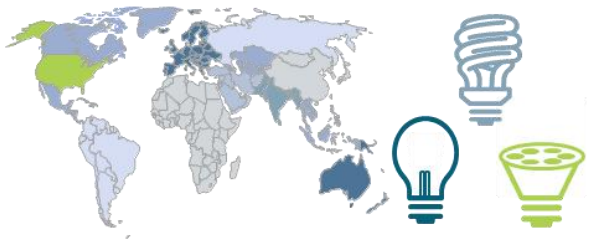


Country:	United States of America
Technology:	Domestic Lighting
Sub Category:	All domestic lamps

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. The definition ensures that comparisons between the participating countries are performed against a specific and consistent set of products/criteria.

The summary definition for this product is:

> *"Lighting products that perform the vast majority of illumination applications within the domestic (household) sector[1]"*

Hence data was sought (where possible) for the following lighting product types (subdivided by wattage buckets):

Mains Voltage Incandescent

Mains Voltage Halogens (Single and Double Ended)

Low Voltage (12V) Halogen

Pin Based and Self Ballasted CFLs

Linear Tubes (T12, T8 and T5) *

Retrofit LEDs

Dedicated LEDs

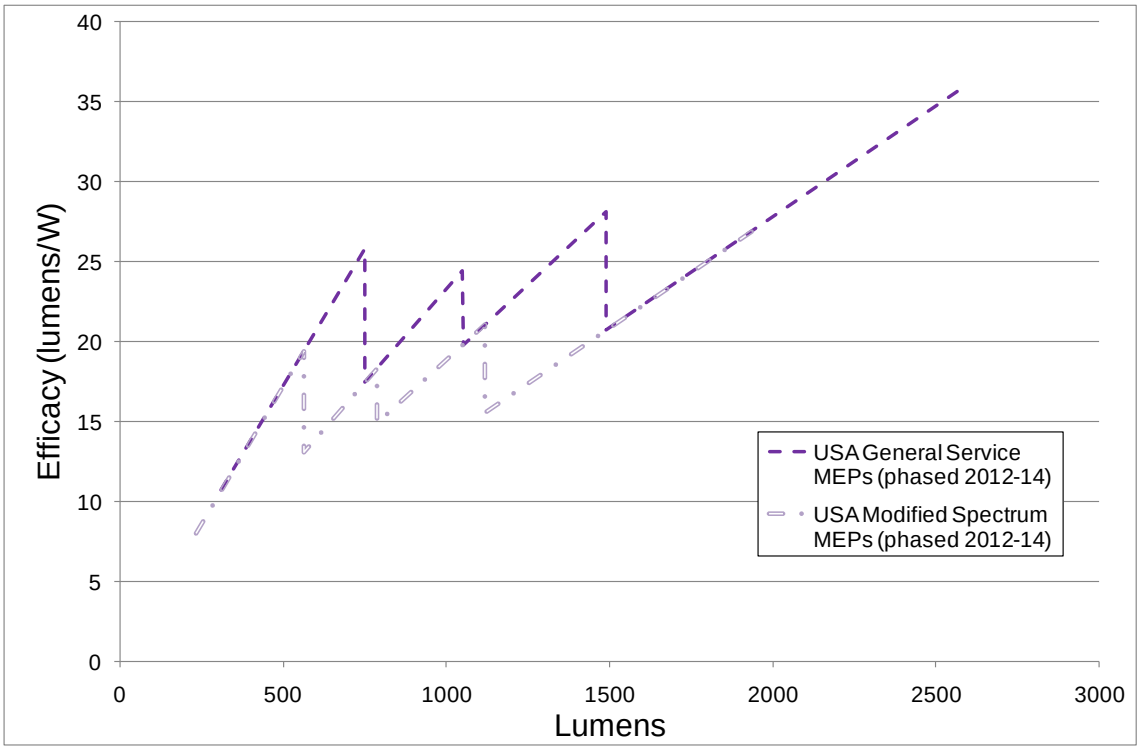
** NOTE: The subsequent analysis in the associated benchmarking report[2] excludes linear fluorescent tubes as, for those countries submitting data, these lamps constituted a small proportion of use in the domestic sector.*

A full product definition is provided at the annex website[2].

[1] *Most 'domestic lighting' products are also used in other areas (e.g. hotels, shops, offices, etc). However, given the functionality of these products is virtually the same in all installations, and in almost all participating countries it will be impossible to separate sales to the domestic sector from sales elsewhere, all products shown will be considered as "domestic lighting" irrespective of final installation point.*

[2] see http://mappingandbenchmarking.iea-4e.org/matrix?type=product&id=5

Higher efficiency regulations for domestic lighting - USA



Key notes on Graph (see notes section 1)

The Energy Independence and Security Act 2007[3] (EISA 2007) requires that sales of the majority of none-specialist 110-130V lamps meet new higher efficiency levels. Key timeframes and values are:

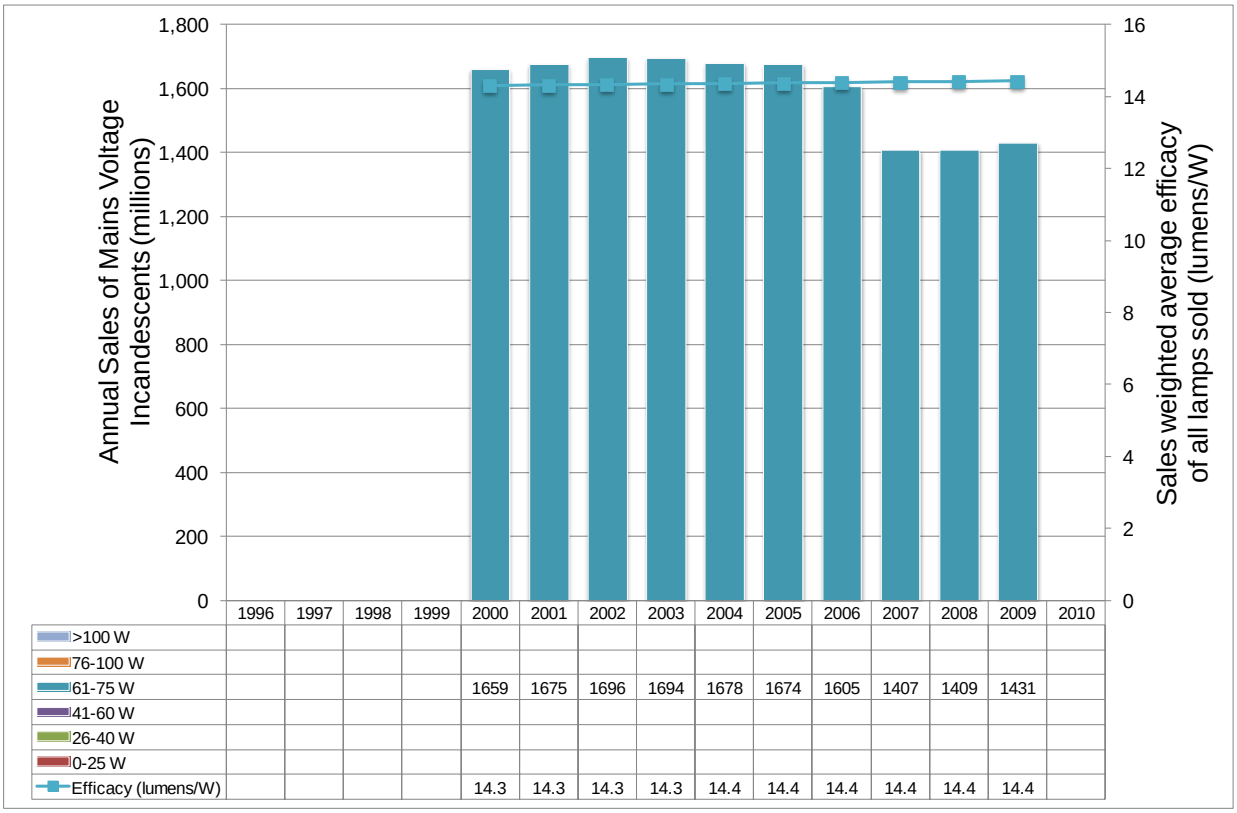
General Service Lamps		Modified Spectrum Lamps	
Lumen Output	**Maximum Wattage**	**Lumen Output**	**Maximum Wattage**
January 1, 2012		**January 1, 2012**	
1490 to 2600 lumens	72W	1118 to 1950 lumens	72W
January 1, 2013		**January 1, 2013**	
1050 to 1489 lumens	53W	788 to 1117 lumens	53W
January 1, 2014		**January 1, 2014**	
750 to 1049 lumens 310 to 749 lumens	43W 29W	563 to 787 lumens 232 to 562 lumens	43W 29W

It is important to note that the act also requires a second rule making to begin in 2014 (and be completed by 2017 which will require a minimum requirement of at least 45 lumen per watt. However, the specific requirements are not yet defined and so have not been included. Please refer to notes section for more details.

A number of other lighting related regulations are in place such as the phase out of T12 magnetic ballast phased from 2007-2012.

[3] http://www.govtrack.us/congress/bill.xpd?bill=h110-6

Sales of ALL Incandescent in the USA[4]



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
>100 W															
76-100 W															
61-75 W					1659	1675	1696	1694	1678	1674	1605	1407	1409	1431	
41-60 W															
26-40 W															
0-25 W															
Efficacy (lumens/W)					14.3	14.3	14.3	14.3	14.4	14.4	14.4	14.4	14.4	14.4	

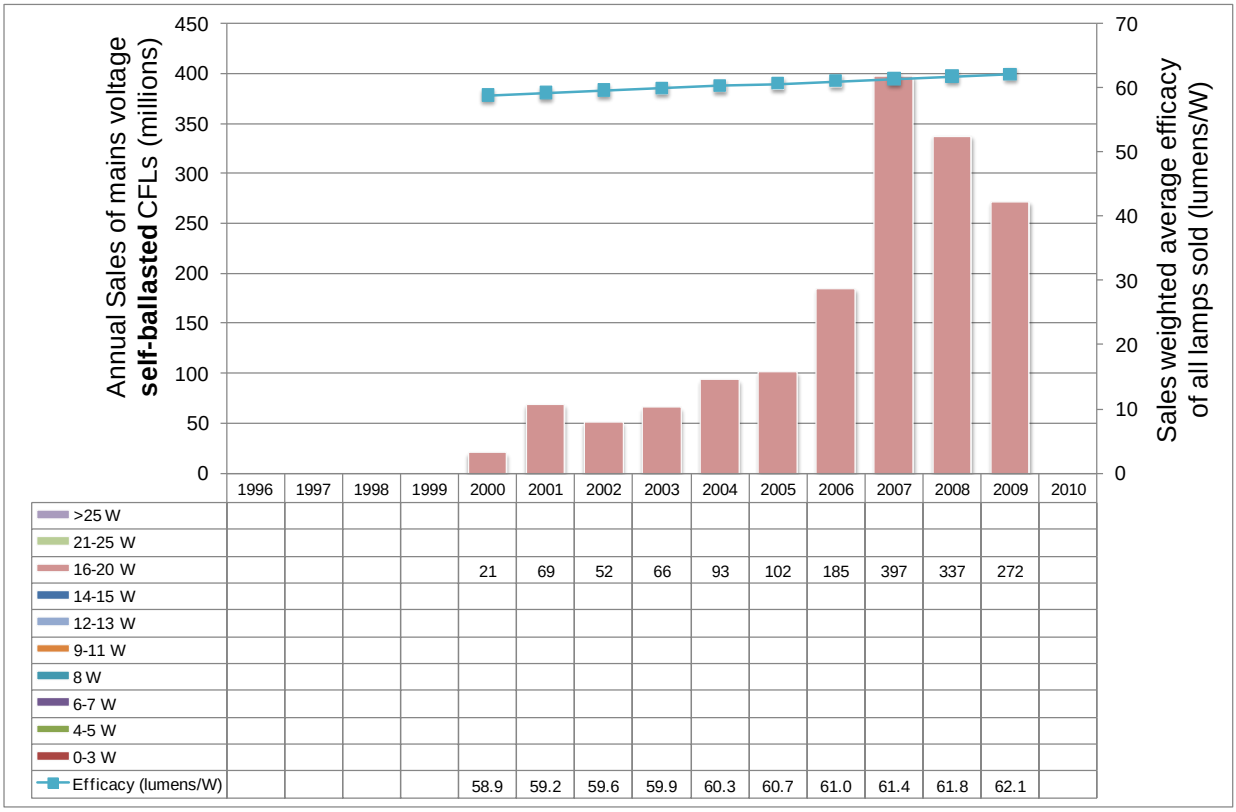
Key notes on Graph (see notes section 2)

- Projections based on a *modelling* of **all incandescent lamp types** (ie general service lamps, and low and mains voltage halogen lamps with one and two ends). Data supplier views these sales values as relatively robust for all domestic (household) sector incandescent lamps[5].
- Average wattage of lamps assumed to be 67W.
- Annual market average efficacies calculated using average global efficacies for ***general service*** 110V lamps at the assumed average wattage of 67W. However, given all incandescent lamp types and wattages are included in the sales values, the reported efficacies will not exactly align with true market values in any one year. For 2010, the data supplier estimates true market sales weighted efficacy of incandescent sales to be 13 lm/watt compared with a derived value of 14.4 lm/watt in 2009. However, this variance will differ by year depending on actual market breakdown of lamp type and wattage within this category.

[4] This graphic has been updated since first publication to correct the efficacy values. The original mapping had benchmarking (i.e. normalised) average efficacy values.

[5] *Most 'domestic lighting' products are also used in other areas (e.g. hotels, shops, offices, etc). However, given the functionality of these products is virtually the same in all installations, and in almost all participating countries it will be impossible to separate sales to the domestic sector from sales elsewhere, all products shown will be considered as "domestic lighting" irrespective of final installation point.*

Sales of ALL CFLs in the USA



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
>25 W															
21-25 W															
16-20 W					21	69	52	66	93	102	185	397	337	272	
14-15 W															
12-13 W															
9-11 W															
8 W															
6-7 W															
4-5 W															
0-3 W															
Efficacy (lumens/W)					58.9	59.2	59.6	59.9	60.3	60.7	61.0	61.4	61.8	62.1	

Key notes on Graph (see notes section 2)

- Data shown is shipment based data. Data supplier views the sales (shipped) values for CFLs as relatively robust for all domestic (household) sector CFLs[6].
- Average wattage of lamps assumed to be 18W. This is *likely* to be slightly higher than overall market resulting in a slight overestimate of average CFL efficacy.
- Annual market average efficacies calculated using estimated average global efficacies for CFLs for 110V lamps.

[6] *Most 'domestic lighting' products are also used in other areas (e.g. hotels, shops, offices, etc). However, given the functionality of these products is virtually the same in all installations, and in almost all participating countries it will be impossible to separate sales to the domestic sector from sales elsewhere, all products shown will be considered as "domestic lighting" irrespective of final installation point.*

Major Policy Interventions (See notes Section 3)

The USA has had a number of national and regional policies related to lighting. These policies can be summarised as:

National Policies

- Minimum Performance Standards: Refer to above and to Notes Section 1
- Energy Star: Energy Star seeks to identify premium performing products (in this case lighting) and promote these products within the market. Current lighting products listed by Energy Star are[7]:
  - Fans, Ceiling
  - LED Light Bulbs
  - Light bulbs (CFLs)
  - Light Fixtures
  - Residential LED Lighting
- Building codes/regulations: Building regulations within the US place specific energy related requirements on the energy consumption of new (and in some cases refurbished) properties. These requirements impact the selection of lighting systems.

Regional and State Based Policies

- Minimum Performance Standards: California and Nevada have regulations placing minimum efficiency regulations on lighting. In general, these regulations will be superseded when the federal (national) regulations noted above come into force.
- Miscellaneous promotional and subsidy programmes: A range of local, state and regional organisations run promotional programmes related to lighting products and lighting design.

[7] http://www.energystar.gov/index.cfm?c=products.pr_find_es_products

Cultural Issues (See Notes Section 4)

1) Average Number of Lamps per Residence (2001)

Lamp Type	Number of Lamps
Standard General Service Incandescent	34
Standard Reflector Incandescent	2
General Service Halogen	0.2
Quartz Halogen	0.1
CFL Screw base	1
CFL Screw based Reflectors	0
Miscellaneous Fluorescent	5
Total Lamps	***43****

**Note the total exceeds actual lamps reported individually. Difference reported as rounding errors*

2) Total number of residential buildings 106,989,000 (2001)

3) Estimated Number of Lamps Installed – all sectors (2001)

Lamp Type	Lamps Installed
Standard General Service Incandescent	3,912,104,000
Standard Reflector Incandescent	344,451,000
General Service Halogen	18,845,000
Quartz Halogen	30,736,000
Halogen Reflector Low Voltage	39,736,000
Halogen less than 25W	44,207,000
T5	6,621,000
T8	585,000,000
T12	1,034,000,000
CFL Pin Based	98,344,000
CFL Screw base	122,352,000
CFL Screw based Reflectors	6,311,000
Miscellaneous Fluorescent	593,385,000

4) By 2010, average number of sockets containing CFLs is thought to be 16% (regional averages range from 10-30%)

Notes on data

Section 1: Notes on Phase out Regulations

1.1 Overview

The Energy Policy and Conservation Act of 1975 (EPCA) established the Energy Conservation Program for Consumer Products Other Than Automobiles, covering major household appliances, designed to improve energy efficiency.

The Energy Independence and Security Act 2007[8] (EISA 2007) amends EPCA and directs the Department of Energy to undertake new energy conservation standards rulemakings. EISA 2007 also amends EPCA with regard to general service fluorescent lamps, incandescent reflector lamps, and general service incandescent lamps.

A Technical Amendment places the energy conservation standards, test procedures, and related definitions prescribed in EISA 2007 in the Code of Federal Regulations[9].

The requirements can be summarised as follows:

Prohibition of sales of medium screw cap incandescent or halogen lamps of 110-130V s. Key timeframes

General Service Lamps		Modified Spectrum Lamps	
Lumen Output	**Maximum Wattage**	**Lumen Output**	**Maximum Wattage**
January 1, 2012		**January 1, 2012**	
1490 to 2600 lumens	72W	1118 to 1950 lumens	72W
January 1, 2013		**January 1, 2013**	
1050 to 1489 lumens	53W	788 to 1117 lumens	53W
January 1, 2014		**January 1, 2014**	
750 to 1049 lumens 310 to 749 lumens	43W 29W	563 to 787 lumens 232 to 562 lumens	43W 29W

It is important to note that the act also requires:

- A new rulemaking by January 1, 2014 and shall finalize it by January 1, 2017.
- The new rule shall go into effect no earlier than three years after publication, but no later than January 1, 2020.
- If this deadline is not met, or the proposed standard does not yield savings equivalent to a 45lm/w (eg, set a 40 lm/w limit for low light output bulbs and a 55 lm/w limit for brighter bulbs with the result being a weighted average that yields savings >=45 lm/w), an automatic limit will come into place that sets an automatic across the board 45lm/w limit effective Jan 1 2020 for none directional lighting

However, as the exact requirement is yet to be developed. Hence the remainder of this section relates to the 2014 requirement.

[8] http://www.govtrack.us/congress/bill.xpd?bill=h110-6
[9] http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/74fr12058.pdf

(Please note that a number of other lighting related regulations are in place such as the phase out of T12 magnetic ballast phased from 2007-2012).

General Service Lamps

1.1.1.1 Energy Efficiency Regulations

The following regulatory requirements are drawn from The Energy Independence and Security Act 2007[10] (EISA 2007).

.

Technical requirements

Regulatory definition

General lighting application means lighting that provides an interior or exterior area with overall illumination.

General service fluorescent lamp means any fluorescent lamp which can be used to satisfy the majority of fluorescent lighting applications, but does not include any lamp designed and marketed for the following nongeneral application:

(1) Fluorescent lamps designed to promote plant growth;
(2) Fluorescent lamps specifically designed for cold temperature applications;
(3) Colored fluorescent lamps;
(4) Impact-resistant fluorescent lamps;
(5) Reflectorized or aperture lamps;
(6) Fluorescent lamps designed for use in reprographic equipment;
(7) Lamps primarily designed to produce radiation in the ultra-violet region of the spectrum; and
(8) Lamps with a Color Rendering Index of 87 or greater.

General service incandescent lamp means a standard incandescent or halogen type lamp that is intended for general service applications; has a medium screw base; has a lumen range of not less than 310 lumens and not more than 2,600 lumens; and is capable of being operated at a voltage range at least partially within 110 and 130 volts; however this definition does not apply to the following incandescent lamps—

(1) An appliance lamp;
(2) A black light lamp;
(3) A bug lamp;
(4) A colored lamp;
(5) An infrared lamp;
(6) A left-hand thread lamp;
(7) A marine lamp;
(8) A marine signal service lamp;
(9) A mine service lamp;
(10) A plant light lamp;
(11) A reflector lamp;
(12) A rough service lamp;

[10] http://www.govtrack.us/congress/bill.xpd?bill=h110-6

(13) A shatter-resistant lamp (including a shatter-proof lamp and a shatter-protected lamp);
(14) A sign service lamp;
(15) A silver bowl lamp;
(16) A showcase lamp;
(17) A 3-way incandescent lamp;
(18) A traffic signal lamp;
(19) A vibration service lamp;
(20) A G shape lamp (as defined in ANSI C78.20) (incorporated by reference; see § 430.3) and ANSI C79.1– 2002 (incorporated by reference; see § 430.3) with a diameter of 5 inches or more;
(21) A T shape lamp (as defined in ANSI C78.20) (incorporated by reference; see § 430.3) and ANSI C79.1– 2002 (incorporated by reference; see § 430.3) and that uses not more than 40 watts or has a length of more than 10 inches; and
(22) A B, BA, CA, F, G16–1/2, G–25, G30, S, or M–14 lamp (as defined in ANSI C79.1–2002) (incorporated by reference; see § 430.3) and ANSI C78.20 (incorporated by reference; see § 430.3) of 40 watts or less.

General service lamp includes general service incandescent lamps, compact fluorescent lamps, general service light-emitting diode lamps, organic light-emitting diode lamps, and any other lamps that the Secretary determines are used to satisfy lighting applications traditionally served by general service incandescent lamps; however, this definition does not apply to any lighting application or bulb shape excluded from the ‘‘general service incandescent lamp’’ definition, or any general service fluorescent lamp or incandescent reflector lamp.

Modified spectrum means, with respect to an incandescent lamp, an incandescent lamp that—

(1) Is not a colored incandescent lamp; and
(2) When operated at the rated voltage and wattage of the incandescent lamp—
(A) Has a color point with (x,y) chromaticity coordinates on the C.I.E. 1931 chromaticity diagram, figure 2, page 3 of IESNA LM–16 (incorporated by reference; see § 430.3) that lies below the black-body locus; and
(B) Has a color point with (x,y) chromaticity coordinates on the C.I.E. 1931 chromaticity diagram, figure 2, page 3 of IESNA LM–16 (incorporated by reference; see § 430.3) that lies at least 4 MacAdam steps, as referenced in IESNA LM–16, distant from the color point of a clear lamp with the same filament and bulb shape, operated at the same rated voltage and wattage.

Requirements
General service incandescent lamps, intermediate base incandescent lamps and candelabra base incandescent lamps.
(1) The energy conservation standards in this paragraph apply to general service incandescent lamps:

(i) Intended for a general service or general illumination application (whether incandescent or not);
(ii) Has a medium screw base or any other screw base not defined in ANSI C81.61 (incorporated by reference; see § 430.3); and
(iii) Is capable of being operated at a voltage at least partially within the range of 110 to 130 volts.

(A) General service incandescent lamps manufactured after the effective dates specified in the tables below, except as described in paragraph (x)(1)(B) of this section, shall have a color rendering index greater than or equal to 80 and shall have rated wattage no greater than and rated lifetime no less than the values shown in the

GENERAL SERVICE INCANDESCENT LAMPS

Rated lumen ranges	Maximum rate wattage	Minimum rate life-time	Effective date
1490–2600	72	1,000 hrs	1/1/2012
1050–1489	53	1,000 hrs	1/1/2013
750–1049	43	1,000 hrs	1/1/2014
310–749	29	1,000 hrs	1/1/2014

table below:

(B) Modified spectrum general service a color rendering index greater than or lifetime no less than the values shown incandescent lamps manufactured after equal to 75 and shall have a rated in the table below: the effective dates specified shall have wattage no greater than and rated

MODIFIED SPECTRUM GENERAL SERVICE INCANDESCENT LAMPS

Rated lumen ranges	Maximum rate wattage	Minimum rate life-time	Effective date
1118–1950	72	1,000 hrs	1/1/2012
788–1117	53	1,000 hrs	1/1/2013
563–787	43	1,000 hrs	1/1/2014
232–562	29	1,000 hrs	1/1/2014

(2) Each candelabra base incandescent lamp shall not exceed 60 rated watts.
(3) Each intermediate base incandescent lamp shall not exceed 40 rated watts.

Section 2: Notes on Sales and efficacy of all lamps, total light output and sales by product type

2.1 Data Source

Data provided is based on information supplied by the Department of the Energy. The following statement was supplied with the data:

> *For shipments of CFLs, DOE has relied on the import data collected by the DOCommerce, US International Trade Commission. Since all CFLs are effectively imported, the import data gives a consistent measure of the number of CFLs flowing into the US market, and an approximate sales volume. As covered in the new CFL Market Profile[11], DOE used this import data to infer the sales of incandescent lamps. This model has been presented to manufacturers, industry experts and program sponsors, and has been widely accepted as a good approximation of the lighting market for CFLs and incandescent lamps.*

Hence, data supplied if considered relatively robust with the following caveat:

1) "Sales" of Incandescents appears to include all types of GLS and all types of halogen lamps. As the actual breakdown of these subset of lamp types is unknown, significant assumptions have needed to be made (as outlined below) which will impact the overall validity of outputs. The degree of impact is unknown.

2.2 Manipulations of Data Supplied

2.2.1 Key assumptions:

Average wattage of incandescent lamps assumed to be 67W based as per the residential sector data drawn from *"Table 5-1 Average Lamp Wattages by Building Sector", US Lighting Characterisation. Office of Energy Efficiency and Renewable Energy, US Department of Energy, September 2002.* However, sales are across all sectors (the basis of sales data) is reported as 69W in the same table.

All CFL sales assumed to be self ballasted. Average wattage of CFLs assumed to be 18W based as per the average self ballasted CFL within the residential sector data drawn from *"Table 5-1 Average Lamp Wattages by Building Sector", US Lighting Characterisation. Office of Energy Efficiency and Renewable Energy, US Department of Energy, September 2002.* This is *likely* to be slightly higher than overall market (taking into account reported industrial and commercial usage, and pin based lamp useage) resulting in a slight overestimate of average CFL efficacy.

Annual market average efficacies calculated using average global efficacies for ***general service*** 110V lamps at the assumed average wattage of 67W. However, given all incandescent lamp types (general service and mains and low voltage halogen lamps with one and two ends) and wattages are included in the sales values, the reported efficacies will not exactly align with true market values in any one year. For 2010, the data supplier

[11] Energy Star CFL Market Profile: Data Trends and Market Insights. US Department of Energy 2010

estimates true market sales weighted efficacy of incandescent sales to be 13 lm/watt compared with a calculated value of 14.4 lm/watt (based on the global average efficacy tables used for all mappings and an assumption that sales are 90% incandescent and 10% halogen). However, this variance will differ by year depending on actual market breakdown of lamp type and wattage within this category.

Tables for assumed efficacy of each lamp type/wattage range for the years 1995-2010 can be viewed in the supporting documents section of the Domestic Lighting area of the Mapping and Benchmarking website – see http://mappingandbenchmarking.iea-4e.org/matrix.

Section 3: Notes on Policy Interventions

The USA has had a number of national and regional policies related to lighting. These policies can be summarised as:

National Policies

- Minimum Performance Standards: Refer to Notes Section 1
- Energy Star: Energy Star seeks to identify premium performing products (in this case lighting) and promote these products within the market. Such promotion is through information campaigns, promotions with partner organisations, listing on the energy star website, etc. Products must complete an initial registration process and are subject to compliance testing. Current lighting products listed by Energy Star are[12]:
  - Fans, Ceiling
  - LED Light Bulbs
  - Light bulbs (CFLs)
  - Light Fixtures
  - Residential LED Lighting
- Building regulations: Building regulations within the US place specific energy related requirements on the energy consumption of new (and in some cases refurbished) properties. These requirements impact the selection of lighting systems.

Regional and State Based Policies

- Minimum Performance Standards: California and Nevada have regulations placing minimum efficiency regulations on lighting. In general, these regulations will be superseded when the federal (national) regulations noted above come into force.
- Miscellaneous promotional and subsidy programmes: A range of local, state and regional organisations run promotional programmes related to lighting products and lighting design.

[12] http://www.energystar.gov/index.cfm?c=products.pr_find_es_products

Section 4: Notes on Cultural Issues

Sources of data:

1) Average Number of Lamps per Residence (2001) - (Extracted from Table 5-1 Average Lamp Wattages by Building Sector, 2001; *US Lighting Characterisation. Office of Energy Efficiency and Renewable Energy, US Department of Energy, September 2002)*

2) Total number of residential buildings 106,989,000 (2001) (Extracted from Table 5-2 Average Number of Lamps per Building, 2001: *US Lighting Characterisation. Office of Energy Efficiency and Renewable Energy, US Department of Energy, September 2002)*

3) Estimated Number of Lamps Installed – all sectors (2001) (Extracted from Table 5-4 Inventory of Lamps in the US by End-Use Sector; *US Lighting Characterisation. Office of Energy Efficiency and Renewable Energy, US Department of Energy, September 2002)*

4) 2010 penetration of CFLs in sockets (Energy Star CFL Market Profile: Data Trends and Market Insights. US Department of Energy 2010)