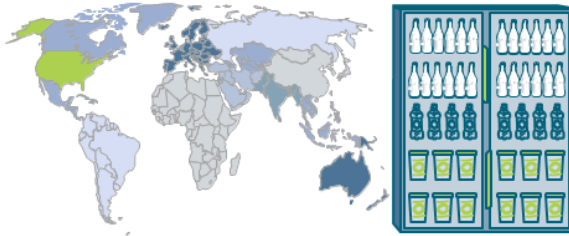
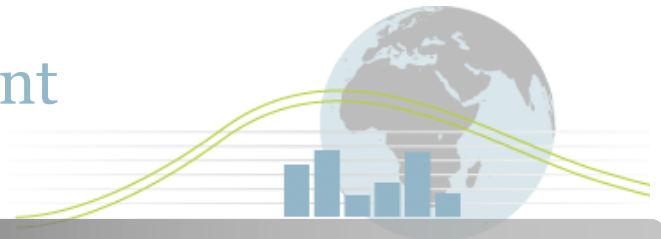


# 4E

## Mapping Document



Country:	USA
Technology:	Retail display cabinets
Sub Category:	Chilled vertical with glass door and frozen horizontal

### 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.

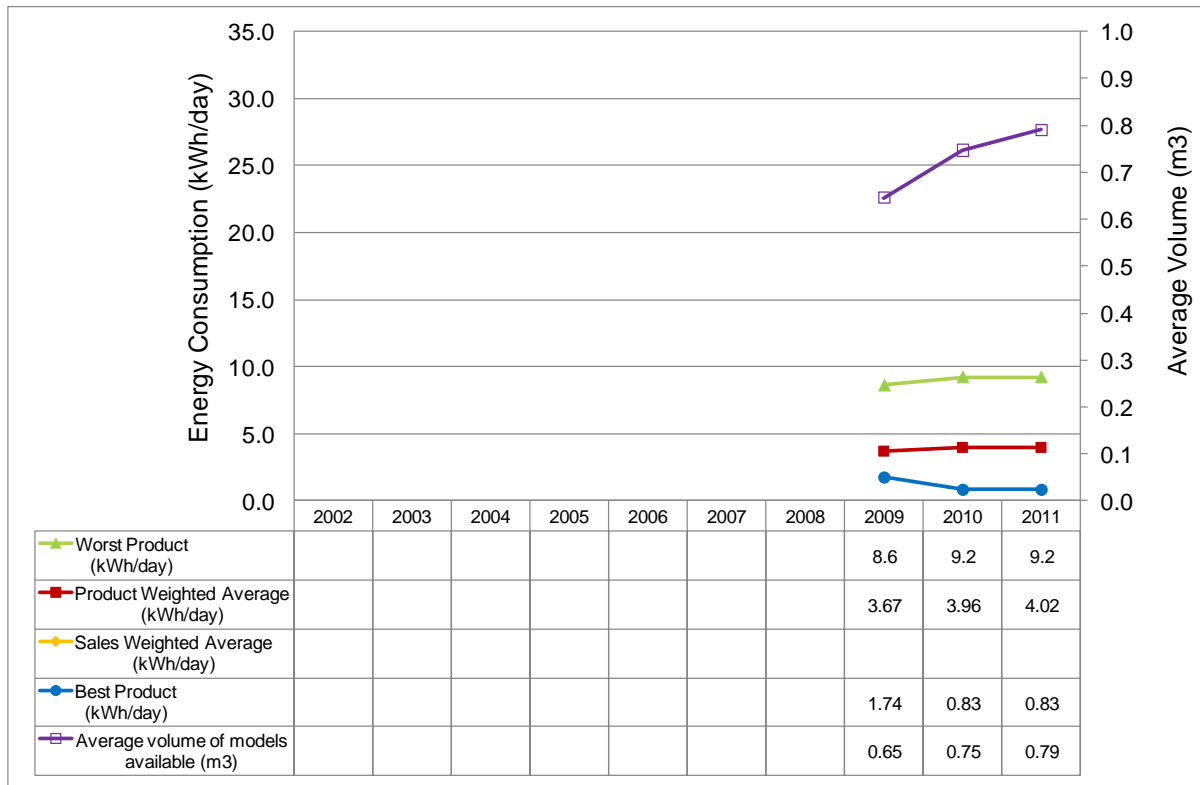
The summary definition for this product is:

Definition & scope	Scope is limited to: <i>“Refrigerated integral retail display cabinets of types a) vertical chilled with glass door(s) as used for beverages and b) horizontal/semi-horizontal freezers as used for ice cream merchandising. Cabinets must enable customers to view the contents stored in the cabinet even when it is closed either through an opening in the cabinet, or through a transparent door or lid, and also enable customers to self-serve contents. ‘Integral’ means ‘plug in’ or self-contained, such that the cabinet incorporates a compressor and condensing unit within its housing.”</i>	
Intended purpose / content	Beverage display or similar uses, i.e. vertical chilled cabinets with glass door(s)	Ice cream display or similar, i.e. horizontal/semi vertical freezer cabinets
Temperature class (storage temperature)	Vertical cabinets with glass door for chilled storage at: a) -1 to +10°C ('H1' class, EU) b) 3.3°C ±1.1°C (USA/Canada) c) 'As manufacturer stipulates' (Australia) d) Others TBD	Horizontal and semi-horizontal ice cream cabinets for frozen storage at: a) -15 and below ('L1' class, EU) b) -21°C (USA, prior to 1Jan2010; Canada prior to 12Apr2012 ) c) -26.1°C (USA since 1Jan2010 and Canada since 12Apr2012) d) 'As manufacturer stipulates' (Australia) e) Others TBD
Cabinet orientation and doors / covers (not night covers)	Vertical chilled cabinet with: a) Single door full height b) Double doors full height c) Single under-counter d) Double under-counter	Horizontal frozen cabinet of: a) Small size (TDA and volume definition TBD) b) Standard size (TDA and volume definition TBD)

Other characteristics to be noted: Refrigerant type; Presence of lighting; Presence of circulation fan; Defrost type; Outer dimensions; Ambient test conditions class. A full product definition is provided at the annex website<sup>1</sup>.

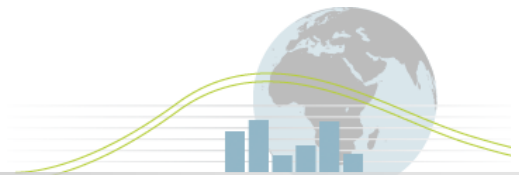
<sup>1</sup> see <http://mappingandbenchmarking.iea-4e.org/matrix?type=product&id=10>

## Energy consumption of new chilled retail display cabinets USA – ENERGY STAR data set

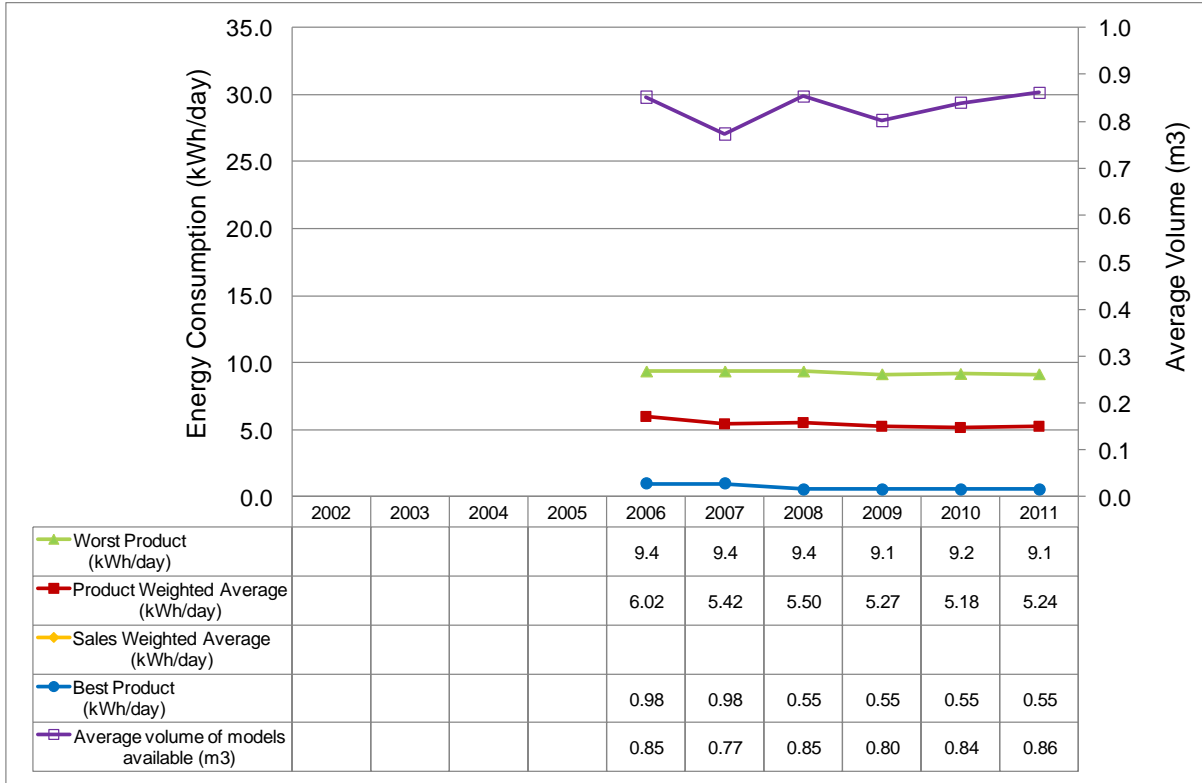


### Key notes on Graph (see notes section 1)

- Products covered are self-contained (integral) vertical chilled cabinets with glass door(s). Volume is the refrigerated internal storage volume.
- Data were supplied by US EPA. No sales data were available.
- This is a partial market data set and includes products meeting the ENERGY STAR criteria and available for sale in each year. Data sets contain between 48 (2009) and 140 (2011) products (including those carried forward from previous years' registrations).

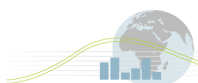


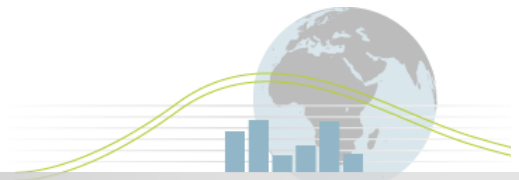
## Energy consumption of new chilled retail display cabinets USA – California Energy Commission data set



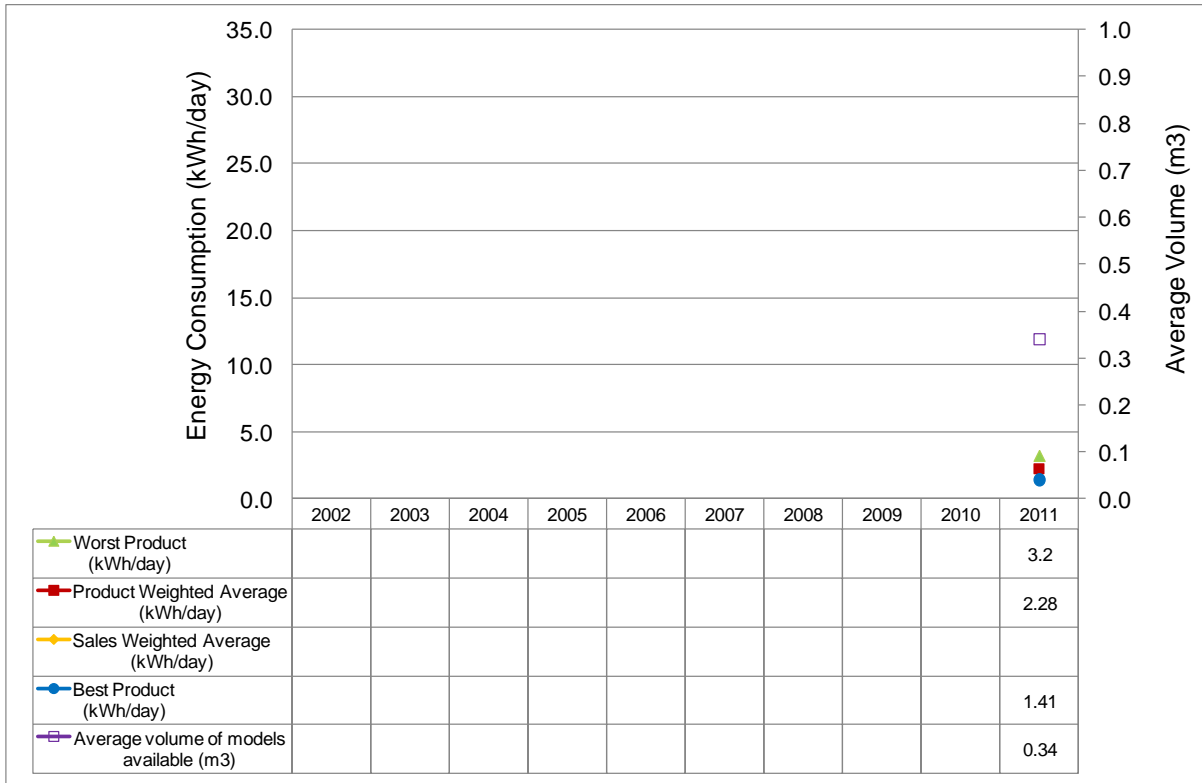
### Key notes on Graph (see notes section 1)

- Products covered are self-contained (integral) vertical chilled cabinets with glass door(s). Volume is the refrigerated internal storage volume.
- Data were downloaded from the California Energy Commission product efficiency database. No sales data were available.
- These are partial market data sets and represent products available for sale in each year that meet the California minimum standards and contain between 112 (2006) and 334 (2010) products (including those carried forward from previous years' registrations).



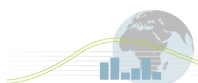


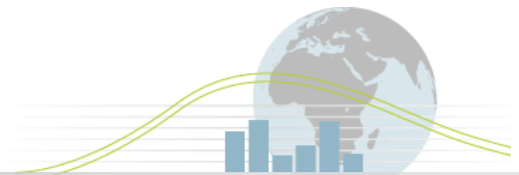
## Energy consumption of new frozen retail display cabinets USA – ENERGY STAR data set



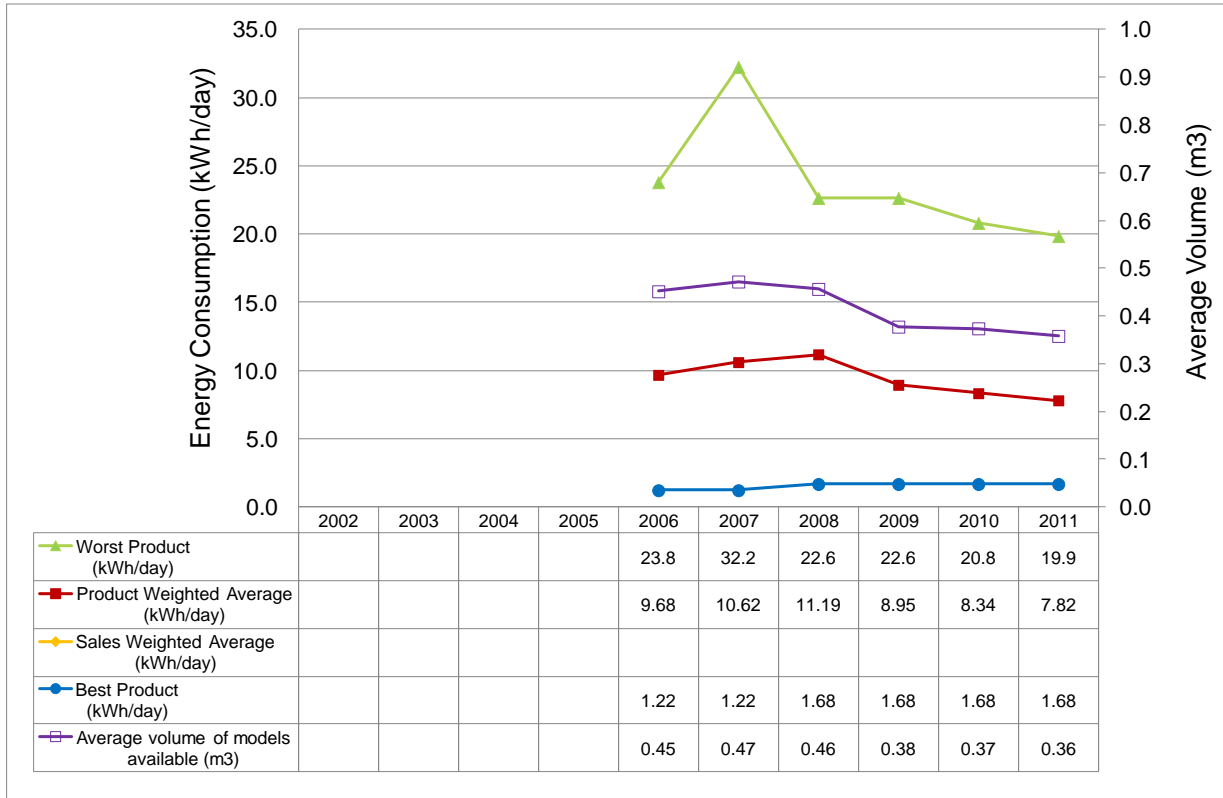
### Key notes on Graph (see notes section 1)

- Products covered are self-contained (integral) horizontal frozen ice cream merchandiser cabinets. Volume is the refrigerated internal storage volume.
- Data were supplied by US EPA. No sales data were available.
- This is a partial market data set and includes products meeting the ENERGY STAR criteria and available for sale in each year. Data set contains only 11 products.



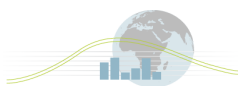


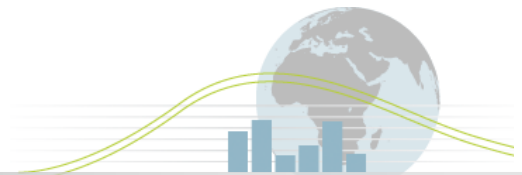
## Energy consumption of new frozen retail display cabinets USA – California Energy Commission data set



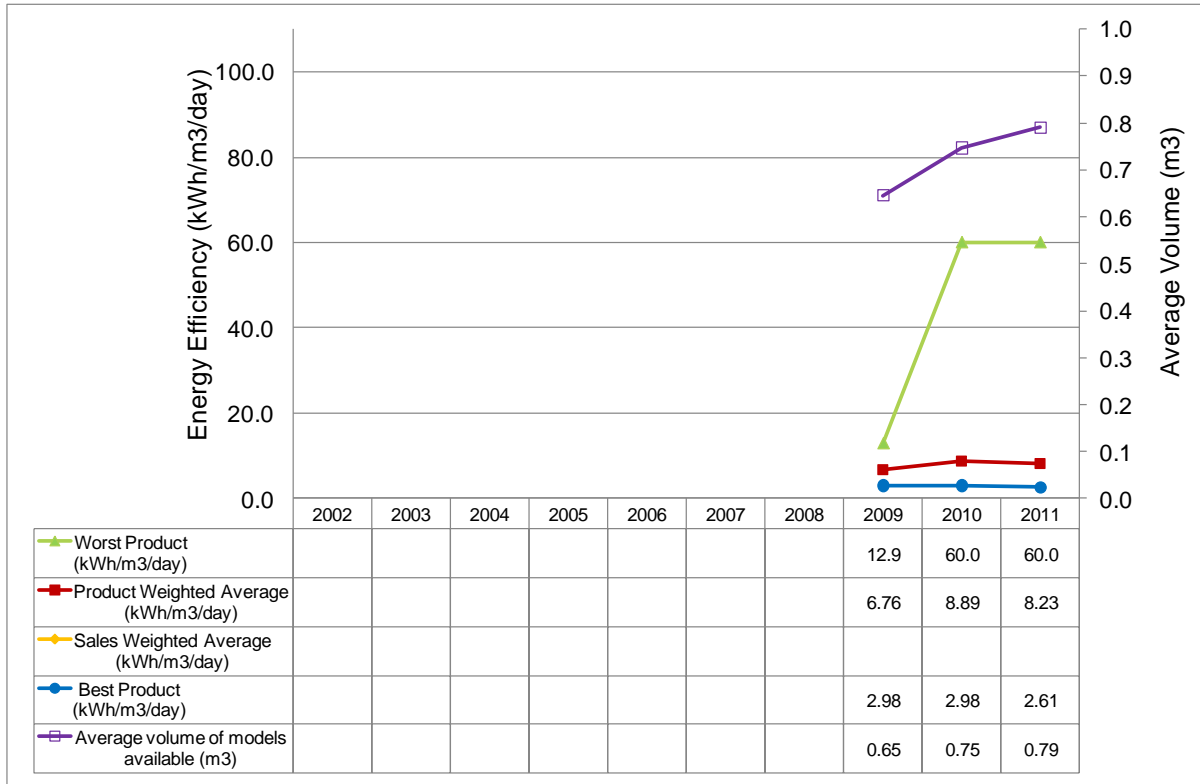
### Key notes on Graph (see notes section 1)

- Products covered are self-contained (integral) horizontal frozen ice cream merchandiser cabinets. Volume is the refrigerated internal storage volume.
- Data were downloaded from the California Energy Commission product efficiency database. No sales data were available.
- These are partial market data sets and represent products available for sale in each year that meet the California minimum standards and contain between 29 (2006) and 95 (2010) products (including those carried forward from previous years' registrations).



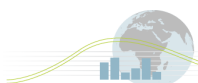


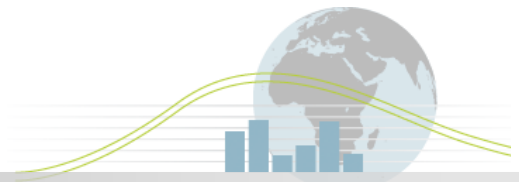
## Energy efficiency of new chilled retail display cabinets USA – ENERGY STAR data set



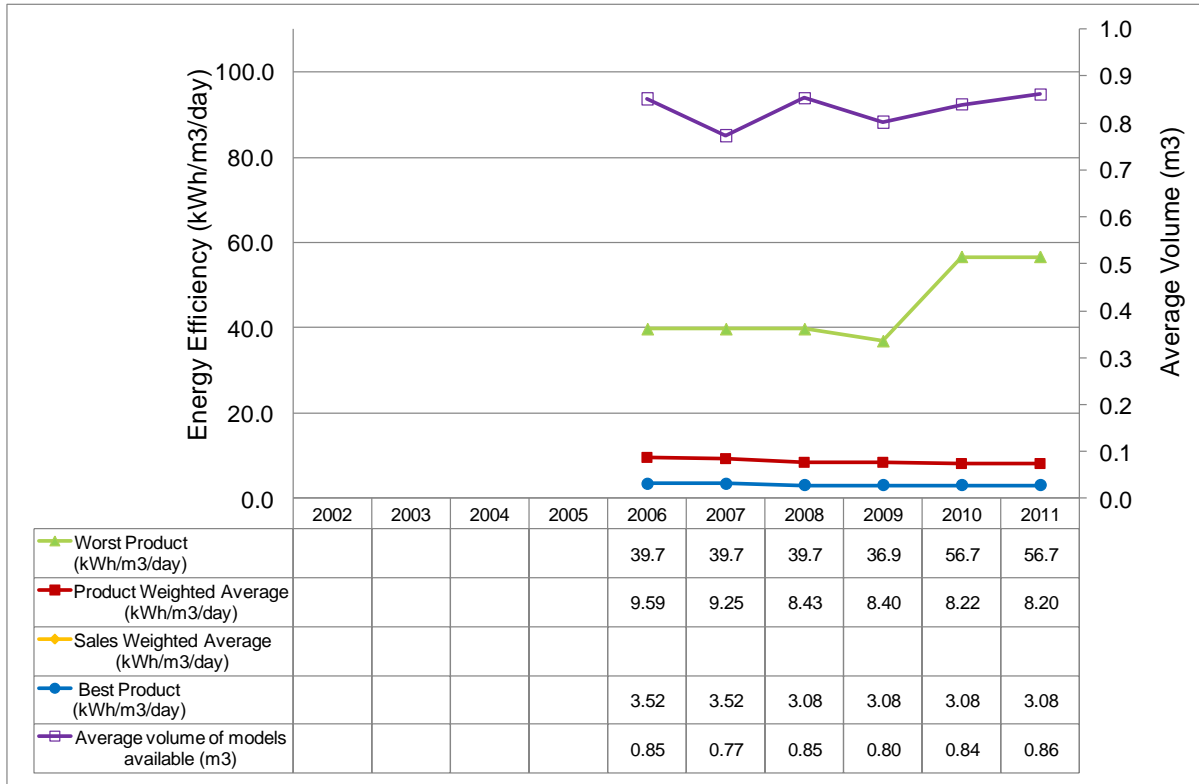
### Key notes on Graph (see notes section 1)

- Products covered are self-contained (integral) vertical chilled cabinets with glass door(s). Volume is the refrigerated internal storage volume.
- Data were supplied by US EPA. No sales data were available.
- This is a partial market data set and includes products meeting the ENERGY STAR criteria and available for sale in each year. Data sets contain between 48 (2009) and 140 (2011) products (including those carried forward from previous years' registrations).



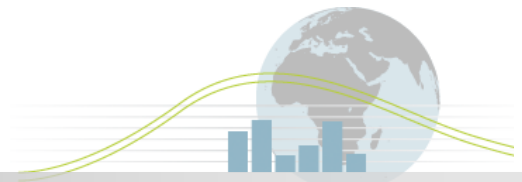


## Energy efficiency of new chilled retail display cabinets USA – California Energy Commission data set

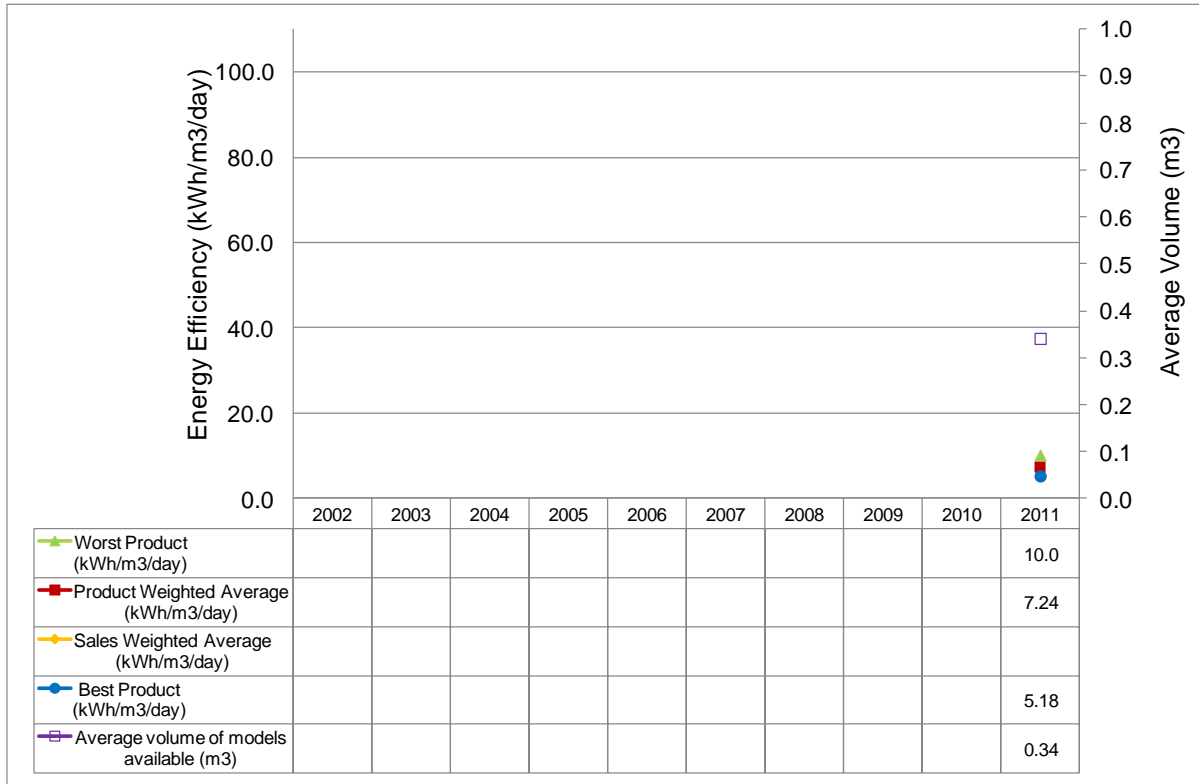


### Key notes on Graph (see notes section 1)

- Products covered are self-contained (integral) vertical chilled cabinets with glass door(s). Volume is the refrigerated internal storage volume.
- Data were downloaded from the California Energy Commission product efficiency database. No sales data were available.
- These are partial market data sets and represent products available for sale in each year that meet the California minimum standards and contain between 112 (2006) and 334 (2010) products (including those carried forward from previous years' registrations).

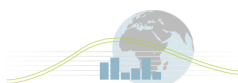


## Energy efficiency of new frozen retail display cabinets USA – ENERGY STAR data set



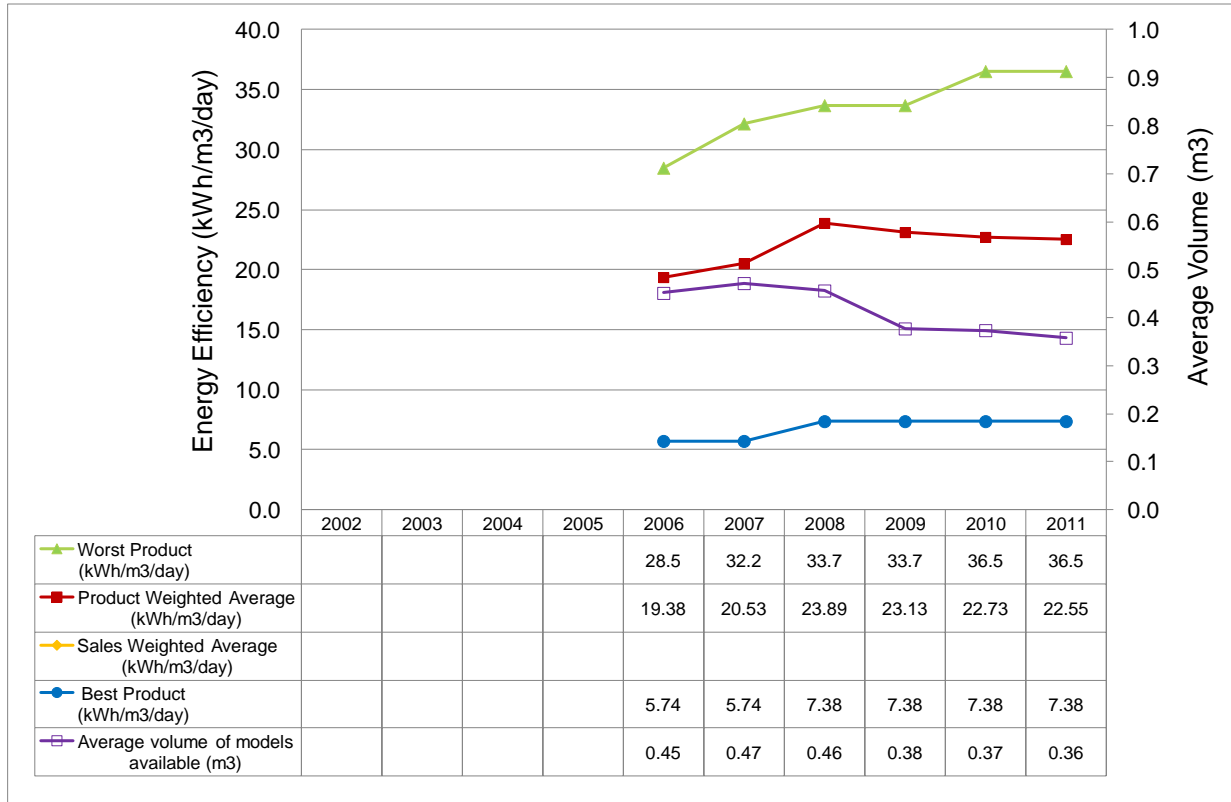
### Key notes on Graph (see notes section 1)

- Products covered are self-contained (integral) horizontal frozen ice cream merchandiser cabinets. Volume is the refrigerated internal storage volume.
- Data were supplied by US EPA. No sales data were available.
- This is a partial market data set and includes products meeting the ENERGY STAR criteria and available for sale in each year. Data set contains only 11 products.



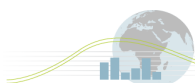


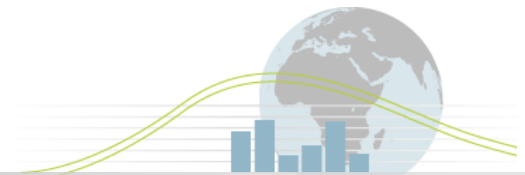
## Energy efficiency of new frozen retail display cabinets USA – California Energy Commission data set



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

- Products covered are self-contained (integral) horizontal frozen ice cream merchandiser cabinets. Volume is the refrigerated internal storage volume.
- Data were downloaded from the California Energy Commission product efficiency database. No sales data were available.
- These are partial market data sets and represent products available for sale in each year that meet the California minimum standards and contain between 29 (2006) and 95 (2010) products (including those carried forward from previous years' registrations).

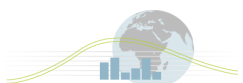




## Total energy consumption in the existing retail display cabinets stock - USA

### **Key notes on Graph (See Notes Section 3 )**

- No data available.



## Major Policy Interventions (See notes Section 4)

There are three major policies applicable to retail display cabinets (commercial refrigeration cabinets) in the USA:

- ENERGY STAR voluntary label for the most efficient products (updated 2010);
- Federal MEPS applicable since 2010 with expansion of scope due January 2012;
- California has had state MEPS since 2003.

Each is considered in more detail below.

### The ENERGY STAR Programme

The USA ENERGY STAR programme is a joint programme of the US Environmental Protection Agency (EPA) and the US Department of Energy. The programme endorses the more energy efficient products.



The ENERGY STAR label was established to:

- Reduce greenhouse gas emissions and other pollutants caused by the inefficient use of energy; and
- Make it easy for consumers to identify and purchase energy-efficient products that offer savings on energy bills without sacrificing performance, features, and comfort.

This voluntary program was designed to create self-sustaining markets for energy-efficient products and services via a common labelling strategy and awareness campaign and through strategic market interventions designed to overcome barriers identified for designated product markets.

An important motivator for suppliers to get products registered with ENERGY STAR is that federal agencies are required to purchase only energy efficient products<sup>2</sup> – defined as being either ENERGY STAR qualified or designated energy efficient by the Federal Energy Management Programme (FEMP). The USA ENERGY STAR programme switched to mandatory third party certification of all products in January 2011.

The first ENERGY STAR criteria for commercial solid door refrigerators and freezers came into effect in 2001. Version 2 was finalised in 2009 to cover both solid door, glass door and mixed door cabinets of both horizontal and vertical orientations<sup>3</sup>. Version 2 came into effect 1 January 2010<sup>4</sup>.

<sup>2</sup> The Energy Policy Act of 2005 requires federal agencies to buy either ENERGY STAR products or products designated as energy efficient by the Federal Energy Management Program (FEMP). These requirements are included in the Federal Acquisition Regulation (FAR) Subpart 23.203. See [http://www.energystar.gov/index.cfm?c=fed\\_agencies.fed\\_ag\\_index](http://www.energystar.gov/index.cfm?c=fed_agencies.fed_ag_index)

<sup>3</sup> Eligible products include reach-in, roll-in, or pass-through units; merchandisers; under-counter units; milk coolers; back bar coolers; bottle coolers; glass frosters; deep well units; beer-dispensing or direct draw units; and bunker freezers. Cabinets NOT eligible include drawer cabinets, prep tables, deli cases, and open air units. Version 2 criteria allowed glass door cabinets to begin qualifying from 1 April 2009.

<sup>4</sup> See [http://www.energystar.gov/index.cfm?fuseaction=find\\_a\\_product.showProductGroup&pgw\\_code=CRF](http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CRF)

The energy requirement is that daily energy consumption must be below a value calculated from formulae involving the internal refrigerated volume of the cabinet. Different formulae are stipulated according to whether the cabinet is refrigerated or frozen, and whether of vertical or horizontal configuration. If vertical, formulae are different whether with solid door or glass door. For example Maximum Daily Energy Consumption (MDEC) for a refrigerated solid door cabinet of volume between 30 and 50 cubic feet must be less than or equal to  $(0.056V + 1.635)$  kWh/day, where V is internal refrigerated volume in cubic feet.

### Federal MEPS<sup>5</sup>

The first USA Federal minimum efficiency standards for commercial refrigerators and freezers were published in 2005 covering only those with solid or transparent doors. These standards came into force January 1, 2010. The thresholds mirror the ENERGY STAR levels set in 2001 and are calculated according to formulae based on the internal volume of the cabinet in cubic feet. For example MEPS for solid door refrigerated cabinets require daily energy consumption to be less than  $0.1V + 2.04$  kWh/24 hours.

A Final Rule was published in January 2009<sup>6</sup> that expanded the scope of MEPS to cover cabinets without doors and also to cover remote cabinets both with and without doors and specific requirements for ice cream freezers. These updated requirements come into force 1 January 2012. The thresholds are calculated according to formulae based upon the total display area (TDA) of open cabinets and those with glass doors; those for solid door cabinets are based upon the internal volume (V) of the cabinet.

### California state MEPS<sup>7</sup>

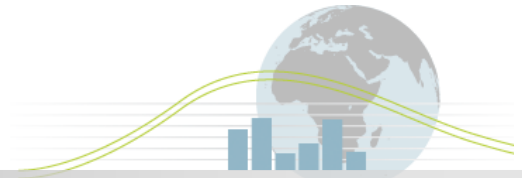
The California Energy Commission has in place minimum standards for commercial refrigerated and frozen cabinets that have solid or transparent doors since 2003. The following types are covered: Reach-in Cabinets, Pass-Through Cabinets, Reach-in or Roll-through Cabinets, and Wine Chillers That Are Not Consumer Products<sup>8</sup>. The requirement for each cabinet type is a maximum daily energy consumption calculated from formulae based upon the internal refrigerated volume of the cabinet. The thresholds were tightened variously and progressively in 2004 and 2006. The current thresholds came into force in January 2007 and coincide with the Federal MEPS for solid and transparent door cabinets that came into force three years later (January 2010). For example a solid door refrigerated cabinet must consume less than  $0.1V + 2.04$  (where V is internal refrigerated volume in cubic feet).

<sup>5</sup> See <http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=558765ddcb854c94ec1115e9805f7733&rqn=div5&view=text&node=10:3.0.1.4.19&idno=10#10:3.0.1.4.19.3.50.5>

<sup>6</sup> Federal Register Part III, Vol. 74, No. 6, Department of Energy, 10 CFR Part 431 Energy Conservation Program for Commercial and Industrial Equipment; Final Rule, Friday, January 9, 2009.

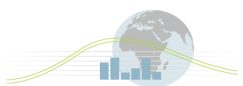
<sup>7</sup> See <http://www.energy.ca.gov/appliances/>

<sup>8</sup> See Appliance Efficiency Regulations, (California Code of Regulations, Title 20, Sections 1601 through 1608), dated September 2010 available from <http://www.energy.ca.gov/appliances/>



## Cultural Issues (See Notes Section 5)

No information available.



## Notes on data

### Section 1: Notes on Product Consumption

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

USA regulations and performance data were based around ASHRAE standard 117 for closed refrigerators, ASHRAE standard 72 for open refrigerators and AHRI 1200:2008 *Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets* (which in turn references tests to ASHRAE standard 72). All of this data is considered mutually comparable with the exception of the freezer cabinet data before and after January 2010 (see Normalisation of Data for Mapping section below).

Federal MEPS have been in place since January 2010 with expansion of scope due in January 2012. MEPS have been in force in California since 2003 which were updated in 2007 to coincide with the 2010 federal requirements.

There are no mandatory labelling requirements, although compliant products with third party certified performance results can register to carry the ENERGY STAR label.

See also section *Major Policy Interventions*.

#### 1.2 Product Consumption Graphic

The chosen metric for consumption for both frozen and chilled cabinets is kWh per day.

##### *Data sources and data cleaning*

The analysis is based upon data from two sources:

- a) US Environmental Protection Agency (EPA) derived from the historical and current ENERGY STAR databases
- b) California Energy Commission, downloaded from the Appliance Efficiency Database<sup>9</sup>.

The data sets covered refrigerated display cabinets of wider scope than that covered in this analysis and so a significant number of products had to be filtered out. As part of the data cleaning process, the following product types were deleted from the data sets, and the table below shows quantities of data and proportions deemed out of scope:

- Products with opaque doors and drawer units
- Refrigerated (chilled) products without doors
- Combination refrigerator/freezer units
- All freezer units higher than 1m (cannot be horizontal units)<sup>10</sup>

<sup>9</sup> See <http://www.appliances.energy.ca.gov/>

- All cabinets noted with configuration as upright/vertical freezer units (cannot be horizontal ice cream units)
- If cabinets are of freezer type then they only remain in the data set for analysis if they are also of 'ice cream' type (this eliminated the 'reach-in' freezers).

Overall, 630 products were deemed within scope of analysis from the Californian data set, with 2,379 out of scope (i.e. only 21% of the products were within scope). Similarly, 151 ENERGY STAR products were analysed and 20 filtered out (i.e. 88% were within scope).

In order to have data sets that represent products available on the market (as opposed to the more limited set of products for which first applications were registered with the Government in that year), it was assumed that products would continue to be available for four years after first registration. I.e. products would be carried forward to four successive years after first registration, except of course if the product falls foul of new MEPS.

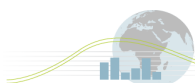
No sales data were available for any products and so data are only product-weighted.

**Table of final number of products analysed in each year (including products carried forward from previous 4 years; excluding products deemed out of scope and with partial or dubious data).**

	Frozen horizontal (ice cream) cabinets		Chilled vertical glass door cabinets	
	ENERGY STAR data set	Californian data set	ENERGY STAR data set	Californian data set
<b>2006</b>	-	29	-	112
<b>2007</b>	-	37	-	189
<b>2008</b>	-	47	-	275
<b>2009</b>	-	76	48	291
<b>2010</b>	-	95	110	334
<b>2011</b>	11	87	140	301
<b>All years</b>	<b>11</b>	<b>371</b>	<b>298</b>	<b>1,502</b>

In addition, where required USA data provided on lighting were edited to add a field to state whether the product has lighting or not: if a lighting wattage or lighting type was provided, the field was set to 'yes'; if the products stated 'no lighting', or 'not applicable' in the lighting type field, combined with no claimed wattage then the field was set to 'no'. Lighting types that stated T8, T12 or T5 were assumed to be 'fluorescent' type lighting.

<sup>10</sup> This filter criterion is imperfect as it allows through vertical frozen cabinets less than 1m high. For example some under counter frozen units could end up in the analysed data set with horizontal ice cream merchandisers. The number of misplaced cabinets is not expected to significantly distort the results.



### *Normalisation of data for mapping*

The only adjustment necessary to USA data for the mapping stage to ensure internal comparability was to compensate for the change in required storage temperature for ice cream freezers at 1 January 2010: the required temperature prior to 1 January 2010 was -21°C, with -26.1°C applicable after that point. To normalise, the energy consumption data from prior to January 2010 (for which cabinets were not required to attain such a low temperature) was increased by 11.2%, being a proportion derived from empirical data<sup>11</sup>.

All other conditions used during test measurements for energy consumption were assumed consistent across all data (for internal storage temperature on other cabinet types, ambient air temperature/humidity and lighting regime during test).

## **Section 2: Notes on Product Efficiency**

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

Test methodologies, standards and labelling apply to efficiency exactly as for product consumption above.

### *2.2 Product Efficiency Graphic*

All data were provided in terms of the products' internal volumes and so the chosen metric for efficiency of USA products is kWh/cubic metre per day.

No analysis was carried out for efficiency in terms of total display area (TDA) as no TDA data were provided although future data sets from USA will include TDA as is the basis of regulatory performance of open and transparent door cabinets from January 2012. Analysis of this data set efficiency by TDA would have involved making significant assumptions to estimate TDA from available external dimensions, product type and volume.

The data sets used for efficiency analysis were exactly the same as for product consumption above.

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

No further information available.

## **Section 4: Notes on Policy Interventions**

No further information available.

## **Section 5: Notes on Cultural Issues**

No further information available.

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<sup>11</sup> See Retail Display Cabinets Benchmarking Report for full explanation of the normalization processes applied.