductwork installed for fossil fuel heating systems, whereas room air conditioners remain popular with Canadians living in older houses that use hydronic heating or baseboard electric heating. Multi-split air conditioners have also taken some of the market that had no installed ductwork;
- Between 1999 and 2006, shipments of central split-system air conditioners increased by nearly 16%. During this period residential split-system air conditioners with a capacity between 21,000 and 26,900 Btu (6.1 kW and 7.9 kW) were the most popular;
- Between 2000 and 2005, room air conditioner sales in Canada increased by 172%, from 147,000 to 400,000 units, the majority of which (between 75% and 85%) were window-mounted models, with installation rates varying between provinces;
- Portable air conditioners represent 10% to 20%, while through-the-wall models represent 5% to 10% of the room air conditioner market;

¹ “A recent report indicates Canadian sales of central AC = about 230,000 / year. Room/window sales about 340,000 / year. Portable AC sales about 60,000 / year (although this number is only an estimate). Numbers for multi-split sales would be relatively low.” This suggests that included products account for around 60% of unit sales, but less than 50% of cooling capacity of sales.



- From 2001 to 2005, window-mounted room air conditioners with a capacity under 8,000 Btu (2.3 kW) dominated sales in Canada, but products with capacities over 12,000 Btu (3.5 kW) are increasing in popularity;
- An Environment Canada regulation, effective January 1, 2010, prohibits the manufacture or import of all equipment using HCFC-22 (R-22), and phases out all HCFC refrigerants from the supply chain;
- The average useful life of a residential split-system air conditioner is roughly 15 years, and roughly 10 years for a room air conditioner.





Notes on data

Section 1: Notes on Product Energy Efficiency Ratio

1.1 Test methodologies, Performance Standards and Labelling Requirements

Test methodology	Used for	Notes on applicable climate class	Based upon (according to EuP Prep Study Task 1 p 42)
CAN/CSA-C368.1-M90 (R2002) Performance Standard for Room Air Conditioners	Room AC includes window and through-the-wall (TTW) air conditioners with cooling capacity up to 36,000 btu/h. Reverse cycle (heat pump) equipment is included.	Appears to use the ISO 5151 climate class T1	ISO5151
CAN/CSA-C744-04 Standard for Packaged Terminal Air Conditioners and Heat Pumps (Bi-National standard, with ARI 310/380-2004)	Testing and rating of cooling and heating capacities and energy efficiency ratios for factory-assembled packaged terminal air-conditioners (PTAC's) and packaged terminal heat pumps (PTHP's) used in residential, commercial, and industrial systems. Excludes room air-conditioners. This is a full load (not seasonal) test standard.	Unable to determine categorically if this uses the ISO 5151 climate class T1 (no budget to purchase methodologies), but assumed to do so.	ARI 310/380+93
CAN/CSA C656-05 Performance Standard for Split-System and Single Package Central Air-Conditioners and Heat Pumps	Air Conditioners and Heat Pumps under 19kW (65,000 Btu/h). Std yields seasonal and full load performance data.	Requires test at ISO 5151 Climate Class T1, and also at a class with the same indoor temp (27DecC), and 28DegC outdoor, which does not correspond to any ISO 5151 class). Unable to determine how these results are combined to give a single EER figure (doc too complex). Assumed to be equivalent to T1.	ARI 210/240

Note: Portables are covered by standard CSA-370.

1.2 Product Energy Efficiency Ratio Graphic

Source:

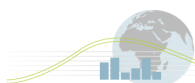
The data for this graphic is sourced from the Federal product database in the relevant year. Data was provided and analysed for each year separately.

The proportion of each type of product within the database varied significantly between years with no obvious pattern, which also gives rise to the significant variation of product weighted cooling capacity. This could indicate that the database may not be representative of the full market in every year, as such swings in type and capacity are unlikely to reflect the reality of sales.

Key calculations undertaken:

Conversion from Btu/hr to kW: Multiply by 0.293/1000.

Conversion of Canadian EER in (Btu/hr/kW) to EU EER (kW/kW): Multiply by 0.293.



No additional normalisations were required as the test conditions are Climate Class T1.

Usage assumptions:

No usage assumptions have been made for air conditioners as there is no simple way to calculate an annual consumption from individual or average product performance data. For total consumption, Government modelling data is quoted where available.

Proportion of data set included:

Portable units, representing <1% to 4% of data in any given year, were removed from the analysis because it was not possible to determine if they were single-duct (to be excluded) or double-duct (to be included).

Packaged Terminal Air Conditioners (PTACs) were excluded from the analysis as they are primarily used in commercial premises (hotels and motels). The proportion of PTAC products in each year of the database varied widely from 0% (in 7 of the years) to 78%, with an average of 23%.

No products were included in the source dataset that had capacities over 14 kW.

Section 2: Notes on Other Energy Related Metrics

2.1 Test methodologies, Performance Standards and Labelling Requirements

No additional information relevant. Refer to section 1.2

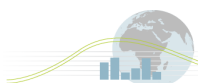
2.2 Other Energy Related Metrics

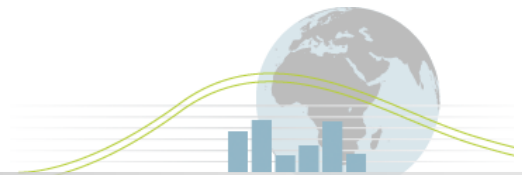
The other metrics used to characterise the market are:

- The percentage of market that use variable speed drives or multi-speed compressors. These features improve efficiency in real use by more closely matching capacity to cooling demand, although efficiency under standard test conditions may not show savings.
- The percentage of market that use refrigerant R410A. This is a high pressure refrigerant fluid that has become commonly used throughout the world. It has been chosen for these graphs as indicative of the move to HFC refrigerants (away from CFCs / HCFCs).
- The percentage of the market that are reverse cycle products. These can be used for heating as well as cooling (often referred to as heat pumps).

Section 3: Notes on product Seasonal Energy Efficiency Ratio

The Seasonal Energy Efficiency Ratio (SEER) is calculated from efficiency performance at several capacity levels (often 25%, 50%, 75% and 100% of full load) according to a typical annual duty cycle. SEER is more indicative of efficiency achieved in practice than simple full load EER.



**Section 4: Notes on EER of Stock**

None.

Section 5: Notes on Consumption of Stock

None.

Section 6: Notes on Policy Interventions

No further issues to add.

Section 7: Notes on Cultural Issues

None.

