European Commission

Ecodesign Impact Accounting

OVERVIEW REPORT
2016

Prepared by
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Energy

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Status: Annual Overview Report 2016

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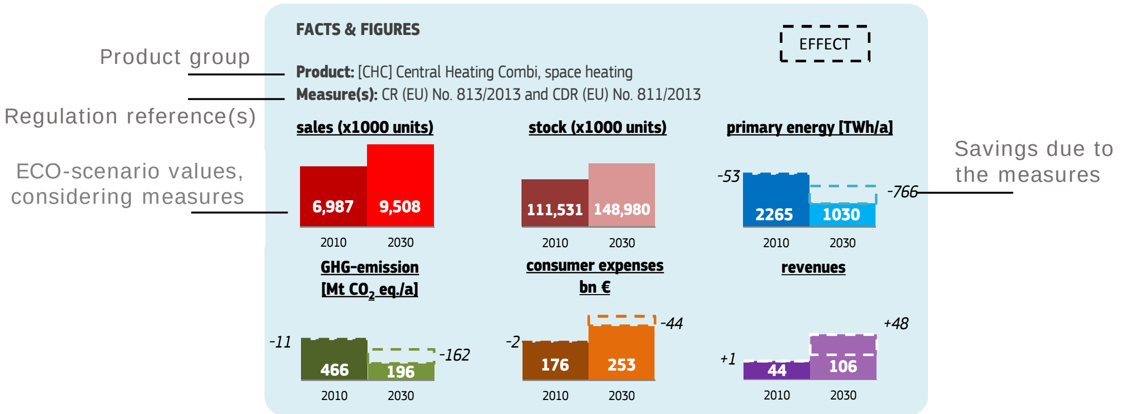
Contents

Abbreviations

a	annum
AEC	Annual Electricity Consumption
BAU	Business As Usual (scenario without measures)
bn	billion (10^9)
CR	Commission Regulation
CDR	Commission Delegated Regulation
ECO	Scenario with Ecodesign and/or Labelling applied
EEI	Energy Efficiency Index
EIA	Ecodesign Impact Accounting
EU-28	European Union of current 28 member states
eq.	equivalent
GHG	Greenhouse gas
HT	High temperature
IA	Impact Assessment
LT	Low temperature
M	Mega (10^6)
MEI	Minimum Efficiency Index
mln	million (10^6)
MT	Medium temperature
SRI	Self Regulatory Initiative
t	ton (1000 kg)
T	Tera (10^{12})
VA	Voluntary Agreement
WD	Working Document
Wh	Watt hour

Facts & Figures graphics

At the beginning of each product sheet a 'Facts & Figures' graphic provides key information on the product group. It shows the sales, stock, energy consumption (primary, electric or fuel), greenhouse gas emissions, consumer expenses and business revenues for years 2010 and 2030. The values inside the bar-graphs are those from the EIA ECO-scenario, i.e. they include the effects of Ecodesign and Energy Labelling measures. The difference with the (BAU) scenario without these measures are shown in italic font next to the bar-graph. These figures indicate the savings obtained due to the measures.



Executive Summary

The European Commission has identified a need to systematically monitor and report on the impact of Ecodesign, Energy Labelling, Energy Star and Tyre Labelling measures, including potentially new forthcoming actions, with a view to improve its understanding of the impacts over time as well as its forecasting and reporting capacity.

In a previous study [1] that ran from September 2013 to November 2015 an Ecodesign Impact Accounting (EIA) methodology was developed, providing a practical tool to achieve those goals. That study also applied the accounting method to the existing Ecodesign preparatory studies and impact assessment reports. The results were first published in May 2014 [2], and updated and extended in December 2015 [3].

The accounting covers projections for the period 2010-2050, with inputs going as far back as 1990 and earlier. Studies of over 35 product groups with over 180 base case products have been harmonised and complemented to fit the methodology. For the period up to 2025-2030 inputs were derived from the available studies. The period beyond 2025-2030 is an extrapolation of the existing trend without any new measures, i.e. it is not in the scope of this study to develop new policies.

Projections use two scenarios: a 'business-as-usual' (BAU) scenario, which represents what was perceived to be the baseline without measures at the moment of the decision making, and an ECO scenario that is derived from the policy scenario in the studies which comes closest to the measure taken.

The Ecodesign Impact Accounting is being continued in the current study [4] (EIA II) for a period of three years starting from December 2015. The interim report of June 2016 updated the accounting to the information available on 1st January 2016 [5], and also contained a first issue of the special report on material resources contained in EIA-products [6]. The latter report is based on the Bills-of-Materials of the Ecodesign preparatory studies. The product weights per material category are multiplied by the EIA-sales or –stock to obtain the total amounts of material contained in EIA products sold in 2010 or installed in 2010. These amounts are compared to the EU-28 material consumptions per category.

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[1] SPECIFIC CONTRACT No ENER/C3/412-2010/FV575-2012/12/SI2.657835 (previous EIA study)

[2] ECODESIGN IMPACT ACCOUNTING Part 1 – Status Nov. 2013, VHK May 2014 for the European Commission, https://ec.europa.eu/energy/sites/ener/files/documents/2014_06_ecodesign_impact_accounting_part1.pdf

[3] ECODESIGN IMPACT ACCOUNTING Part 2 - Status May 2015, VHK December 2015 for the European Commission

[4] SPECIFIC CONTRACT No ENER/C3/2013-523/09/FV2015-543/SI2.722015 "Extended impact accounting of Ecodesign, Energy Label and Tyre labelling legislation as well as actions under the Energy Star programme (EIA II)" (current ongoing EIA II study)

[5] ECODESIGN IMPACT ACCOUNTING – Status Report January 2016 – VHK for the European Commission, June 2016, https://ec.europa.eu/energy/sites/ener/files/documents/Ecodesign%20Impacts%20Accounting%20%20-%20status%20January%202016%20-%20Final-20160607%20-%20N....pdf

[6] Special Report Material Inputs for Production, pertaining to the study on Ecodesign Impact Accounting, VHK for the European Commission, June 2016, https://ec.europa.eu/energy/sites/ener/files/documents/EIA%20Special%20Report%20Material%20Consumption%2020160607.pdf

The December 2016 EIA reporting takes into account the information available on 1st September 2016 and consists of:

- EIA Annual Status Report 2016 (the 'usual' EIA report, updated)
- EIA Annual Overview Report 2016 (new issue)
- Special Report on Materials in EIA products (issue of June 2016)
- EcoReport for the average EIA product (new issue)
- related Excel files

The Status Report is the main EIA document, containing full and detailed data and a description of the EIA-methodology. It is mainly organized per parameter, e.g. sales, stock, load, efficiency, energy, emissions, prices, expenses. The Status Report is intended for insiders/experts and for analysts requiring detailed figures.

The Overview Report (this document) addresses a wider, non-technical audience and aims at making the EIA data more easily accessible.

The first part of the Overview Report summarizes the main EIA results, presenting the combined impact of all EIA products on EU energy consumption, emissions, user expenses, business revenues and jobs. This section also includes the main results from the Special Report on Materials and the EcoReport for the Average EIA product.

The second part of the Overview Report is organized per product, giving a quick overview and discussion of the key facts and figures for that product, and describing the product and its most relevant features.

EIA Results summary

In 2010 the products included in the accounting represent approximately 38 700 PJ (925 Mtoe) of direct and indirect primary energy consumption. This is 53% of total EU-28 gross energy consumption in 2010 (1759 Mtoe).

For these products the following main results were obtained for the EU-28 in 2020 (ECO versus BAU):

- Close to 6900 PJ (165 mtoe, 1918 TWh) primary energy saving, i.e. a saving of 18% for the average product;
- Of this, 4320 PJ (103 mtoe, 1200 TWh) is primary energy saving due to saving 480 TWh (41 mtoe) of electricity, and 2588 PJ (62 mtoe, 719 TWh) is direct fuel saving. The sum of electricity saving and direct fuel saving ('final' energy saving) is 1199 TWh (103 mtoe);
- 319 Mt CO_2 equivalent (7% of 2010 EU-total) less greenhouse gas emissions;
- 336 million m^3 drinking water and 0.4 Mt printer paper saving; avoided 144 kt SO_2 equivalent direct NO_x-emissions, 141 kt direct CO-emissions, 10 kt direct OGC-emissions and 9 kt direct PM-emissions [7];

[7] Direct emissions are intended here as those that occur during the use of products burning fuels (mainly for heating). This does not include emissions during the generation of electricity or emissions during non-use phases, e.g. manufacturing, distribution, end-of-life.

- € 112 bn net saving on consumer expenditure (€ 174 bn gross saving, € 62 bn extra acquisition);
- € 57 bn extra revenue for industry, wholesale, retail and installation sector;
- 0.8 million extra direct jobs for industry, wholesale, retail and installation sector.[8]
- Nearly 52% of the 2020 savings comes from the residential sector, 31% from the tertiary sector, 14% from the industry sector and 3% from other sectors [9].

For 2030 these results increase by over 60%. The monetary consumer savings on expenditure are tripled, also due to rising energy prices. The projections for the period 2030-2050 show that without new measures the pace of improvements slows down and eventually evens out.

The 2020 savings represent approximately 9% of the current EU energy consumption total (1759 mtoe in 2010) and 7% of the carbon emission total (5054 MtCO2 eq. in 2010). In 2030 this is projected to grow to 15% of EU energy consumption and 11% of carbon emission totals. The consumer's monetary saving is close to 1% (in 2020) and 2.6% (in 2030) of the current GDP of the European Union (12790 billion euros in 2010).

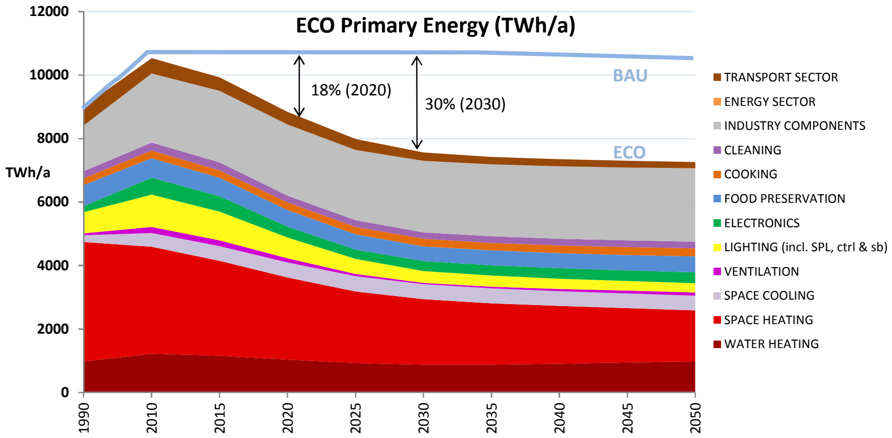
For further details see the EIA Summary in the first part of this report.

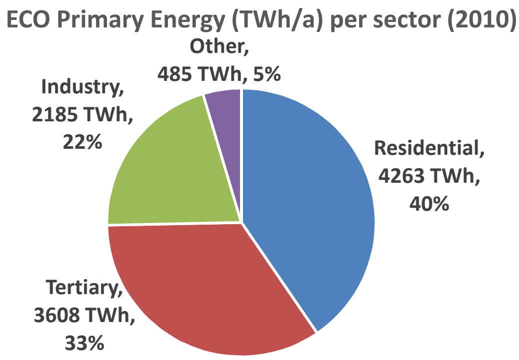
[8] Direct jobs means jobs in the value-added chain. Indirect employment effects may be a factor 3 to 5 higher, but no consensus agreed factor is available.

[9] Other sectors include e.g. the Energy sector and Agriculture and Forestry.

PRIMARY ENERGY 2010

In 2010 the products included in the accounting represent 38 700 PJ (925 Mtoe) of direct and indirect primary energy consumption. This is 53% of total EU-28 gross energy consumption in 2010 (1759 Mtoe, source: Eurostat Energy Balance Sheets). The major energy consumers are Space Heating (32% of total), Industry Components (20%), Water Heating (11%) and Lighting (10%).





PRIMARY ENERGY SAVING 2020 AND 2030

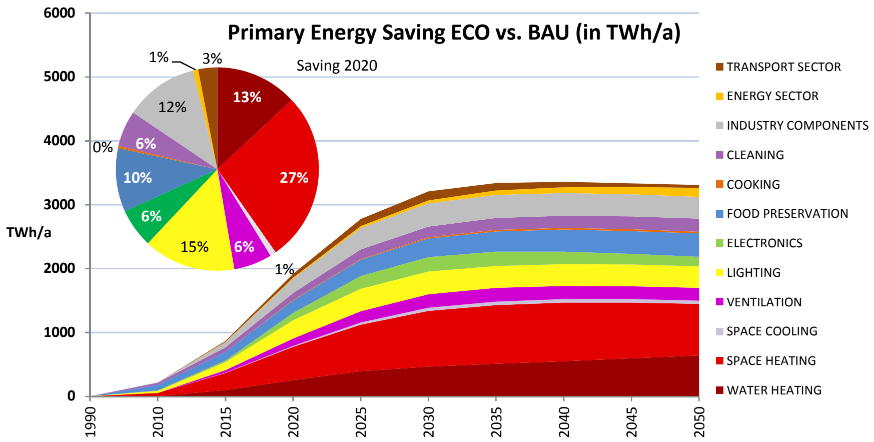
In 2020 the primary energy savings due to Ecodesign and Energy Labelling measures (ECO 2020 versus BAU 2020) are close to 6900 PJ (165 mtoe, 1918 TWh), i.e. a saving of 18% versus BAU 2020 for the average product.

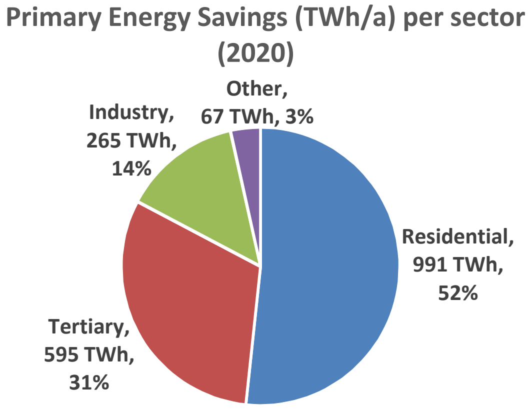
Of this, 4320 PJ (103 mtoe, 1200 TWh, 62%) is primary energy saving due to saving 480 TWh (41 mtoe) of electricity, and 2588 PJ (62 mtoe, 719 TWh, 38%) is direct fuel saving. The sum of electricity saving and direct fuel saving ('final' energy saving) is 1199 TWh (103 mtoe).

Nearly 52% of the 2020 savings comes from the residential sector, 31% from the tertiary sector, 14% from the industry sector and 3% from other sectors (energy sector, agriculture, forestry).

In 2030 the primary energy savings increase to 11500 PJ (280 mtoe, 3200 TWh), i.e. a saving of 30% versus BAU 2030 for the average product.

The 2020 savings represent approximately 9% of the 2010 total EU-28 gross energy consumption total (1759 mtoe in 2010). In 2030 this is projected to grow to 15%.





ASSUMPTIONS

Main assumptions:

- Net caloric value (NCV) of fuels used, in line with Eurostat;
- 40% efficiency for electricity generation and distribution;
- 1% load reduction per year for space heating (better insulation, ventilation);
- Increase in load where appropriate (trend towards more and bigger appliances, lamps, computers, displays);
- Product interactions assessed, e.g. Ventilation Units have own electricity savings but also lead to savings on Space Heating;
- Double Counting issues addressed for Motors, Fans, Circulators, Condensing Units, and Distribution Transformers. Full data are reported at the lowest level. Double Counted amounts are removed from the aggregated totals.

EIA Summary, Emissions

GHG EMISSIONS

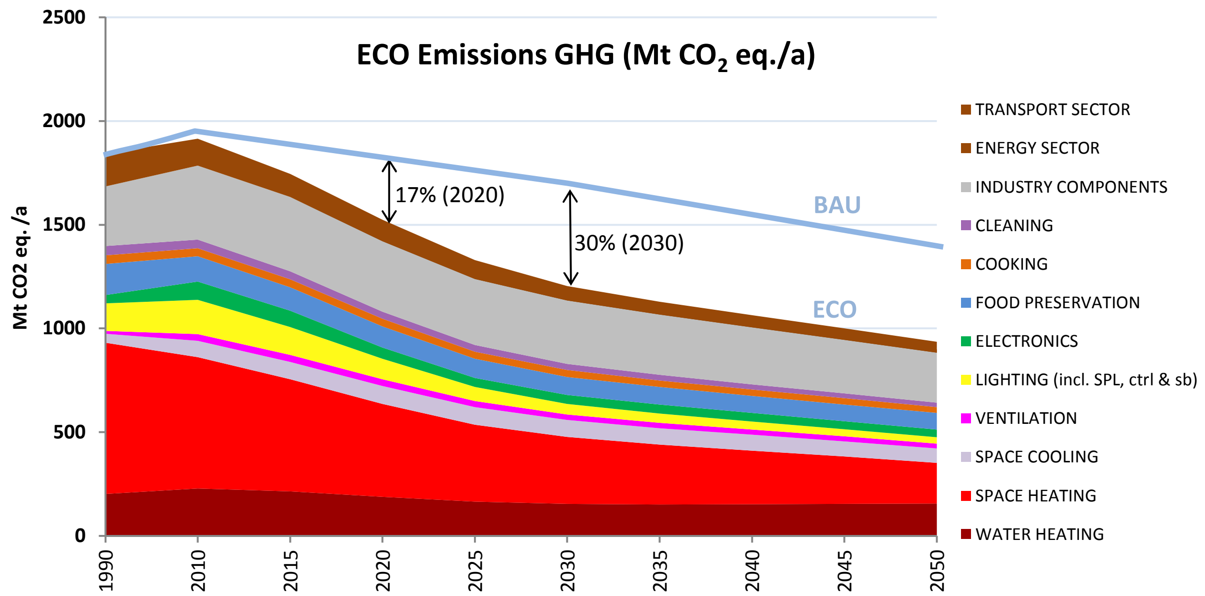
Greenhouse Gas (GHG) emissions in EIA are the sum of fuel related emissions and refrigerant losses, expressed in their Global Warming Potential (GWP100 in Megatonnes CO_2 equivalent, $MtCO_2eq$).

In 2010 the products included in the accounting were responsible for 1955 $MtCO_2eq$ of GHG-emissions. This is 41% of the total EU-28 emissions of 4721 $MtCO_2eq$ (source: EEA, GHG Inventory 2012, excl. LULUCF).

In 2020 the reduction in GHG-emissions due to Ecodesign and Energy Labelling measures (ECO 2020 versus BAU 2020) are 319, $MtCO_2eq$, i.e. a saving of 17% versus BAU 2020 for the average product. The reduction is around 7% of the EU total emissions in 2010.

In 2030 the emission reduction increase to 509, $MtCO_2eq$, i.e. a saving of 30% versus BAU 2030 for the average product. The reduction is around 11% of the EU total emissions in 2010.

For electricity the GWP (in $kgCO_2$equivalent/kWh) is assumed decreasing from 0.41 in 2010 to 0.34 in 2030. For other fuels and for refrigerants the GWP is taken constant over the years, see details in the EIA Status Report.



OTHER EMISSIONS

Other direct emission reductions in 2030:

- NitrogenOxides (NOx): -229 $ktSO_2$equivalent (2% of EU-total)
- CarbonMonoxide (CO): -507 kt (1.8% of EU total)
- Organic Gaseous Carbon (OGC): -22 kt (0.2% of EU-total)
- Particulate Matter (PM): -38 kt (1.4% of EU total)

Direct emissions are intended here as those that occur during the use of products burning fuels (mainly for heating). This does not include emissions during the generation of electricity or emissions during non-use phases, e.g. manufacturing, distribution, end-of-life. Direct emissions are included in EIA as far as available data permitted.

EIA Summary, User Expense

TYPES OF COSTS

The User Expenses for EIA products include Acquisition costs (purchase and installation) and Running costs (energy, consumables and maintenance). All prices and costs are in fixed 2010 euros.

Acquisition costs are computed multiplying a unit product price by the number of products sold in a given year. For most products, prices in EIA are defined in function of the product efficiency. In the ECO-scenario the average product efficiency is typically higher, leading to a higher product price than in the BAU scenario. Prices cover purchase and installation and include 20% VAT for residential users.

Energy costs are computed multiplying the energy consumption by the electricity- or fuel-rate. Separate rates are used for the residential and non-residential sectors. Until 2013, rates are based on Eurostat data; in later years a 4% increase per year is assumed. Consumable costs are computed multiplying the consumable consumption (paper, toner, water, detergents, vacuum cleaner bags) by a unit price. Maintenance costs are computed multiplying the maintenance cost per product per year by the quantity of products installed (stock) in the EU-28 in a given year. In EIA there are no differences in maintenance costs between the BAU and ECO scenarios.

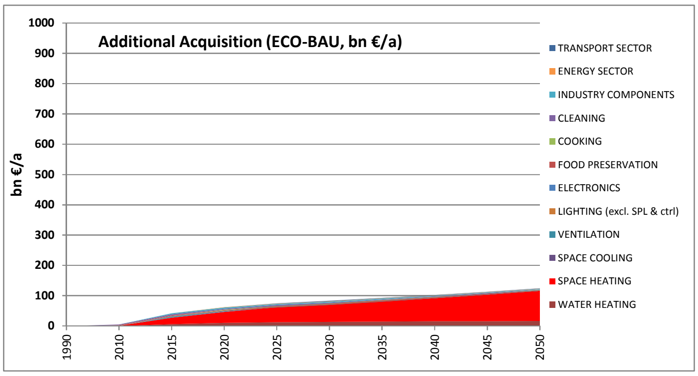
EXPENSE AND SAVINGS

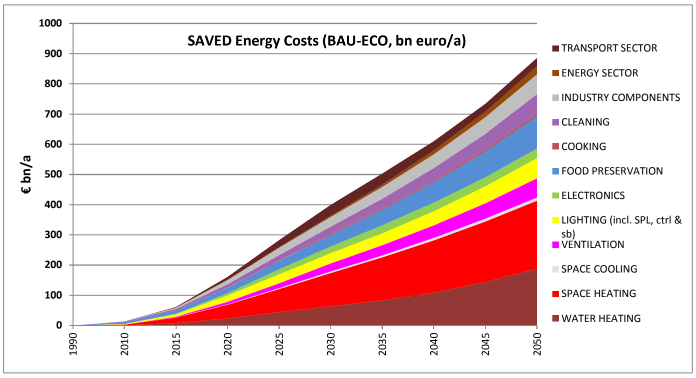
In 2010, users spent 1044 billion euros for EIA-products, of which 373 bn for acquisition, 578 bn for energy, 49 bn for maintenance and 44 bn for consumables.

Without measures, by 2020 this would increase to 1424 bn euros, but due to Ecodesign and Labelling regulations this is expected to be limited to 1312 bn euros. The saving of 112 bn is the balance of 62 bn euros additional acquisition costs (for better products) and 174 bn euros savings on costs for energy and consumables (e.g. 336 million m³ drinking water and 0.4 Mt printer paper saving). By 2030 the total expense savings are expected to increase to 338 bn euros, also due to rising energy prices. The consumer's monetary saving is close to 1% (in 2020) and 2.6% (in 2030) of the GDP of the European Union (12790 billion euros in 2010).

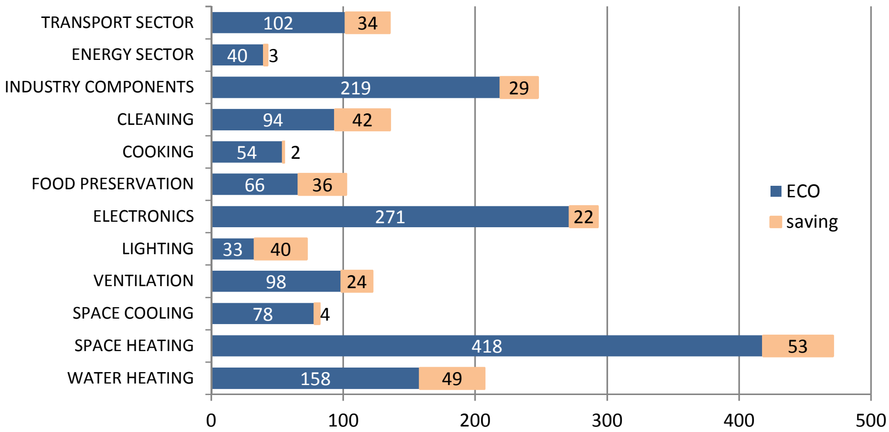
In 2030, the largest contributors to user expenses are Space Heating, Electronics and Industry Components (graph at bottom of page). The 2030 expense savings are distributed over many product groups. The absolute largest savings are obtained on Space Heating (53 bn euros) and Water Heating (49 bn euros), with relative savings versus BAU 2030 around 11% and 24% respectively. Very large relative savings derive from Lighting (40 bn euros, 55%) and Food Preservation (36 bn euros, 35%).

bn euros	2010	2020			2030		
	BAU	BAU	ECO	Inc.	BAU	ECO	Inc.
Acquisition	373	450	512	+62	525	608	+83
Energy Cost	578	860	699	-161	1261	863	-399
Maintenance	49	60	60	0	71	71	0
Consumables	44	54	41	-13	68	46	-22
Total Expense	1044	1424	1312	-112	1925	1588	-338





User expenditure
ECO scenario and saving vs. BAU 2030, in bn. €



EIA Summary, Revenues and Jobs

REVENUES AND JOBS

The unit product price in EIA is split in revenue shares for business sectors: industry, wholesale, retail, installation (and VAT). The total EU-28 revenues per sector are derived multiplying the total acquisition costs by the sector share. In general, in the ECO-scenario, the products sold have a higher average efficiency, a higher price and therefore lead to higher business revenues than in the BAU-scenario.

The direct sector jobs related to EIA products are derived dividing the revenue by a revenue per employee. The latter values differ per sector (see details in the Status Report).

For industry the jobs include OEM's and industry services. Direct jobs means jobs in the value-added chain. Indirect employment effects may be a factor 3 to 5 higher, but no consensus agreed factor is available.

In 2020 the additional business revenue due to Ecodesign and Energy Labelling measures is 57 billion euros and this can increase to 74 billion euros by 2030. The related jobs increase by more than 800 thousand in 2020 and by around 1 million in 2030.

Total revenue by functional group (in bn €)

	1990	2010			2020			2030		
	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
WATER HEATING	14	19	19	0	21	30	9	23	34	12
SPACE HEATING	40	64	65	1	78	109	32	89	140	51
SPACE COOLING	3	16	16	0	25	26	1	31	32	1
VENTILATION	32	77	77	0	86	89	2	97	99	2
LIGHTING	5	11	11	0	11	11	0	8	3	-5
ELECTRONICS	23	113	113	0	137	138	0	175	176	1
FOOD PRESERVATION	11	12	13	1	12	15	2	13	15	2
COOKING	11	15	15	0	16	18	1	17	18	1
CLEANING	10	21	23	2	30	33	3	34	36	2
INDUSTRY COMP.	6	10	10	0	12	17	5	13	17	4
ENERGY SECTOR	3	5	5	0	5	6	1	7	8	1
TRANSPORT SECTOR	19	22	22	0	25	26	1	29	30	2
TOTAL in bn euros	175	384	388	4	459	516	57	535	609	74

Total revenue by sector (in bn €)

Sector	1990	2010			2020			2030		
	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Industry	72	162	164	2	194	218	25	226	258	32
Wholesale	14	31	31	0	37	43	7	43	52	9
Retail	33	81	83	2	99	108	9	117	126	9
Installation	30	67	67	0	78	95	17	88	113	24
Maintenance	25	43	43	0	52	52	0	61	61	0
TOTAL in bn euros	**175**	**384**	**388**	**4**	**459**	**516**	**57**	**535**	**609**	**74**

TOTAL direct jobs by sector (in 1000 jobs)

Sector	1990	2010			2020			2030		
	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Industry (incl. OEM & services)	1447	3233	3272	39	3872	4364	492	4526	5157	631
Wholesale	57	124	125	1	147	174	27	171	207	36
Retail	546	1356	1382	26	1648	1795	147	1949	2105	156
Installation	304	670	673	3	783	948	165	884	1125	241
Maintenance	249	428	428	0	517	517	0	606	606	0
TOTAL in 1000 jobs	**2603**	**5810**	**5879**	**70**	**6968**	**7799**	**831**	**8136**	**9200**	**1064**

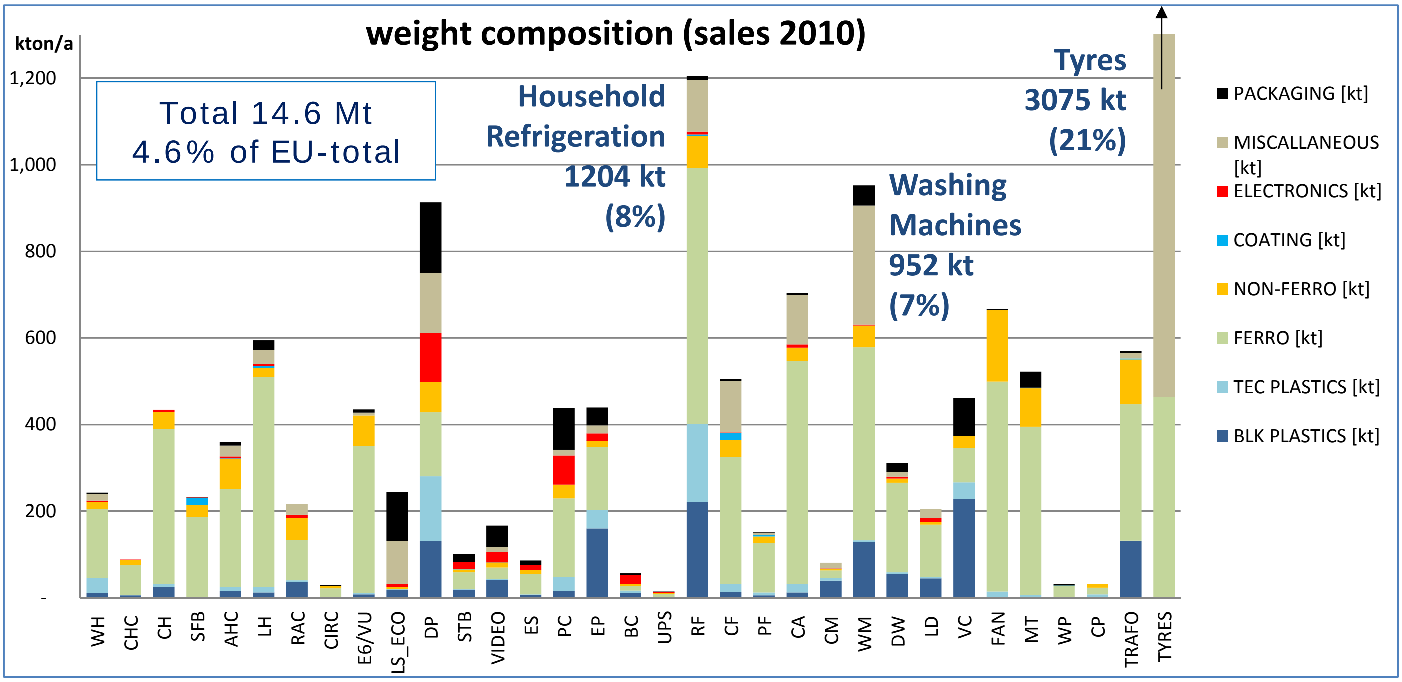
MATERIAL IN EIA PRODUCTS

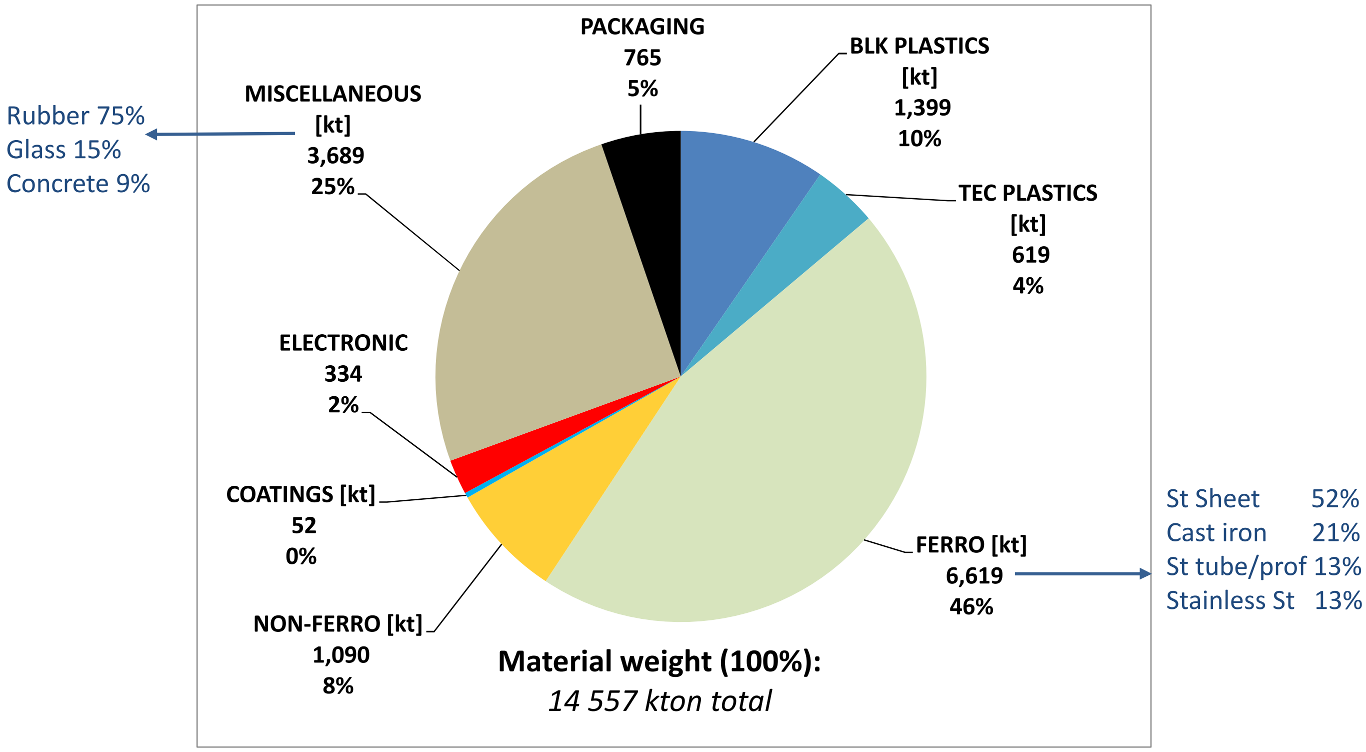
In the Ecodesign preparatory studies, Bills-of-Materials (BoM) have been defined for typical products. Multiplying the BoM weights per material category (metals, plastics, electronics, etc.) by the EIA-sales or –stock, the total amount of materials contained in sold or installed products is obtained. Summing the contributions of all products, the total material in all EIA-products is derived, subdivided in material categories. Different from the situation for other EIA data, material resource data are not a time series, but for one given year (around 2010).

For details see the 'EIA Special Report on Materials'.

The total weight of EIA-products sold in 2010 is 14.6 Mt. This is 4.6% of the total EU consumption of plastics, metals, glass, cardboard and rubber. The 'heaviest' product groups are Tyres (3075 kt, 21% of total), Household Refrigerators (1204 kt, 8%) and Washing Machines (952 kt). Ferrous metals (galvanized steel sheet, cast iron, steel tubes and profiles, stainless steel) represent 46% of the total weight. Plastics (bulk and technical) account for 14%, and non-ferrous metals (e.g. aluminium, copper) for 8%. The 'miscellaneous' category mainly consists of rubber for the tyres (natural and synthetic).

Amount of material per category contained in EIA-products sold in EU-28 in 2010





EIA Summary, Material Resources

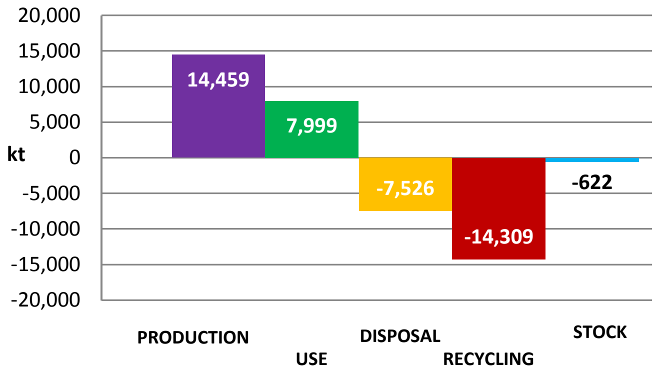
ECOREPORT

The EcoReport is a standard Excel tool to assess life cycle environmental and economic impacts of products. It has been developed as part of the 'Methodology for the Ecodesign of Energy-related Products' (MEErP).
A single EcoReport has been created for the average EIA-product, using e.g. the Bill-of-Materials of the average product (Total EIA-material of the previous page divided by Total Sales of all products), total sales and stock, and average unit electricity consumption and price.

This EcoReport confirms the EIA data regarding energy consumption, GHG-emissions and costs related to the Use-phase of the products, but provides additional information on spare parts, consumables and refrigerants (that are not present in the BoMs), on the end-of-life distribution of materials over 'disposal' and 'recycling', on the energy and emissions due to materials processing, manufacturing, distribution and end-of-life phases, and on waste caused by materials processing, manufacturing and energy generation. For details see the 'EcoReport for the average EIA product'.

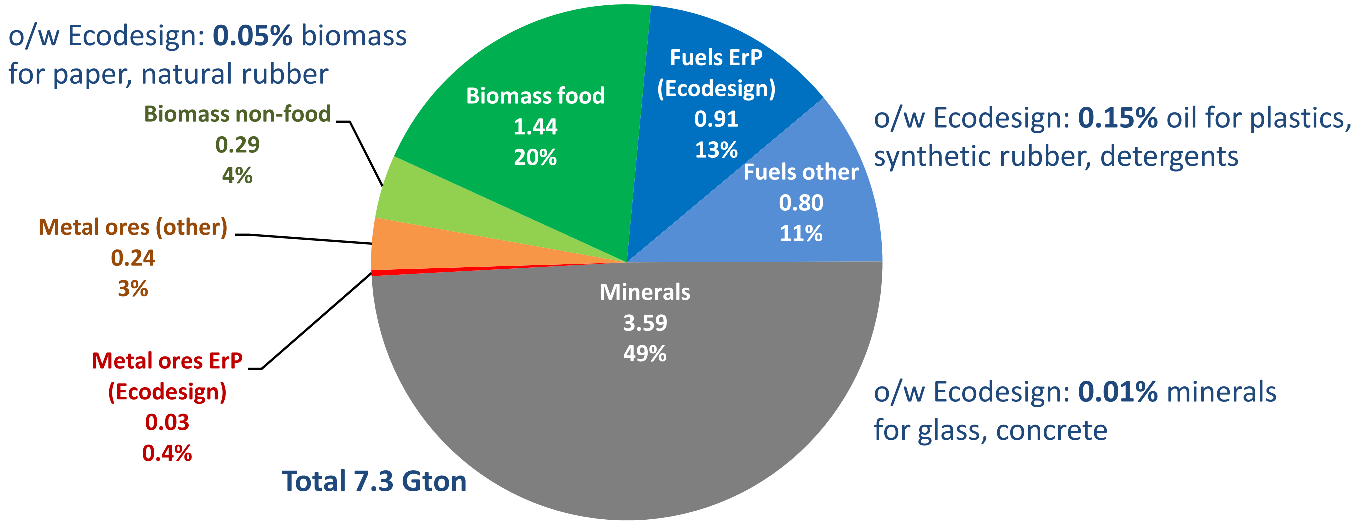
In addition to the 14.5 Mt of materials contained in EIA products sold in 2010, 8 Mt per year of spare parts, consumables and refrigerants are related to the use of EIA products, for a total of 22.5 Mt. Of this material, 66% is recycled (including re-use and incineration with heat recovery) and 34% is disposed of (landfill, fugitive, incineration without heat recovery).

Amount of material contained in EIA products, consumed during use (excl. energy), and end-of-life waste destinations.



The EcoReport shows an additional waste due to materials extraction, materials processing, product manufacturing, and generation and distribution of energy (fuel or electricity) of 21.3 Mt per year. Adding this to the amount derived above, the total waste related to EIA-products is 43.8 Mt per year. This is 0.6% of the total EU domestic material consumption of 7300 Mt. The weight of fuel consumed by EIA products is 910 Mt (13%), and thus a factor 20 higher than non-energy materials related to EIA products.

Total EU Domestic Material Consumption, 7.3 Gton.
Non-energy materials related to EIA-products represent only 0.6%.
Fuel consumed by EIA products represents 13%.



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Building Installation Products

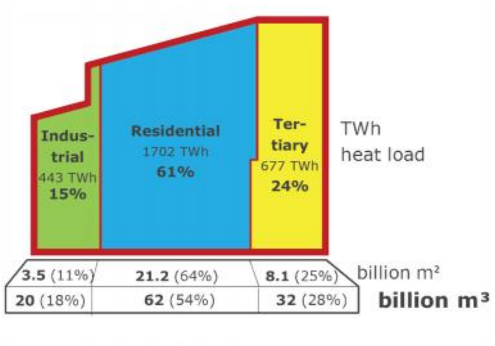
Building Installation Products

Building installations include heating, cooling, ventilation and lighting products. In terms of energy, Space heating and cooling products are the most important. This section introduces the basic terminology used in this area.

BUILDING STOCK

The total heat output that is required from heating and cooling appliances depends first of all on the size and the geometry of the buildings. The total heated surface area of all buildings in the EU is approximately 32,800 km² (32.8 billion m^2). Spread out at ground floor level, this surface is comparable to that of a country like Belgium. The land surface covered, taking into account on average 3.1 floors, is little over 10 billion m^2. The total heated indoor volume is estimated at 114 billion m^3 (EU 2010). The geometry is also relevant, because it determines the outer surface of the building walls, roof and floor in proportion to its volume, the so-called 'S/V ratio'. The next page shows reference buildings that are used to estimate the S/V ratio. The diagram below gives the split-up of heat load, floor area and volume by sector.

EU BUILDING STOCK HEAT LOAD BY SECTOR (2010)



Data refer to heated volumes and surfaces (inner dimensions) at equivalent of18°C indoor temperature (24/7) in the EU 2010 (source: VHK 2014)

CLIMATE

The second factor is climate. Almost two-thirds of the EU population lives in a relatively mild climate (green area in figure below). Around 10% live in a colder winter-climate, in Eastern and Northern regions or in mountain areas (blue area in figure). One quarter of Europeans live in a warm Mediterranean climate. Almost 70% live in a city, which is 1-2°C warmer than the countryside and 41% live in coastal regions, which is also warmer in winter. The orange area in the figure below indicates these warmer climate zones. It should be noted that small areas with the hottest European climate, such as cities in the south and the Mediterranean coast, were not split into a separate category.
In Europe, the average outdoor temperature is 6.5°C during the 7 months buildings are heated (5 months in a warm climate, 9 months in a colder climate).

HEATING SEASONS IN EUROPE

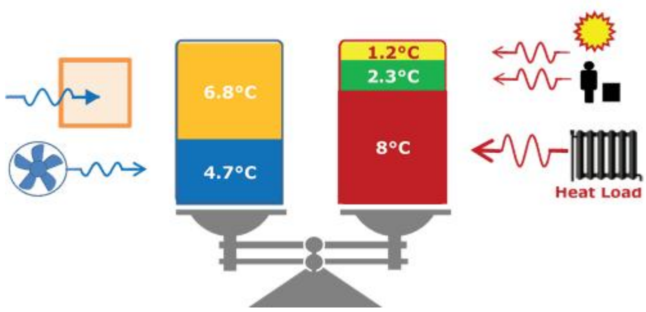
Three indicative heating season zones as defined by EC.

HEAT BALANCE

The average indoor temperature, 24/7 and over all rooms, is 18°C. This means that on average heating systems are required to offset a temperature difference of 11.5°C. The sun and the heat from people and equipment inside the buildings increase 3.5°C. On average 8°C is needed from the heating system during the heating season, to compensate for the heat dissipated through the building shell (60%) and the cold air entering the building from ventilation and infiltration (40%). These are EU-averages, i.e. the proportion between transmission and ventilation losses varies and depends on the insulation and type of ventilation (e.g. windows or mechanical). For individual cases also the orientation, wind, etc. are relevant.

EU BUILDING STOCK HEAT BALANCE

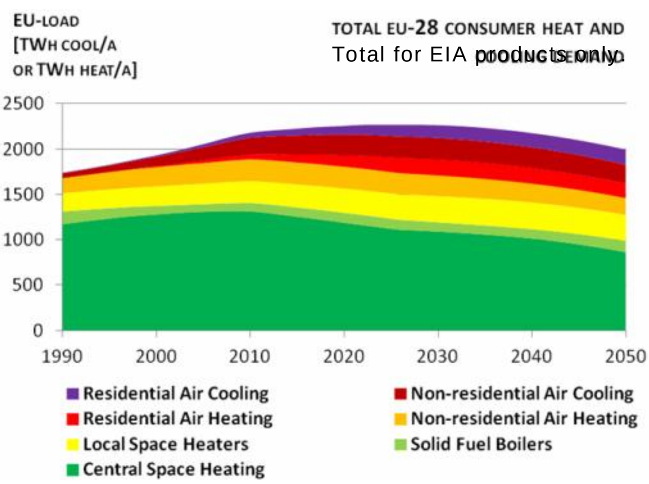
6.5°C outdoor, 18°C indoor, 11.5°C difference



From the previous can be estimated that the space heating demand, i.e. the 'heat load' that space heating solutions have to deliver, is around 2400 TWh and the space cooling load around 220-260 TWh (EU 2010). This heat load is the total EU heat demand. The heat load of EIA products covers 70% - 80% of this amount.

TREND

Trends in space heating and cooling load are affected by many factors. Improved insulation, optimised ventilation (with heat recovery), increased urbanisation (heat islands) and global warming decrease the load. Growth of population, dwelling size, comfort level and lower internal gains increase the space heating load.
For the future, a slightly decreasing heating demand can be expected. By contrast, a rising trend for cooling demand, in absolute numbers much smaller than heating demand, is foreseen. Local climate conditions, economical and behavioural patterns play a dominant role but are difficult to predict.



GEOMETRY

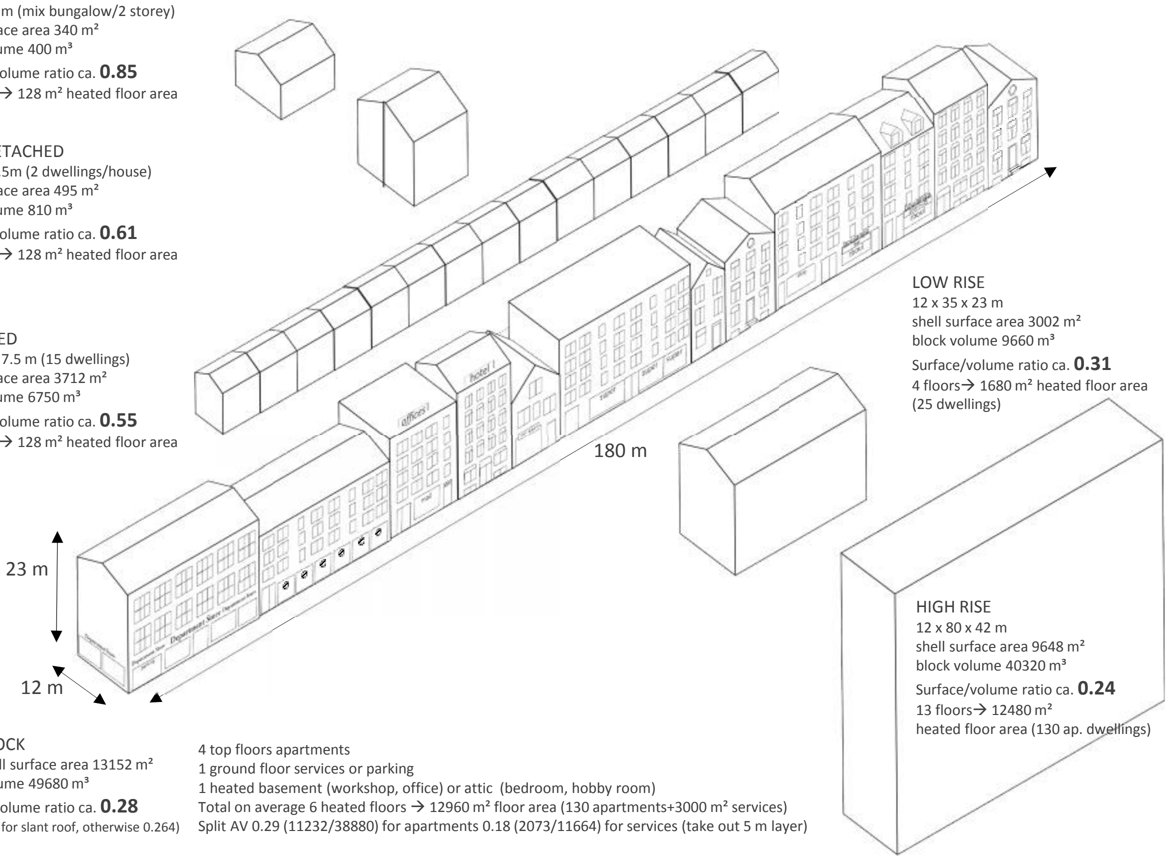
Residential reference buildings

OVERALL SURFACE/VOLUME RATIO **0.51**

DETACHED
8 x 10 x 5 m (mix bungalow/2 storey)
shell surface area 340 m²
block volume 400 m³
Surface/volume ratio ca. **0.85**
1.6 floors→ 128 m² heated floor area

SEMI-DETACHED
12 x 9 x 7.5m (2 dwellings/house)
shell surface area 495 m²
block volume 810 m³
Surface/volume ratio ca. **0.61**
2.5 floors→ 128 m² heated floor area

TERRACED
90 x 7.5 x 7.5 m (15 dwellings)
shell surface area 3712 m²
block volume 6750 m³
Surface/volume ratio ca. **0.55**
2.5 floors→ 128 m² heated floor area



LOW RISE
12 x 35 x 23 m
shell surface area 3002 m²
block volume 9660 m³
Surface/volume ratio ca. **0.31**
4 floors→ 1680 m² heated floor area
(25 dwellings)

HIGH RISE
12 x 80 x 42 m
shell surface area 9648 m²
block volume 40320 m³
Surface/volume ratio ca. **0.24**
13 floors→ 12480 m²
heated floor area (130 ap. dwellings)

CITY BLOCK
block shell surface area 13152 m²
block volume 49680 m³
Surface/volume ratio ca. **0.28**
(corrected for slant roof, otherwise 0.264)

4 top floors apartments
1 ground floor services or parking
1 heated basement (workshop, office) or attic (bedroom, hobby room)
Total on average 6 heated floors → 12960 m² floor area (130 apartments+3000 m² services)
Split AV 0.29 (11232/38880) for apartments 0.18 (2073/11664) for services (take out 5 m layer)

NON-RESIDENTIAL REFERENCE BUILDINGS

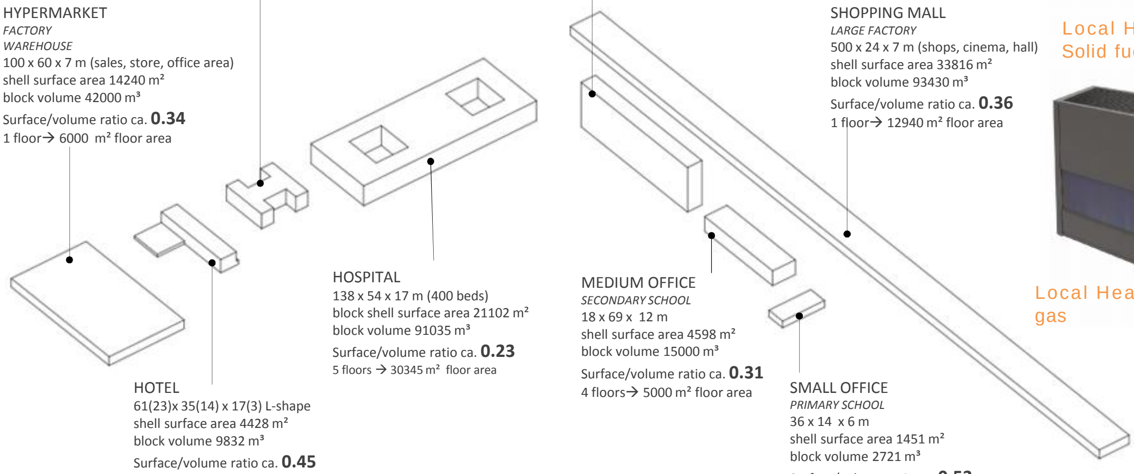
NON-RESIDENTIAL
SURFACE/VOLUME RATIOS

RETIREMENT HOME
36 x 37 x 13
shell surface area 4195 m²
block volume 11750 m³
Surface/volume ratio ca. **0.36**
4 floors→ 3916 m² floor area

LARGE OFFICE
109 x 11.5 x 36 m
shell surface area 11154 m²
block volume 45000 m³
Surface/volume ratio ca. **0.25**
12 floors→ 15000 m² floor area

HYPERMARKET
FACTORY
WAREHOUSE
100 x 60 x 7 m (sales, store, office area)
shell surface area 14240 m²
block volume 42000 m³
Surface/volume ratio ca. **0.34**
1 floor→ 6000 m² floor area

SHOPPING MALL
LARGE FACTORY
500 x 24 x 7 m (shops, cinema, hall)
shell surface area 33816 m²
block volume 93430 m³
Surface/volume ratio ca. **0.36**
1 floor→ 12940 m² floor area



HOSPITAL
138 x 54 x 17 m (400 beds)
block shell surface area 21102 m²
block volume 91035 m³
Surface/volume ratio ca. **0.23**
5 floors → 30345 m² floor area

MEDIUM OFFICE
SECONDARY SCHOOL
18 x 69 x 12 m
shell surface area 4598 m²
block volume 15000 m³
Surface/volume ratio ca. **0.31**
4 floors→ 5000 m² floor area

HOTEL
61(23)x 35(14) x 17(3) L-shape
shell surface area 4428 m²
block volume 9832 m³
Surface/volume ratio ca. **0.45**
4 floors→ 3668 m² floor area

SMALL OFFICE
PRIMARY SCHOOL
36 x 14 x 6 m
shell surface area 1451 m²
block volume 2721 m³
Surface/volume ratio ca. **0.53**
2 floors→ 1008 m² floor area

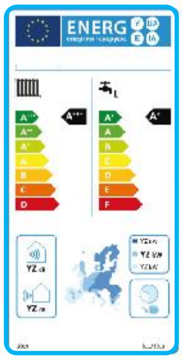
Building Installation Products

PRODUCTS

Installation products covered by Ecodesign and Energy Label regulations are:

- Central Heating Boilers (CH)
- Solid Fuel Boilers (SFB)
- Local Space Heaters (LH, Solid Fuel and Other)
- Room Air Conditioners (RAC)
- Central Air Cooling and Heating equipment (CAC, Ecodesign only)
- Circulators (CIRC, Ecodesign only)
- Ventilation Units (VU)
- Light Sources (LS)

Ventilation Units (VU) and Light Sources (LS) are indirectly related to space heating and cooling but are part of installation products especially in non-residential buildings.



REGULATIONS

Energy losses due to the building shell (insulation, fighting infiltration) are not (yet) regulated through Ecodesign, but primarily through Energy Performance of Buildings (EPB) legislation. Ecodesign and Energy Label concern the efficiency with which installation products provide heating, cooling or lighting. Improvements of the building shell are inherently slow, because of the large inertia of the building stock (average life 40-50 years), whereas heating and cooling appliances are changed every 17 years.

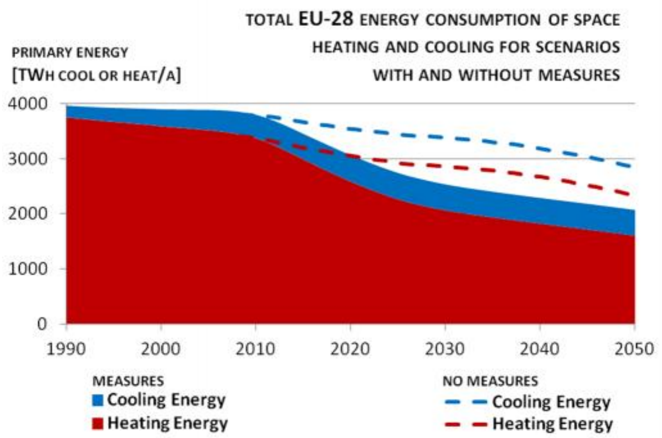
Space heating products covered by Ecodesign and Energy Label measures represent approximately 70% or 2000 TWh/year of the building heat load. Not covered are district heating and very large appliances, e.g. boilers over 400 kW.

Building installation products, including but not limited to space heating and cooling appliances, make up more than half of the energy use and greenhouse gas emissions of all Ecodesign-regulated products.

ENERGY

Although only introduced in 2013, the Ecodesign and labelling measures for space heaters and coolers were anticipated by industry since 2011. There are large differences of up to a factor 10 in primary energy efficiency of space heating appliances, ranging from 30% for an open fire place to over 300% for the best heat pumps. Average efficiency is less than 60% (EU 2010), leading to an energy consumption of over 3300 TWh/a to provide the required heat output of 2000 TWh heat/a for Ecodesign-regulated products.

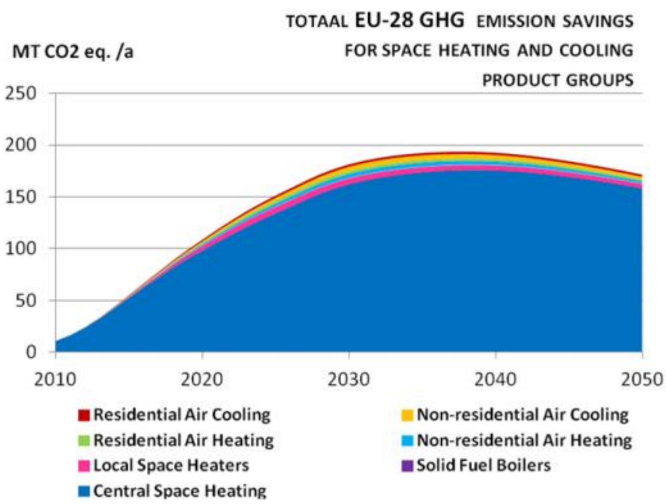
The graph shows the primary energy consumption (direct fossil fuels plus fuels to generate electricity) from 1990 till 2050. In 2015 the savings with respect to a scenario without measures were 264 TWh/a (heating) and 4 TWh/a (cooling). Combined, this equals 31% of the total 863 TWh/a savings on primary energy by regulated products. In 2030 savings are expected to be 868 and 51 TWh/a respectively, which then accounts for 29% of the total 2030 savings. The cumulative savings in the 2015-2030 period (for both heating and cooling) would be 10,174 TWh.



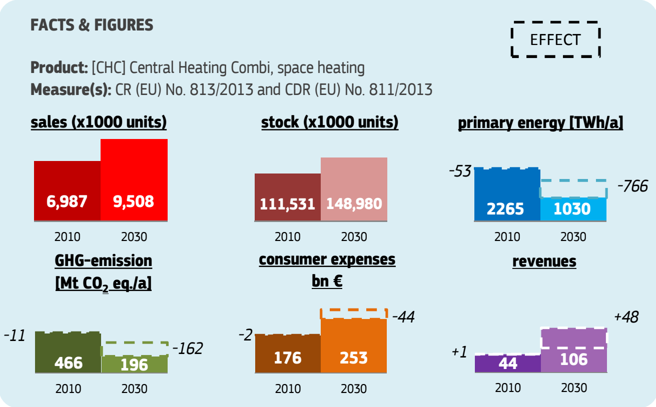
EMISSIONS

The reduced energy consumption also causes less greenhouse gas emissions. The combined 2015 GHG-emissions for space heating and cooling amount to 623 Mt CO_2 eq./a. This is 14% of the total EU GHG-emissions (4,419 Mt CO_2 eq./a in 2014). Through Ecodesign and Energy Label measures a saving of 100 Mt CO_2 eq./a is expected for 2020. In 2030, these savings rise to 182 Mt CO_2 eq./a, which would then be 36% of the savings on EU GHG-emissions by regulated products.

Several regulations for space heaters have limit values for other emissions (NOx, CO, CxHy and PM).



Central Space Heating



INTRODUCTION

Since 2013 Ecodesign and Energy Label measures are in place for Central Heating Boilers (CHB). The Ecodesign-scope includes gas- and oil-fired boilers, electric resistance boilers and electric or gas-fired hydronic heat pumps with power output ≤400 kW (≤70 kW for the Energy Label) as well as cogeneration boilers producing both heat and electricity having a maximum electric output ≤50 kW.

Solid fuel or biomass boilers, central air heaters and local space heaters are excluded here but addressed through other Ecodesign and Labelling measures. District heating end-use equipment as well as very large, typically custom-made CH-boilers are excluded because they are outside the scope of the Ecodesign Directive. The Ecodesign and Labelling measures rate the space heating performance. If the boiler also provides sanitary hot water ('combi-boiler'), that functionality is rated separately to make them comparable to the Ecodesign-rating of dedicated water heaters for which there are separate regulations.

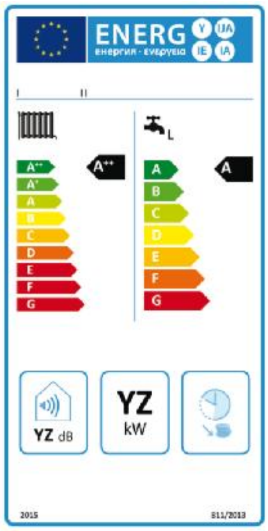
Ecodesign introduced –for the first time-- the space heating performance rating not only of single boilers, but also of boiler-packages with possibly a series of boilers ('cascades'), multiple boiler-technologies ('hybrids' e.g. of conventional boiler and heat pump), thermal solar assistance and temperature control devices. This increases transparency for installers and consumers and promotes the use of these often more energy efficient but also more complex heating solutions.

Ecodesign also introduced a 'seasonal' boiler efficiency rating, comparable across technologies, that is based on real-life boiler-operation with an important role for part-load efficiency, start-stop losses, etc. The measures thus aim to realise real-life energy savings, real-life greenhouse gas emissions and also, through specific requirements, realise decrease of NO_x-emissions and noise power level.
To address the very frequent problem of 'oversizing' the Ecodesign and Label measures introduced a new, easy-to-understand metric for boiler capacity, ranging from very small sizes for 'Near-Zero' dwellings (3XS) to very large (4XL) boiler-solutions for apartment blocks.

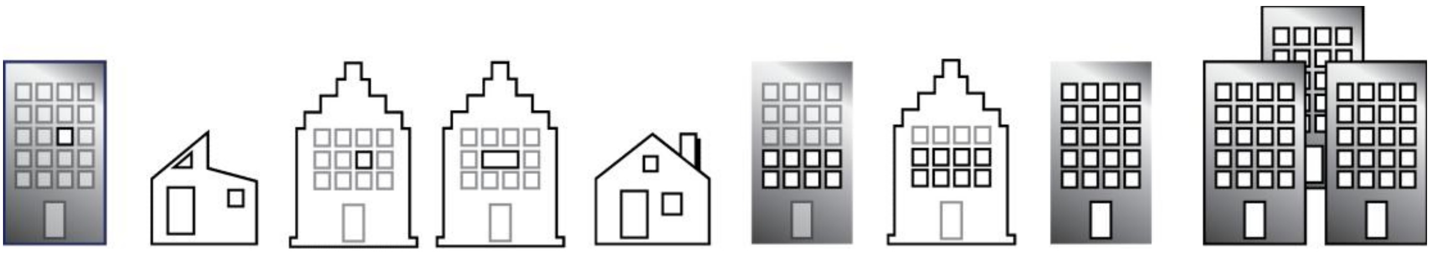
Because the measures cover such a wide range of technologies and efficiencies, and because –depending on local circumstances—not all boiler-solutions are feasible, the 7 standard classes 'A' to 'G' are not enough and the Energy Label uses 9 classes ranging from 'A^{++}' to 'G'.

The preparation of the new Ecodesign and Label measures for CH-boilers took 7 years, involving a myriad of stake-holders and their experts. It is probably the most ambitious and innovative piece of legislation ever developed in the field of space heating and firmly places the sector in the 21st century, far ahead of other continents.

The implementation of the measures, i.e. the obligation to display the labelling information and phase out less efficient products, started only in 2015 and will probably take many years for consumers and other market actors to get used to. The European Commission has anticipated that process and has foreseen regular reviews, for the first time in 2018, to optimise the methodology and repair possible flaws.



Energy label for a Central Heating combi-boiler, showing space heating efficiency class and (sanitary) water heating efficiency class.



XXS: new apartment | XS: new house | S: old apartment | M: large old apartment | L: d house | XL: 8 new apartments | XXL: ± 8 old apartments | XXL: ± 20 new apartments | 3XL: ± 3 apartment blocks

Central Space Heating

GENERAL INFO

Central heating boilers are the largest Ecodesign- and Energy Label regulated product group in terms of energy and other impacts, making up 20% of the total.

In 2015, 120 million CH-boilers were installed in the EU, 50 million more than in 1990. They covered a building heat load of ~1,250 TWh/a, i.e. over 60% of the total heat load of regulated space heating products. The efficiency of the average installed CH-boiler is 67% and thus consumed ~1,870 TWh of primary energy annually to realise the 1250 TWh output. The energy input consisted of fossil fuels (84%) and electricity (16%). The electricity, expressed in primary energy equivalent, was used for heat pumps, resistance boilers and auxiliaries such as the circulator pump.

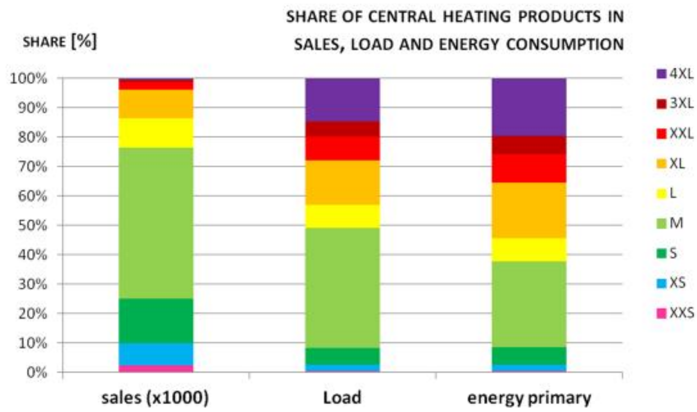
The 1,870 TWh primary energy input caused 381 Mt of greenhouse gas (GHG) emissions as well as direct emissions of 0.42 Mt nitrogen-oxides (NOx), 2.4 Mt carbon-monoxide (CO), 0.18 Mt organic gaseous carbon (OGC) and 0.17 Mt of particulate matter (PM).

For 2020 an annual energy use of ~1,490 TWh is foreseen, i.e. 20% less than in 2015, due to an increased share of condensing boilers, heat pumps, better controls and smarter heating packages. For 2030 an annual energy use of ~1030 TWh is expected, with a 28% share of electricity mainly for heat pumps.

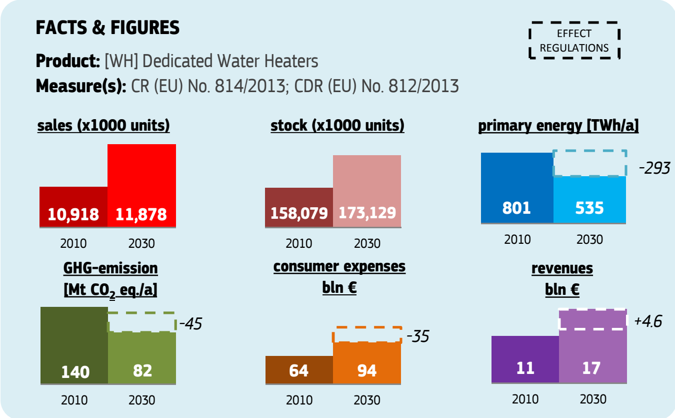
The emissions from combustion processes are expected to decrease proportionally to these saving figures.

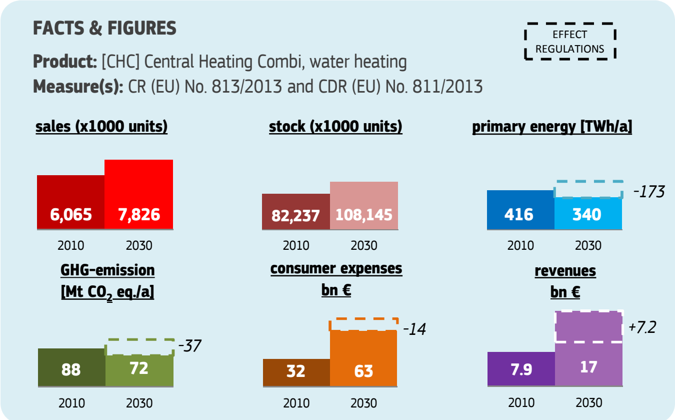
SIZES AND MARKETS

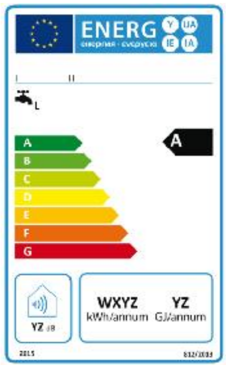
More than half of the systems (51%) are medium sized and fit e.g. the heat demand of an apartment in an older building. However, since energy consumption of these systems is also moderate, the total energy consumption of all M sized systems accounts for only 29.4% of the total energy consumption of central heating. Most energy is consumed by systems of size 4XL (19.8% of total) and XL (18.9% of total) with related sales shares of 0.6% respectively 9.8%. This phenomenon can be seen in all of the larger products: Systems sizes L – 4XL only have a 23.5% sales share, but consume 62.6% of the energy.



Water Heating





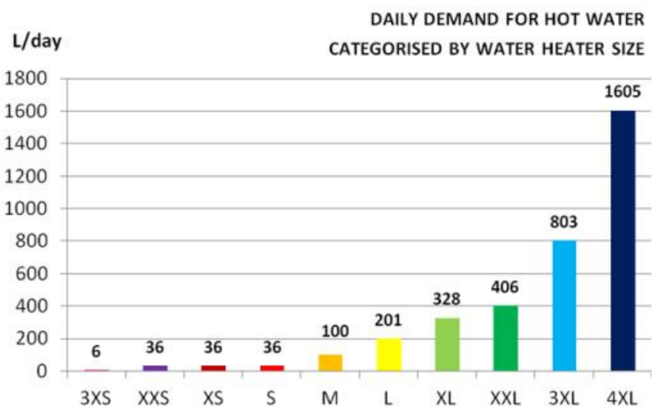


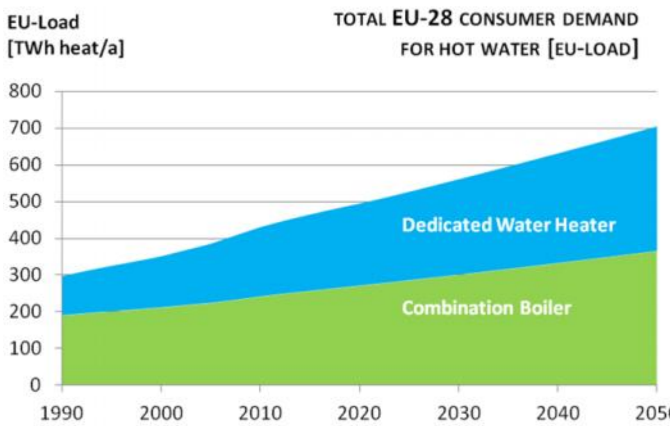
INTRODUCTION

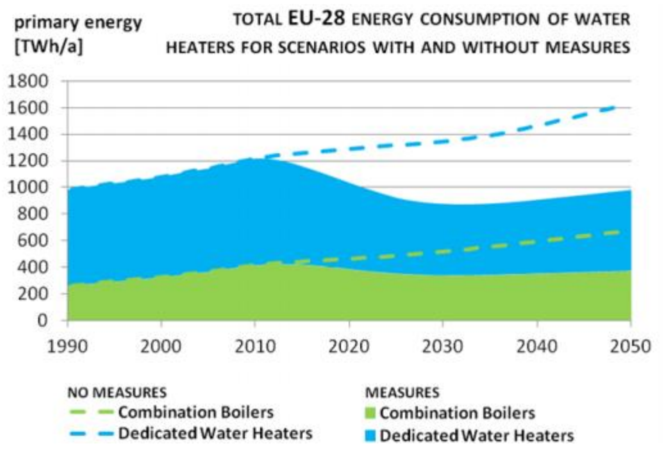
In 2015, EU citizens and businesses owned ~250 million water heaters, producing almost 8 billion cubic metres of hot water (60 °C equivalent) for showers, baths and taps. This is 43 litres per capita per day, compared to 30 litres in 1990. For 2030, at current annual growth rate of 2%, a rise to 60 litres per capita is expected. Hot water consumption per capita varies greatly within the EU, with the Scandinavians using twice as much and Mediterranean countries using considerably less than the EU average. Roughly three quarters of hot water volume is consumed in private households, with the service sector using the rest. Water heaters take up as much as 5.6% of the total EU primary energy consumption. In 2013 two different sets of Ecodesign and Energy Label regulations entered into force: one set for dedicated water heaters and one set for combi-boilers, i.e. integrated with the space heating functionality of these boilers discussed in the previous section.

SIZE

The EU Energy Label introduced, for the first time after 20 years of struggle at the level of standards, a reference for the capacity ('size') of water heaters that helps consumers to make the right choice. The capacity is determined by the ability to deliver a certain tapping pattern, ranging from very small 3XS electric water-heaters up to very large 4XL indirectly fired water heaters that can service a multitude of apartments. Most individual households use water heaters in the medium (M) or large (L, XL) range for their main hot water supply. For example, an 'M'-appliance can deliver a 7 minute shower (6 litre/minute) in morning and evening, with intermediate draw-offs for kitchen and other taps. An 'L'-appliance can deliver twice as much and would be enough to take a bath.





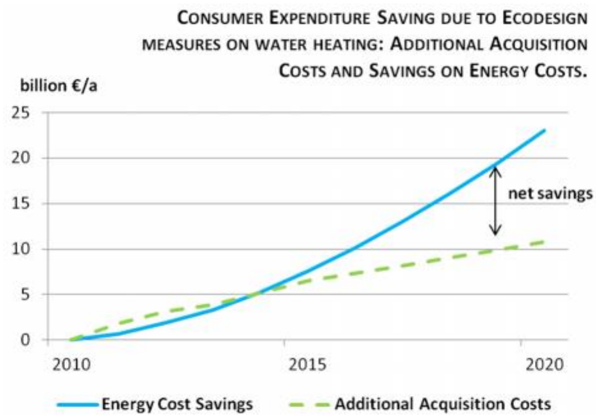


ENERGY

In 2015, despite a 40% higher hot water use, the energy consumption per capita increased only by 10% with respect to 1990. In 2020, with a continued growth of hot water use, energy consumption per capita is expected to be lower than in 1990 because primary energy efficiency of new water heaters will have more than doubled over that period. This is due to using more efficient combi-boilers, more solar and --recently-- heat pump water heaters. It is only because of the inertia of the market, i.e. it takes 17 years before all existing water heaters are replaced, that the efficiency of the average installed water heater is not even higher (e.g. the water heating efficiency of combi-boilers selling in 2020 is expected to be 76%, but the average of installed boilers in the same year will be only 58% as many older less efficient models are still in use).

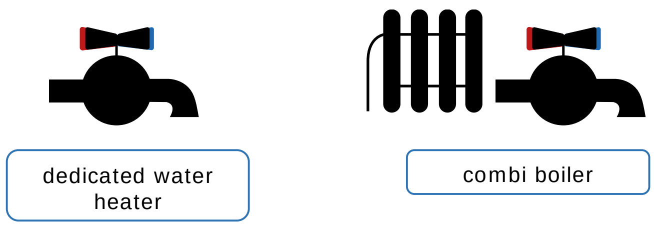
CONSUMER EXPENDITURE

Water heater efficiency has been promoted through national rulemaking for years, but it is believed that EU Ecodesign and labelling act as a catalyst. Over the last 3 years, since the introduction of the EU Ecodesign and Energy Label, it is estimated that consumer expenditure on water heater energy has decreased by as much as 7 billion Euros per year (€ 33 per household per year). In 2030 the projected money saving amounts to 63 billion Euros per year, compared to a 'Business-as-Usual' scenario without those EU measures.



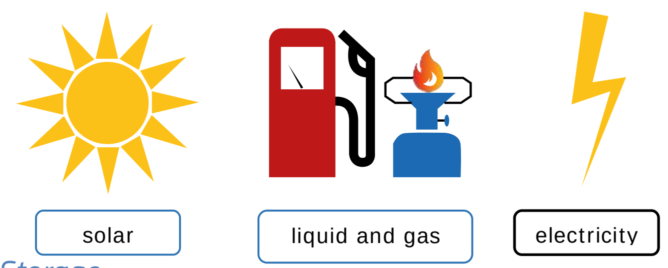
WATER HEATER DESIGN OPTIONS

Functionality

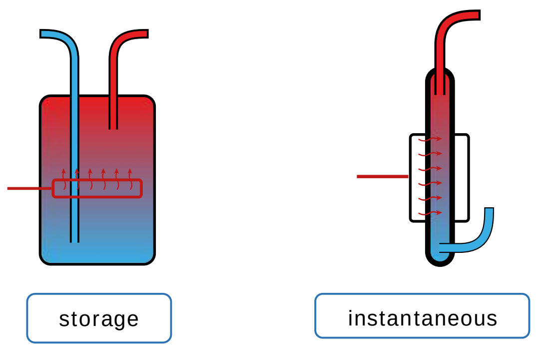


There are several types of water heaters. Dedicated water heaters [WH] will supply hot water for sanitary purposes only. Combination boilers [CHC] combine space heating of the dwelling with the supply of sanitary hot water. The majority of the products is either electric, gas or liquid fuel powered. Newer technologies involve solar (assisted) powered systems or heat pump systems.

Energy source



Storage



Water heaters may have a storage tank or heat the water instantaneously when you open the tap. A storage water heater has the advantage that hot (pre-heated) water is immediately available and that the heating element inside the tank can be relatively small. On the other hand, the capacity of the storage tank heater is limited and it takes energy to keep the water warm. Instantaneous heaters might take 10-30 seconds to start and require a larger heater (more kW), but hot water supply is limitless and there is no energy loss when not in use. Hybrid solutions of an instantaneous heater with a small storage to shorten the waiting time also exist.

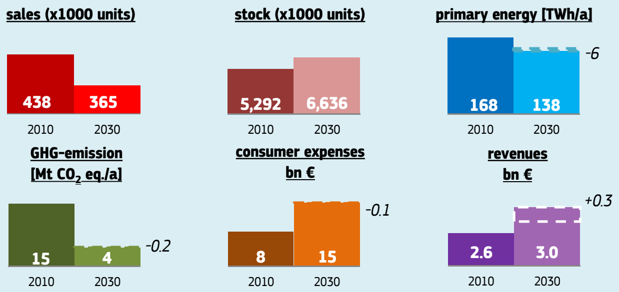
Solid Fuel Boiler

FACTS & FIGURES

EFFECT REGULATIONS

Product: [SFB] Solid Fuel Boilers

Measure(s): CR (EU) No. 2015/1187 and CDR (EU) No. 2015/1189

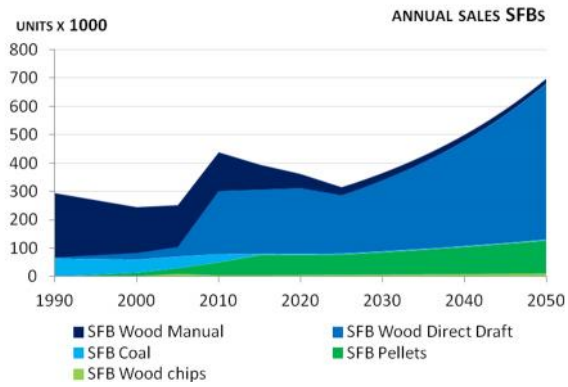





woodlog coal pellets woodchips

GENERAL INFO

Solid fuel boilers are similar to central heating boilers. Their purpose is to heat multiple rooms by means of the transport of hot water through a plumbing system. The difference is the input source, which are solid fuels instead of gas, liquid fuels or electricity.

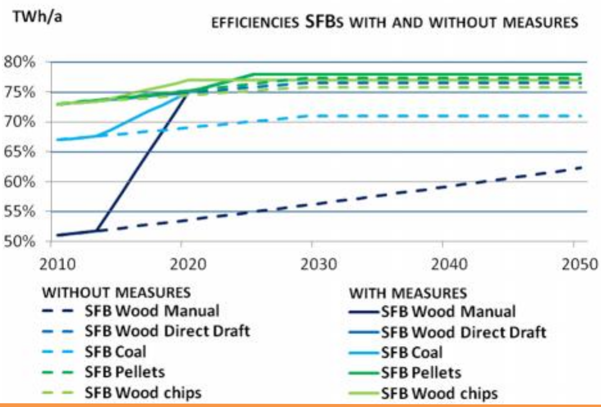


SALES

The market for solid fuel boilers has been variable over the last two decades. Their use was mainly popular in Eastern European countries, but during the 1990s the demand for SFBs was decreasing in that region. Boilers using coal tended to disappear from the market, with annual sales of 64 thousand units in 1990 dropping to 45 thousand in 2000 and only 4 thousand unit sales left by 2015. However, at the beginning of the 21st century, modern SFBs came onto the market. Especially the increase in sales of more efficient automatic wood boilers and pellet boilers led to peak annual sales of 438 thousand units in 2010. The underlying cause can be found in measures encouraging the use of biomass fuels. Additionally, the increasing prices of gas and oil played a part in these increasing sales numbers. After this peak in sales, numbers are decreasing again, with an expected low in 2025 of 315 thousand units, a decrease of 28% compared to 2010. After this low, sales of the biomass fuelled product are expected to grow once again.

ENERGY EFFICIENCIES

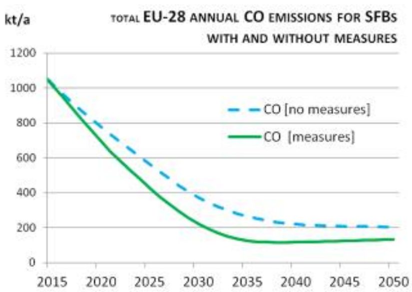
Ecodesign measures and labelling for Solid Fuel Boilers were introduced in 2015. The graph on the right shows how the efficiencies increase over time. Especially improvements for manual wood boilers (22 %point) in 2030 are significant. In 2030, all SFB are expected to reach an efficiency of either 77% or 78%. These improvements yield energy savings of 5.7 TWh/a in 2030, with corresponding GHG-savings of 0.2 Mt CO_2 eq./a. The majority of these savings are due to manual wood boilers, which account for 4.3 TWh/a primary energy savings (74%) and 0.09 Mt CO_2 eq./a (45%).

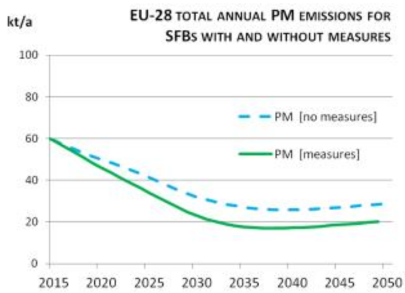


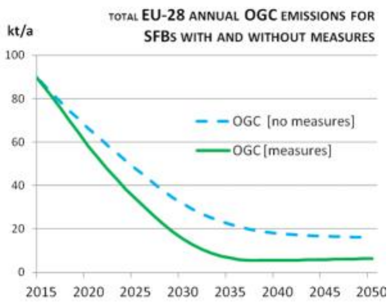
EMISSION SAVINGS

In addition to minimum efficiency requirements, the regulations also enforce limitations on emissions. Besides GHG-emissions, SFBs produce organic gaseous carbon [OGC], particulate matter [PM] and carbon monoxide [CO]. These emissions arise when the combustion of fuels is incomplete, due to a lack of oxygen or too low temperatures. The use of improved combustion technology can not only cause more energy efficient, but also cleaner products.

From 2015 to 2030, OGC emissions will decrease from 87 kt/a to 16 kt/a (-18% vs. no measures in 2030), PM emissions from 59 kt/a to 23 kt/a (-39% vs. no measures in 2030) and CO emissions from 1019 kt/a to 221 kt/a (-22% vs. no measures).







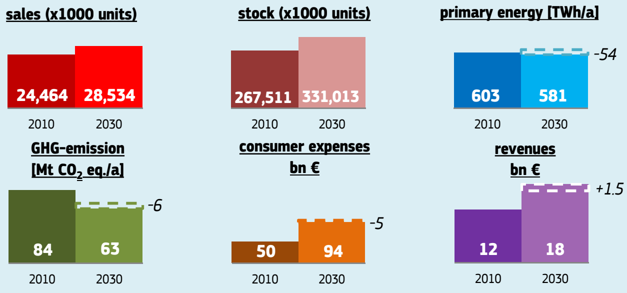
Local Space Heater

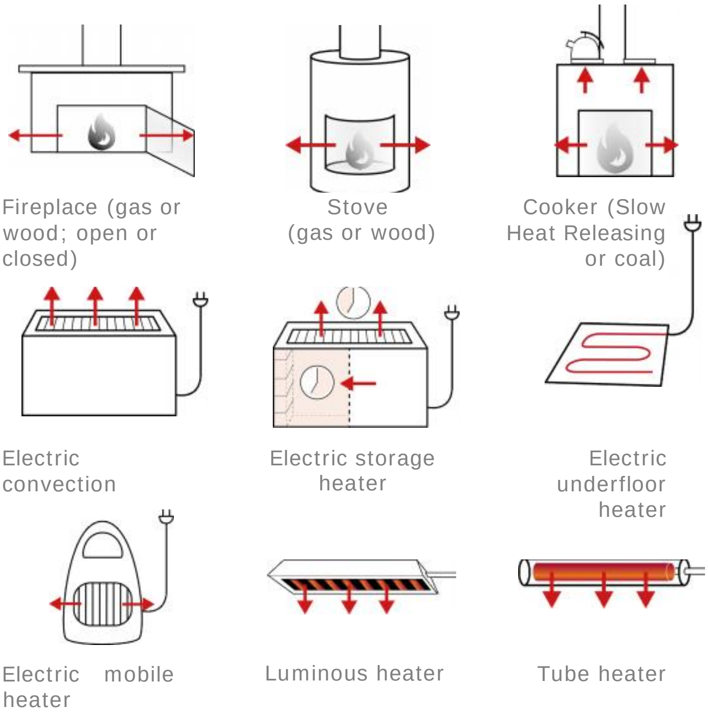
FACTS & FIGURES

EFFECT REGULATIONS

Product: [LH] Local Heaters

Measure(s): CR (EU) No. 2015/1188, CR (EU) No. 2015/1185, CDR (EU) No. 2015/1186





GENERAL INFO

Local space heaters (LH) are heating products that heat the room they are installed in. The products range from simple open fireplaces fuelled by wood to tube heaters used for commercial and agricultural applications. The variety of products led to two separate Ecodesign regulations, separating the solid fuel devices from oil/gas-fired and electric products. Energy labelling also applies to LH, except electric-, tube- and luminous-heaters.

SALES

The wide scope of LH makes it one of the largest groups of EIA in terms of stock units and definitely the largest of the Space Heating segment, with almost 285 million units installed in 2015. This number is expected to rise over the years, to over 331 million units (plus 16%) in 2030. The upswing of the pellet stoves is the most significant of all. The amount of operational pellet stoves in 2010 is expected to almost triple in 2030, while in 1990 these products were not even on the market.

Furthermore the closed fireplaces gain popularity, with 2030 stock almost double that of 2010. Other significant stock growth can be seen with cookers (77% increase from 2010 to 2030) and slow heat release stoves (+66% for the same period). Products with a decreasing stock are coal stoves (-30% from 2010 to 2030) and flueless fuel heaters (-17% over the same period).

SAVINGS ON ENERGY

The Ecodesign requirements and labelling promote improved product design by manufacturers. This will lead to products with higher energy efficiency, but also with higher prices.

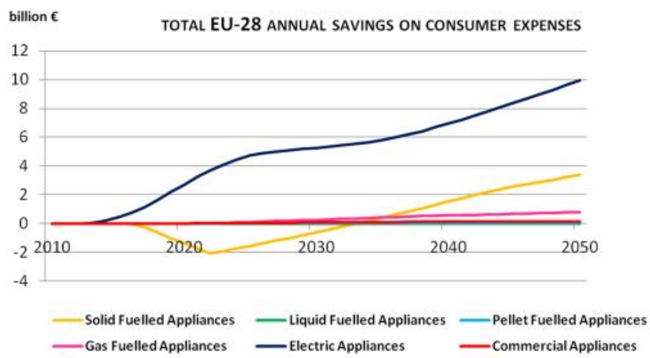
The highest energy savings are expected on electric local heaters. Total primary energy savings of LH are 54 TWh/a in 2030, of which 73% (39 TWh/a) on electric appliances. This is due to their high share of installed LH (71%). Most opportunities for improvements are found in electric convector appliances (accounting for 36% of the expected 2030 LH energy savings).

SAVINGS ON EXPENSES

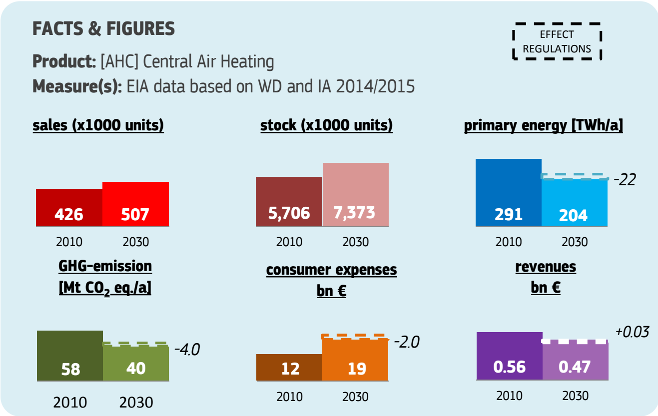
The improved product quality leads to an increase of product prices. The highest additional annual acquisition costs for LH are expected in 2025: +29% (4.4 billion Euros) compared to 2015. These additional costs are mainly caused by increased prices for solid fuelled appliances such as open and closed fireplaces, stoves and cookers. For these appliances, no savings are yielded up to 2033.

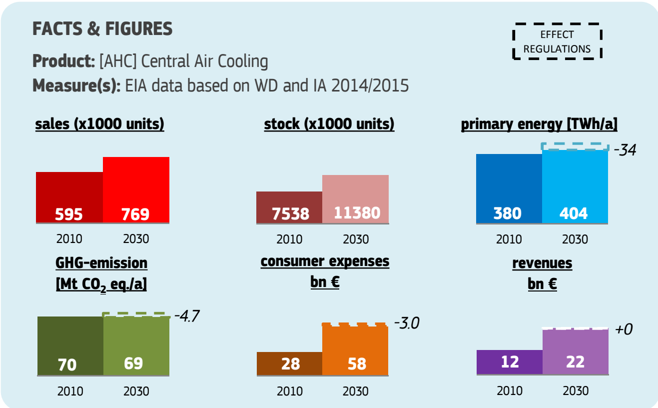
Costs of electric appliances are not expected to change significantly, except electric storage heaters (+€45, or +7% from 2015 to 2030). This makes electric heaters an attractive product group for Ecodesign requirements. The additional acquisition costs are more than compensated by lower energy costs. As a balance, consumer expenditure savings on LH of 5.1 billion Euros are expected in 2030.

Other heaters, such as pellet stoves and commercial appliances have only minor savings on consumer expenses.



Air Heating and Cooling





INTRODUCTION

In 2015 a new regulation has been proposed regarding Ecodesign requirements for (central) air heating products, cooling products and high temperature (process) chillers. The corresponding data have already been inserted in EIA and cover the following product types:

- Air Heaters (AH)
- Air conditioners (AC)
- Chillers (CH)
- High-Temperature Process Chillers (HT-PCH)

The Air Heaters considered here are:

- central heating systems, which distinguishes them from the Local Space Heaters,
- working on liquid fuel or gas (AHF) or on electricity (AHE), which distinguishes them from the Solid Fuel Boilers,
- using air as the medium to heat the space, which distinguishes them from Central Heating Boilers, that use water as the heating medium.

The Air Conditioners considered here are:

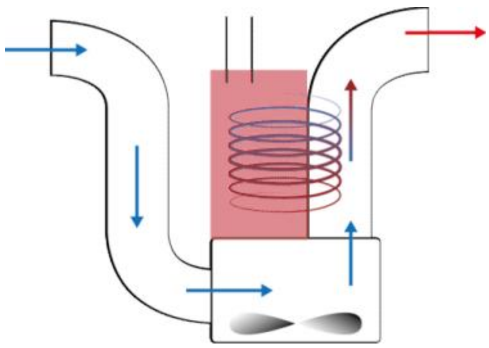
- the larger ones, not covered by CR (EU) No 206/2012, i.e. with a rated cooling capacity > 12 kW (the smaller ones are discussed later as Room Air Conditioners),
- often reversible, meaning that they have both a cooling function and a heating function,
- using air as the medium to cool/heat the space.

The Chillers use a liquid (water or oil) as the cooling medium, which distinguishes them from the AC. They are used in systems that cool spaces to provide thermal comfort to human beings. This distinguishes them from High-Temperature Process Chillers that also cool spaces, but for other reasons than comfort of human beings, e.g. to cool spaces with computers in data centres.

AIR HEATING

The air heating products can be split into two groups. The first group includes reversible air conditioners (AC rev), also referred to as heat pumps, and the second group are dedicated air heaters (AH). Heat pumps work according to the reversed vapour compression cycle (see below on cooling). Instead of extracting heat from an enclosed space and releasing this to the ambient, now the heat is extracted from the outside air and released in the enclosed space.

Dedicated air heaters use fuel combustion or electricity to generate heat which is transferred to the indoor air. The choice for either an air heater or a heat pump depends on the place of installation. The efficiency of heat pumps will reduce as the outdoor temperature drops, because less heat can be extracted from the outdoor environment at the same effort. The efficiency of air heaters does not depend on the outdoor climate.



Airflow in an electric heater; Fresh, outside air is sucked in by a fan and led through a heating chamber. In the heating chamber a heating element is placed which heats the cold air. This warm air is then released to the indoor environment.

AIR HEATING , ENERGY SAVINGS

Without measures, AH and reversible AC would be expected to consume 226 TWh/a primary energy in 2030. Due to the measures this can be reduced to 204 TWh/a (-22 TWh, -10%). The largest savings (13.4 TWh, 61%) are obtained on the 1.3 mln installed fuel fired air heaters (AHF), due to an increase in efficiency from 66% in 2015 to 82% in 2030.

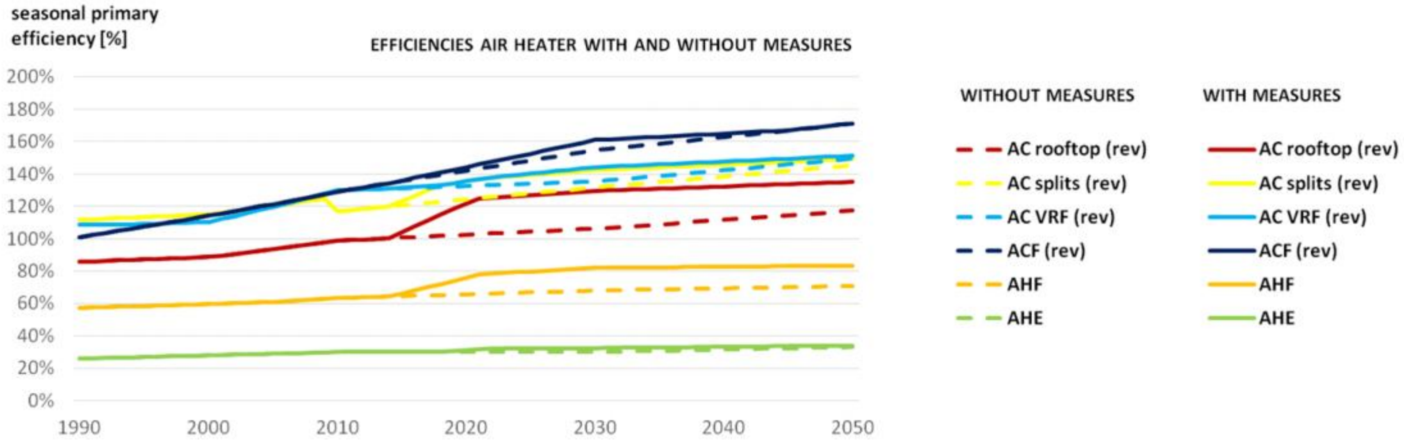
Split heat pumps (AC splits rev) have the largest stock (3.5 mln units, 52% of total) but consume only 23% of the total energy of air heaters. Their contribution to the energy savings is 4.0 TWh/a (18%).

Although rooftop heat pumps (AC rooftop rev) show a large efficiency improvement (104% → 127%), their contribution to energy savings is modest (2.1 TWh/a, 10%), because stock is much lower (300 thousand units).

Variable refrigerant flow systems (AC VRF rev) are the only air heating products with increasing stock (1.5 mln in 2015, 2.5 mln in 2030). Their average efficiency will increase from 131% in 2015 to 144% in 2030, with a contribution of 2.3 TWh/a (10%) to the total primary energy savings.

AIR HEATING, EFFICIENCY

The efficiency of heat pumps (AC rev) is generally higher than that of air heaters (AH). This can be explained by the fact that air heaters have to generate the required heat, while heat pumps use fuel or electricity to move heat from one space to another. This enables energy efficiencies over 100%, since the output energy (which is heat in this particular case) can be higher than the input energy. Ecodesign requirements will be implemented in 2018 and 2021. To meet the 2018 requirements, the rooftop heat pumps need to improve their average efficiency of sold products by 11% with respect to the 2015 average efficiency. For fuelled air heaters a 16% improvement is required. The average efficiency of electric air heaters (AHE) and fuelled heat pumps (ACF rev) sold in 2015 already meet the 2018 requirements.



SPACE COOLING, LARGE AIR CONDITIONERS

The proposed regulation targets air conditioners (AC) with a rated cooling capacity above 12 kW. This excludes the smaller Room Air Conditioners (RAC) that are separately regulated in CR (EU) No 206/2012 (see later section).

In 2015 there were 7.4 mln AC installed in EU-28, of which 5.3 mln (72%) were reversible, meaning that they can cool in summer and supply (some) heating in winter. Apart from the fuel-driven ACF, that represent only 0.1% of the stock, EIA reports on three types of AC: 'split' (or multi-split), 'rooftop' and 'variable refrigerant flow' (VRF).

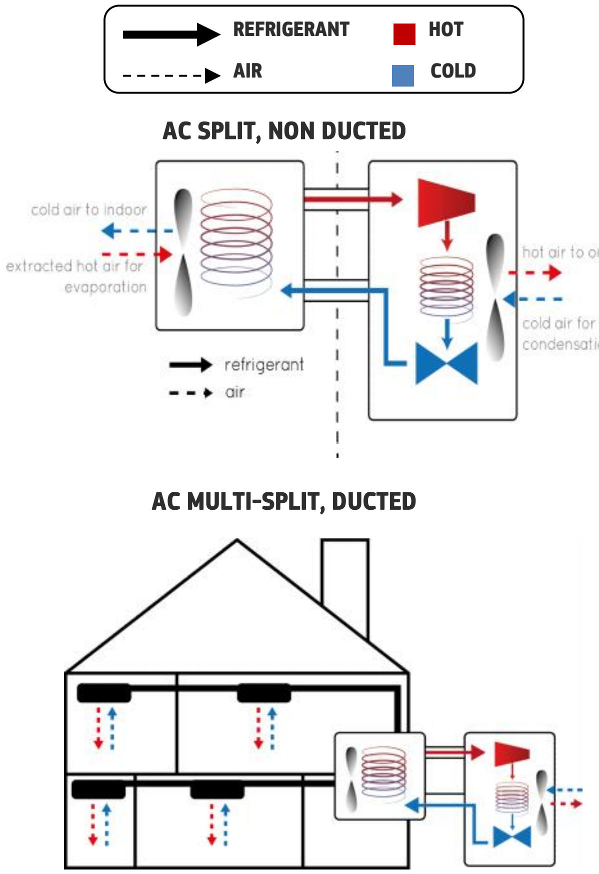
By far the most numerous (5 mln units installed) are relatively small 'split' units in the range of 12-23 kW cooling capacity. These units are 'split' between an indoor and an outdoor unit with a refrigerant feed- and return-tube in between. There is a distinction between single split and multi-split systems, whereby the latter means that one outdoor unit can work with multiple indoor units.

VRF-units are basically large multi-split installations, e.g. 28 kW, where a (cascade of) outdoor unit(s) is feeding a 2-pipe refrigerant-line circuit with several indoor units and is able, through the use of a so-called 'inverter' to adjust refrigerant flow to the system needs. The quantity of installed VRF is growing, from 1.7 mln in 2015 to expected 3.0 mln in 2030.

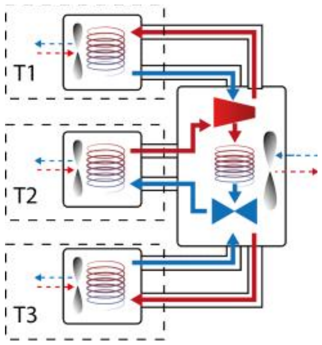
The borderlines between RACs, professional split units, multi-splits and VRF systems are becoming more and more blurred as even the smallest unit (RAC) can have an inverter and be reversible. The main difference is in size (capacity), quality and service. But what all above units have in common is that they use 2-pipe refrigerant lines to transport the heat/cooling from the indoor to the outdoor units.

This is different for the traditional AC, usually placed outdoors on the roof ('rooftop') or side of the building. There the transport medium is air, which is cooled by the AC and subsequently transported through air ducts by an air handling unit (AHU) that might also have a ventilation function. The stock of these traditional air conditioners is decreasing, amongst others because of pollution problems in the air ducts ('sick building syndrome').

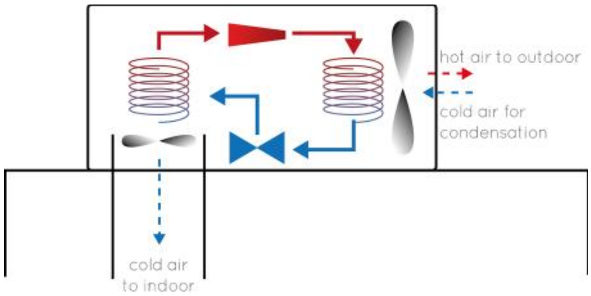
Below: schemes of vapour-compression cooling cycle. A refrigerant in a closed circuit is evaporated (absorbing heat) by warm in-house air, thus cooling it. Next the refrigerant vapour is compressed (energy use) and then condensed by e.g. external ambient air, releasing heat. Following this the refrigerant is expanded in a valve and the cycle recommences. In some appliances the cycle can be reversed so that heat is extracted from the external environment and released indoor (heating function, heat pump)



VARIABLE REFRIGERANT FLOW [VRF]



ROOFTOP

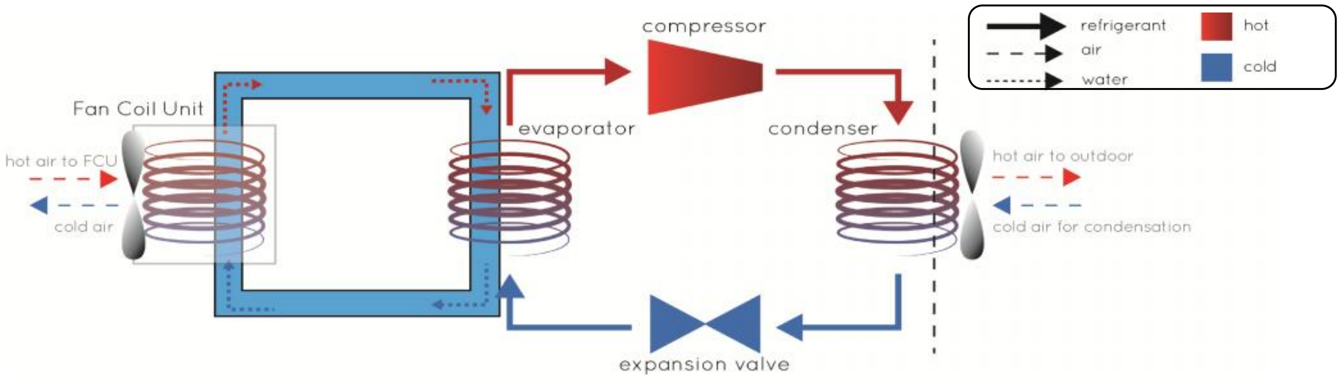


SPACE COOLING, CHILLERS

Chillers are centralised systems, that use a liquid (water- or oil based) to transport cooling/heating to indoor fan coil units (FCUs), comparable to how a central boiler heating system with radiators works in a house, but usually much larger. Depending on how the chiller dissipates its heat there are two types: air-cooled (CHA), where the condenser (the hot part of the refrigeration circuit) is cooled by large fans, or water-cooled (CHW), where the cooling action of the fans in a 'wet' cooling tower is enhanced by spraying also water drops on the chiller's hot heat exchanger.

In 2015 there were 2.2 mln chillers installed in EU-28 of which 1.8 mln smaller air-cooled models (< 400 kW). Most chillers are electric: fuel-driven CHF are only 0.3% of the stock.

High-Temperature process chillers (HT-PCH) differ from the other chillers (CH) mainly by their application. The latter provide space cooling for the comfort of human beings while the former provide space cooling for other purposes. HT-PCH are often used in e.g. data-centres to cool computer-rooms. In 2015 there were around 400 thousand installed in EU-28.



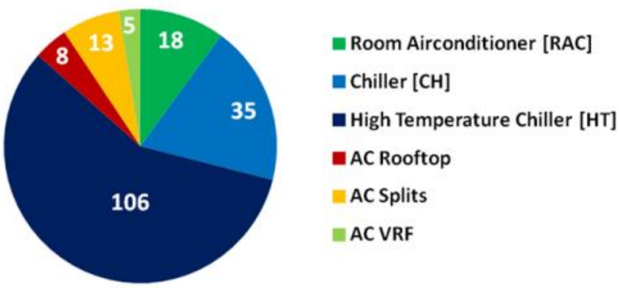
SPACE COOLING, ELECTRICITY CONSUMPTION

The 9 mln installed cooling products covered by the proposed regulation consumed 166 TWh/a of electricity in 2015. For comparison: the separately regulated 65 mln (smaller) Room Air Conditioners consumed 18 TWh/a.

Although there are relatively few HT-PCH (4% of stock), they have high cooling outputs (ranging from 865 to 6375 MWh/a/unit), and as a result consume 64% (106 TWh) of the total electricity. Chillers represent 21% of the stock, have medium cooling outputs (25 to 900 MWh/a/unit), and are responsible for 21% of total electricity use for space cooling. Air conditioners (excluding RAC) represent 75% of the stock but have relatively low cooling outputs (9 to 40 MWh/a/unit) and therefore use only 15% of the electricity.

The proposed measures on cooling products are expected to save 14 TWh/a of electricity in 2030, corresponding to 34 TWh/a of primary energy for the generation and distribution of this electricity. Most of these savings are obtained oh high-temperature process chillers.

EU-28 Total Electricity consumption of space cooling appliances in 2015. Total 166 TWh/a plus 18 TWh/a for separately regulated RACs.



SPACE COOLING, EMISSIONS

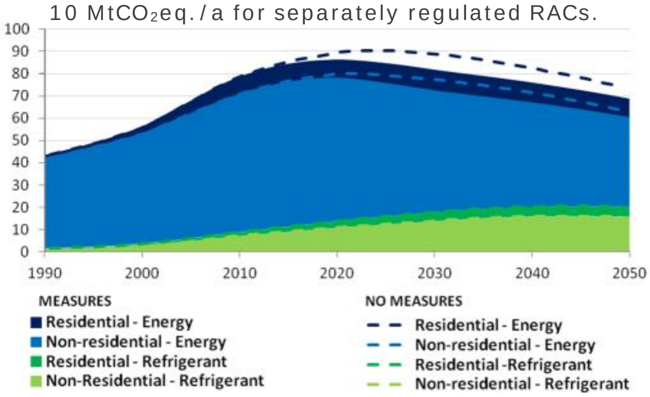
The total GHG emissions due to cooling products covered by the proposed regulation were 74 $MtCO_2eq./a$ in 2015, of which 87% is due to fuel combustion (for electricity generation or direct use in the appliance) and 13% due to refrigerants. (An additional 10 $MtCO_2eq./a$ is due to the separately regulated RACs.)

GHG emissions due to fuel combustion are calculated by multiplying the energy consumption (kWh) by the Global Warming Potential of the fuel or of the electricity (GWP in kg CO_2 equivalent / kWh energy).

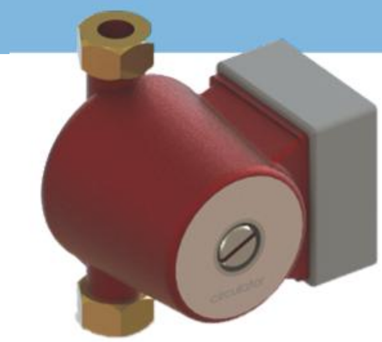
Refrigerant-related GHG emissions are due to leakage of refrigerants during the lifetime of the cooling appliance and/or to release of refrigerants at product end-of-life. The total weight (kg) of consumed refrigerant is estimated and multiplied by a GWP expressed in $kgCO_2eq$ / kg refrigerant. Different refrigerant types have different GWP-values (i.e. they are more or less polluting) and enable different energy efficiencies.
The use of refrigerants with high GWP is increasingly being limited by national- and EU-legislation and by worldwide agreements. This is beyond the scope of Ecodesign, but some Ecodesign measures do take into account the trade-off between energy efficiency and GWP of refrigerants.

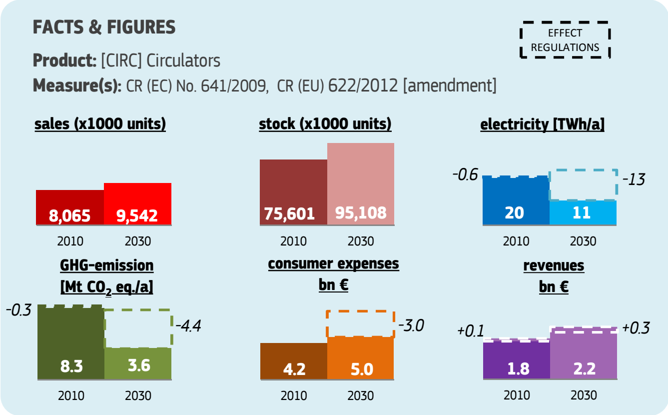
The demand for space cooling is expected to grow rapidly, i.e. with 27% over the 2015-2030 period (see also introductory section on building installation products). Nevertheless, mainly through energy efficiency measures the GHG emissions are expected to be slightly lower in 2030 (82 $MtCO_2eq./a$) than in 2015.

EU-28 Total GHG-emission of space cooling appliances in 2015. Total 74 $MtCO_2eq./a$ plus 10 $MtCO_2eq./a$ for separately regulated RACs.



Circulators



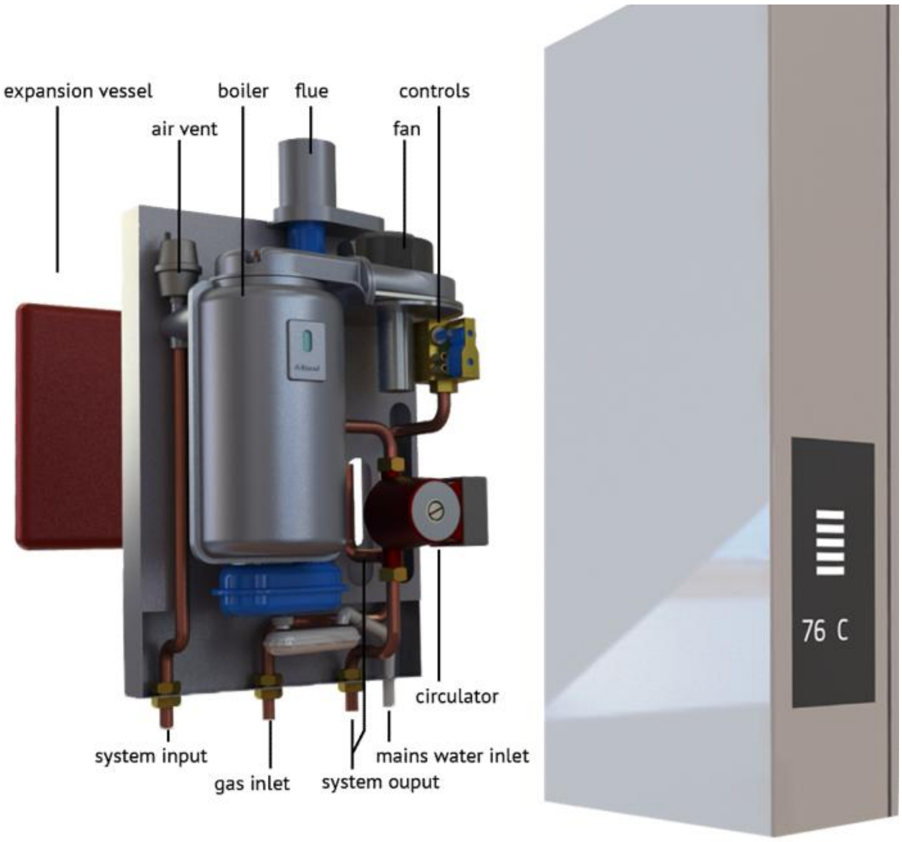


GENERAL INFO

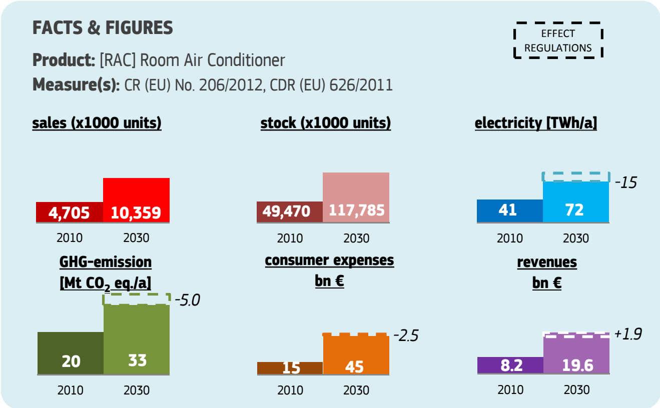
Circulators are special pumps which are being used to circulate a substance through a closed loop system. A common use is in central heating systems, with the function of transporting hot water. In the product study for circulators, two base cases were identified: standalone and boiler integrated devices. Both types are included in the final Ecodesign regulation.
The circulator pumps included in the regulations are 'glandless' which means the shaft of the motor is directly coupled to the pump, while 'glanded' circulators have an external shaft to which the motor can be attached. This specification was introduced to prevent an overlap with the Ecodesign regulation for 'Pumps'. In the Ecodesign Impact Accounting, only data for integrated circulators were included. The energy consumption and savings for circulators are reported in EIA, but not considered in EIA totals, because they are already included in the data for 'Central Heating Boilers'.

ELECTRICITY CONSUMPTION

Circulators are a typical example where forward-looking manufacturers, WILO and Grundfos, pressed the Commission to investigate the eligibility for an Ecodesign regulation for their products because they believe that ambitious standards in energy efficiency are not only good for the environment but also good for business. Circulators pumps up to 2.5 kW are typically, but not exclusively, used to pump water through (closed) central heating systems. Although power consumption may be limited, they are ubiquitous and make very long operating hours (typically 5000 hours per year). They may be a component in a heating boiler ('integrated') or used as a standalone product mounted by the installer somewhere in the heating circuit. At the time when the Commission investigated the product in 2008 - 2009 their electricity consumption amounted to over 20 TWh/year, which is a significant number and comparable to e.g. the energy use of all household dishwashers in the EU. Furthermore, the energy saving potential was substantial, due to the tendency in the sector to vastly over-dimension the pump and use only basic controls. The new metrics of the Ecodesign regulation played an important role in turning the market around and already in 2015 the electricity use dropped to 14 TWh/a and it is projected that in 2030 an electricity use of only 11 TWh/a will be achieved. This is a 50% saving in electricity and CO_2-emissions while at the same time the product contributed in achieving a higher, more even heating comfort.



Room Air Conditioners



GENERAL INFO

In the relatively mild European climate, space cooling equipment is still relatively rare compared to e.g. the US, Japan or South Korea. Not surprisingly, much of the EU air conditioner (AC) and chiller market is dominated by companies originating from those parts of the world and – with time and increased income of Europeans—have succeeded in realising market growth not only in offices but also in the home.

While in 1990 less than 5 million room air conditioners (RACs) were installed, this number has increased to over 65 million in 2015. A conservative estimate for 2030 is that over 117 million RACs will be installed. This implies, assuming e.g. 3 RACs per dwelling, that 12-15% of the European dwellings (primary and secondary) will be equipped with space cooling.

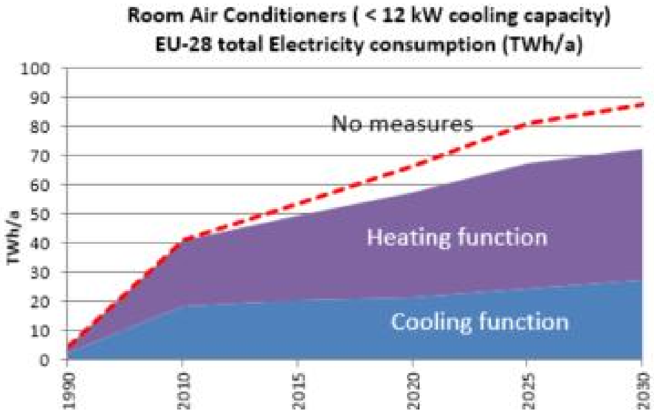
In 2015, 71% of the RACs were reversible, meaning that in addition to the cooling function for the summer they also have a heating function during the winter.

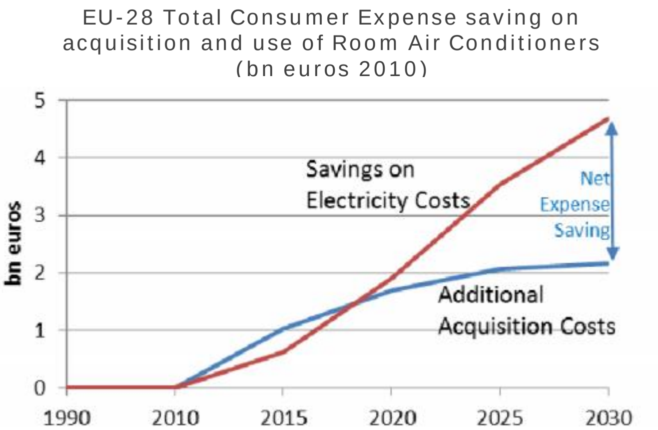
Single-split unit room air conditioner. Upper part: in-house cooling unit; Lower part: external heat-rejection unit.
For schemes of the employed vapour-compression cooling cycle, and for additional information on (larger) air conditioners and chillers, see section on Air Heating and Cooling.

ELECTRICITY CONSUMPTION

Despite the large numbers, the electricity use of RACs in cooling mode (20 TWh in 2015) is modest compared to the 166 TWh consumed in cooling mode by the 9 million larger, mostly centralised, air conditioning and chiller systems in commercial buildings that will be subject to an upcoming Ecodesign regulation (see section on Air Heating and Cooling).

The electricity use of RACs in heating mode is 29 TWh/a in 2015 and thus higher than the consumption in cooling mode. This is mainly due to the average annual demand for heating output per unit (1952 kWh heat/a) being larger than the demand for cooling output (1152 TWh cool/a). In addition, efficiencies are higher in cooling mode than in heating mode. The measures lead to savings on both functions.

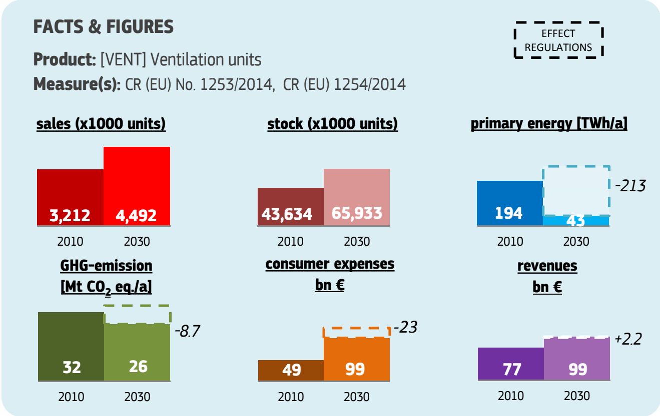




EXPENSE SAVINGS

Due to the Ecodesign and Labelling measures the average cooling efficiency of RACs increases by a factor 1.53 and the heating efficiency by a factor 1.37 over the 2010-2030 period. These improved products have higher acquisition costs (+2.2 bn euros in 2030) but lead to savings on energy costs (-4.7 bn euros in 2030), for net consumer expense savings of 2.5 bn euros (fixed euros 2010 incl. VAT for residential users).

Ventilation Units

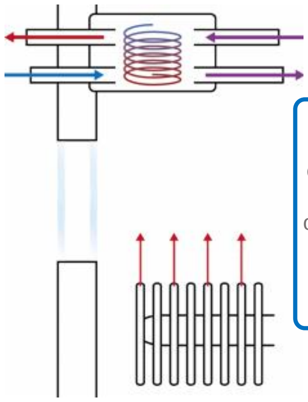


GENERAL INFO

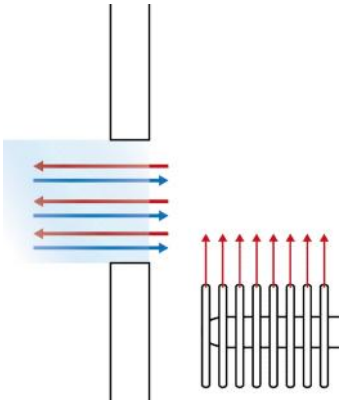
Ventilation units (VUs) use electricity to expel stale air from a room, replacing it with fresh air from the outside.
In the heating season, the incoming outside air is colder than the outgoing indoor air. An efficient ventilation unit therefore preferably includes a heat recovery system that uses the heat contained in the outgoing air to warm up the incoming air. In this way heat losses due to ventilation are reduced (as compared to natural ventilation, e.g. opening windows) and energy can be saved on the space heating system.
Consequently energy efficiency of VUs has two aspects: (1) the reduction of electricity consumed by the VU itself, and (2) the reduction of the space heating load and associated reduction of energy consumed by space heating products. Note that the latter also depends on the space heating efficiency: if this efficiency is low, the reduction in the load due to VUs becomes relatively more important.

In the Ecodesign Impact Accounting both aspects are taken into account (see details in the EIA methodology report).

Ecodesign regulation 1253/2014 on VUs acknowledges that there may be an interaction between the two efficiency aspects: non-residential VUs having a higher heat-exchange efficiency are allowed to consume more power for the fans they employ.



Using a mechanical ventilation unit, the air exchange is controlled and heat contained in the outgoing air can be used to warm up the incoming air. This saves energy on the space heating system.



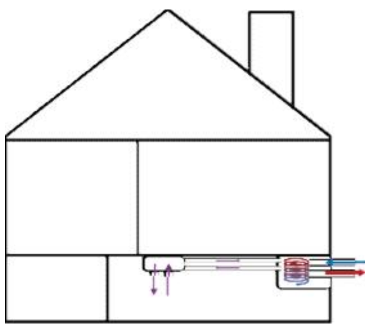
Using natural ventilation (opening windows), cold fresh air enters a room and warm stale air goes out. The heat of the outgoing air is lost and needs to be reintegrated by space heating .

Local ventilation units will only ventilate the room they are installed in.

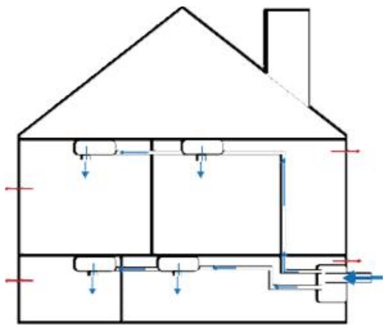
Balanced ventilation systems supply fresh air with the same rate as they expel stale air. This maintains a balanced pressure system in the building. If the ventilation systems is ducted, it should be separated from other ducted systems such as air conditioning, to prevent the disturbance of the pressure balance.

Central ventilation systems have a ductwork to supply multiple rooms in a building with fresh air.

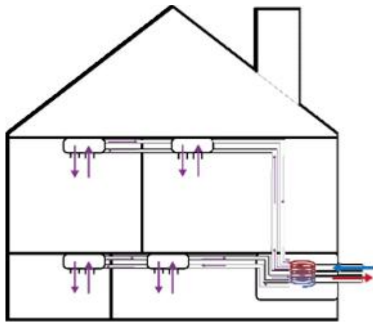
Unidirectional ventilation systems provide an air flow in one direction. This means that the ventilation unit either supplies or exhausts air only. The ventilation equilibrium is balanced by natural air exhaust or supply.



Local balanced



Central unidirectional



Central balanced

Ventilation Units

ENERGY SAVINGS

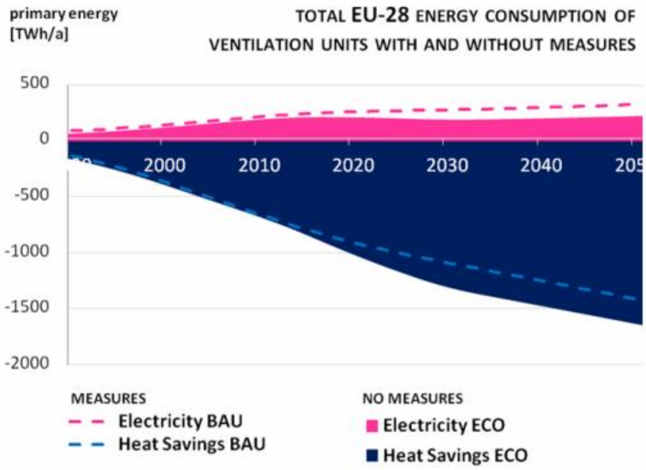
In 2015, 52 mln VUs were installed in EU-28 of which 8 mln (15%) in the non-residential sector (NRVUs). These VUs consumed 222 TWh/a primary energy for their electricity, of which 173 TWh (78%) for NRVU. The use of these VUs allowed a primary energy saving on space heating (compared to natural ventilation) of 812 TWh, of which 757 TWh (93%) for NRVU. Consequently these VUs had a net positive primary energy effect of 812-222= 590 TWh/a. If these VUs had not been installed, the total EU-28 primary energy consumption for space heating would not have been around 3300 TWh/a as it is now, but close to 3900 TWh/a.

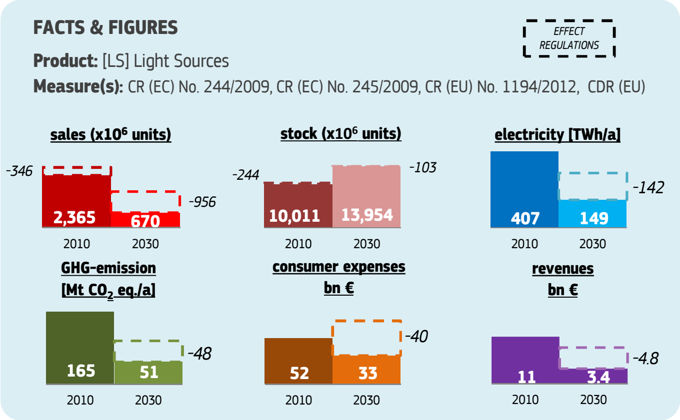
By 2030 the number of installed VUs is expected to increase to 66 mln (+27% vs. 2015). Without Ecodesign measures (BaU scenario) these VUs would consume 256 TWh primary energy for electricity (+15% vs. 2015) and allow 1108 TWh primary energy savings on space heating (+36% vs. 2015), with a net positive effect of 852 TWh/a.
Due to the Ecodesign measures, the 2030 consumption of primary energy for electricity is expected to decrease to 192 TWh/a (-64 TWh, -25% vs. BaU 2030), while the associated savings on space heating increase to 1317 TWh/a (+210 TWh, +19% vs. BaU 2030).
The above primary energy savings on space heating assume the conventional 75% space heating efficiency of the regulation. The real space heating efficiency in 2030 is expected to be 106% and this reduces the 210 TWh savings to 149 TWh/a. Consequently the net positive effect of Ecodesign measures on VUs is 64(elec) +149(heat) =213 TWh/a of primary energy in 2030. This is 12% of the total expected primary energy consumption for space heating in 2030.

This energy saving corresponds to a reduction in greenhouse gas emissions in 2030 of 9 Mt CO_2 eq/a.

CONSUMER EXPENDITURE

In 2015, EU-28 consumers spent 79 bn euros for purchase and installation of ventilation units. Without Ecodesign measures this would increase to 93 bn euros in 2030 (+18%). This increase is entirely due to an increase in sales quantities, not to an increase in prices. Due to the Ecodesign measures, consumers are expected to have to spend 2.7 bn euros extra for acquisition of VUs in 2030 (higher price for products with higher efficiency).
The total EU-28 energy costs related to VUs in 2030 are expected to drop by 26 bn euros due to the Ecodesign measures (6 bn euros due to lower electricity costs for VUs and 20 bn euros due to lower fuel costs for space heating).
Consequently the net consumer expenditure saving due to Ecodesign measures for VUs is around 23 bn euros in 2030.

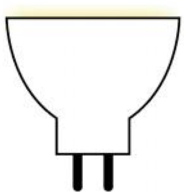




GENERAL INFO

Light sources (lamps) are the largest Ecodesign product group in terms of installed units. In 2015, over 11 billion lamps were in use in Europe, which is more than 21 lamps per EU-28 citizen. Although a single light source uses a relatively small amount of energy compared to other Ecodesign products, the huge quantity of installed products makes lighting the 4th largest energy consumer (following space heating, industry components and water heating), covering nearly 10% of the primary energy accounted in EIA for year 2015. The various Ecodesign studies distinguish many different lamp types, but EIA summarizes their data in the six main groups explained below (GLS, HL (tungsten), CFL, LFL, HID and LED).

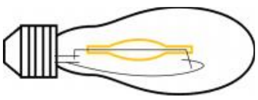
GLS = General Lighting Service: the classical 'Edison' filament lamp. When an electric current is made to pass through a thin metal wire (the 'filament'), the metal opposes the current flow (electrical resistance) and as a result heats up and starts to glow (becomes 'incandescent'), emitting electro-magnetic radiation of which a small part is visible, called light. Dominated sales until 2008-2010, but now phased-out due to Ecodesign. Efficacy around 10 lm/W.



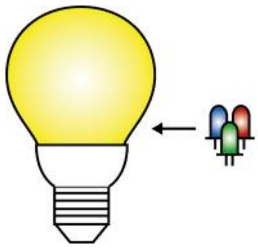
Tungsten (Halogen, HL) = modern version of the filament lamp. The filament is contained in a small capsule (often placed inside a larger bulb) that is filled with a halogen gas. This extends the lifetime and allows a slightly higher efficacy. HL are available in mains-voltage or low-voltage. Typical efficacies 12 to 20 lm/W. Halogen lamps were popular as substitutes for GLS, but Ecodesign imposes the phase-out of many types in the coming years (2016-2018).

CFL = Compact fluorescent lamp. In a fluorescent lamp an electric current passes through a gas containing some milligrams of mercury vapour. Excited by the current, this vapour emits an ultraviolet light, that is converted to visible white light by a phosphor coating on the inside of the glass tube (fluorescence). In CFLs the tube is U-bent or a spiral, allowing a compact design that can substitute GLS or HL. Efficacy 50-70 lm/W. Have a warm-up time.

LFL = Linear Fluorescent lamp. Use technology similar to CFL, but are straight tubes with electric connections on both sides. Available in different lengths (e.g. 0.9, 1.2, 1.5 m) and in different diameters (e.g. T8: 25 mm, T5: 16 mm), often applied for office lighting. Older models (T12 and T8 halo-phosphor) now phased-out by Ecodesign. LFL T8 tri-phosphor have efficacy around 80 lm/W (operating on old electro-magnetic ballast). Still widely used, but many substituted in recent years by modern LFL T5 with efficacy around 90 lm/W (operating on more efficient electronic ballast).



HID = High-Intensity Discharge lamp. Creates an electric discharge arc between two electrodes in a quartz or ceramic tube-like enclosure that contains a gas and metal salts. Provides high-intensity light from a small space. Often used in street lighting. High-pressure mercury lamps phased-out by Ecodesign in 2015. High-pressure sodium lamps (characteristic orange light, not suitable indoor) have efficacy 90-140 lm/W. Recent metal-halide lamps produce white light with efficacy 80-120 lm/W.



LED = Light Emitting Diode. Light emission derives from electrons that fall back from a high-energy state to a low-energy state, emitting the difference in energy as a photon (a small quantity of light). Emission occurs in a solid material consisting of very thin (microns) semi-conductor layers ('solid state lighting (SSL)'. In 2015: 80-140 lm/W. Expected > 200 lm/W in future.

The quantity of light emitted by a lamp is measured in lumen (lm). A lamp emits a spectrum of electro-magnetic radiation, consisting of different wavelengths (colours), of which a large part cannot be perceived by the human eye. The other part (called light) still consists of different colours, and the sensitivity of the human eye depends on the colour. The lumen-measure takes these different sensitivities into account and consequently can be conceived as the useful amount of emitted light, as perceived by humans. The instantaneous amount of electrical input to a lamp is called the input power, expressed in Watt (W).The efficacy (efficiency) of a lamp is the ratio of the light output (in lumen) and the power input (in Watt) and consequently expressed in lm/W.

RESIDENTIAL LIGHTING

In 2005 around 4.6 bln lamps were installed in the EU-28 residential sector (24 lamps per household (hh) on average), consuming 100 TWh/a electricity (514 kWh/a/hh). Around 70% of these lamps were low-efficiency incandescent lamps (GLS). Ecodesign regulations 244/2009 (non-directional household lamps) and 1194/2012 (directional lamps) introduced a gradual phase-out (2009-2014) of most GLS-types, expecting consumers to mainly substitute them by the 5 times more efficient CFL. However, CFLs were initially not well received by consumers due to unpleasant light, warm-up times, mercury content, higher prices and dimming problems. As a consequence, many GLS were replaced by the 'only' 1.5-2 times more efficient halogen lamps (HL).

In 2015 around 6.5 bln lamps were installed in the EU-28 residential sector (30 lamps per hh), consuming 73 TWh/a electricity (338 kWh/a/hh). Without measures this would have been around 93 TWh/a. 60-70% of these lamps were CFL or HL, 20-30% was still GLS, and less than 2% was already LED.

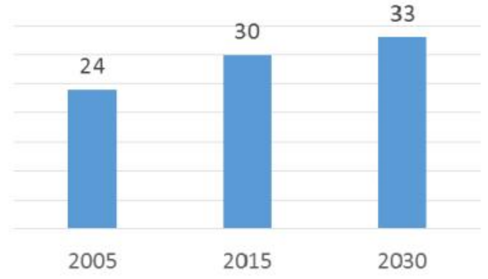
In the period 2016-2018 many types of halogen lamps will be phased-out by existing Ecodesign regulations and they are expected to be replaced by LED. The shift to LED (now 5 to 8 times more efficient than HL) is occurring at a much faster pace than could be expected in 2007 when current regulations were drawn up. Main reasons for this are that LED efficiency is still increasing, LED prices are coming down fast and LED lighting quality has improved.

For 2030 it is expected that 7.5 bln lamps will be installed in the EU-28 residential sector (33 lamps per hh), consuming 14 TWh/a electricity (62 kWh/a/hh). This is 86% less than in 2005, while the number of installed lamps per household increased by 38%. Nearly 70% of these lamps is expected to be LED. Without measures the 2030 electricity consumption would have been around 41 TWh/a.

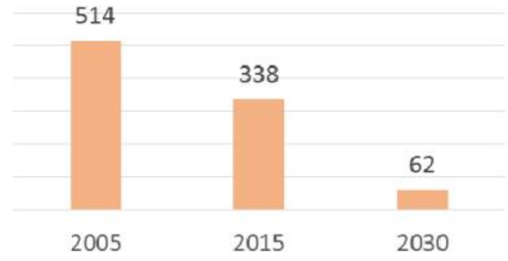
HL and CFL have higher lifetimes than GLS. In households, LEDs have lifetimes of decades. The shift from GLS, first to HL and CFL, and now to LED therefore implies a much lower need to replace lamps. This entails a collapse in sales quantities of lamps for the residential sector, from 1.6 bln units/a in 2005, to 1.0 bln in 2015, and expected 0.2 bln in 2030. Lamp manufacturers are trying to compensate this by offering new features: smart lamps allowing remote dimming and colour control (through internet or from mobile phone), acting as WiFi transmitters, integrating audio functions, etc.

In 2005 residential consumers spent 19 bln euros (incl. VAT) for lighting their homes (98 euros/hh), of which 3 bln euros for light source acquisition and 16 bln euros for electricity costs.
In 2015 this increased to 24 bn euros (111 euros/hh), of which 7 bln euros for light source acquisition and 17 bln euros for electricity costs. The higher acquisition costs are mainly due to investments in (still relatively expensive) LEDs. The more or less stable electricity costs are a balance between reduced energy consumption and increasing electricity prices.
In 2030 total residential expenses for lighting are expected to decrease to 13 bln euros (58 euros/hh), of which 1 bln euros for acquisition and 12 bln euros for electricity. The decrease is due to energy savings and notwithstanding an assumed 4% per year increase of electricity costs.

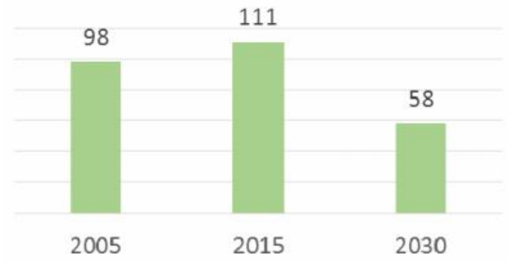
Number of light sources per household

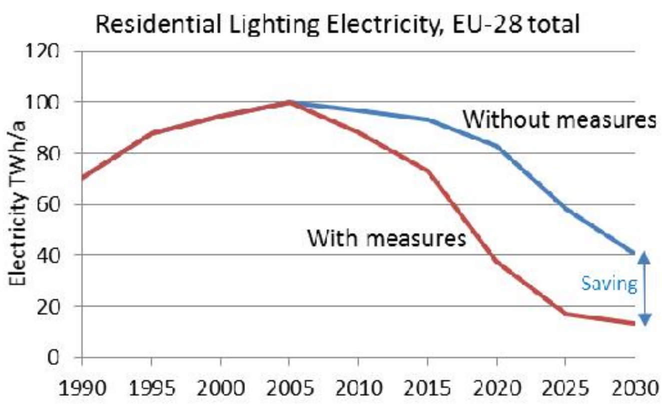


Annual Electricity consumption for residential Lighting per household (kWh/a/hh) (with measures)



Annual consumer expense for residential Lighting per household (euros/a/hh, fixed euros 2010, incl. VAT)





NON-RESIDENTIAL LIGHTING

Around 75% of lighting electricity is consumed in the non-residential (NRES) sector, of which 60% by linear fluorescent lamps (LFL), 23% by high-intensity discharge lamps (HID), and the remainder by CFL, HL and LED (2015). The major consumers are offices (20%), shops (15%), manufacturing areas (15%), road lighting (14%) and circulation areas in buildings (entrance halls, corridors, stairs, toilets, etc., 10%).

In 2005, 3.4 bln light sources were installed in the non-residential sector, consuming 284 TWh/a electricity. In 2015 the quantity of light sources increased to 5.3 bln (+56%) and the consumption to 287 TWh/a (+1%). That electricity use increased far less than the number of light sources is due to Ecodesign regulation 244/2009, which phased-out the least performing and most mercury containing LFLs (T12s and T8s with halo-phosphor coating) and high-pressure mercury lamps. The same regulation also set minimum efficiency requirements for the ballasts (control gears) that manage the power supply to LFLs and HIDs, promoting the substitution of electro-magnetic ballasts by more efficient electronic ballasts.

In 2030 the quantity of NRES light sources is expected to increase to 6.5 bln (+23% vs. 2015) while electricity consumption is expected to decrease to 136 TWh/a (-53% vs. 2015). This positive effect is mainly due to LFL and HID being substituted by LED lighting products, which is the ongoing trend.

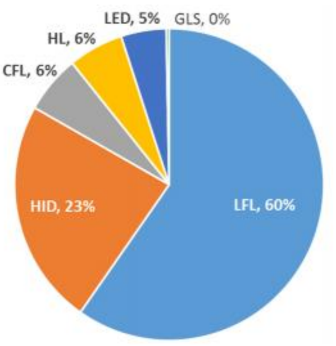
Substitution of conventional technology light sources by LED is less straightforward in the non-residential sector than in the residential sector, for various reasons:

- Following the Ecodesign regulation, many NRES users recently substituted phased-out conventional lamps by more efficient conventional lamps (LFL T5, high-pressure sodium lamps, metal-halide lamps). They need time to amortize these investments before they switch to LED.
- While residential users can often use retrofit LED lamps that fit in existing luminaires, in many situations NRES users have to buy a new LED luminaire, because LED retrofits are not always available (e.g. for LFL T5 and for HID lamps). This increases substitution costs.
- In the NRES sector, lighting installations are often designed to supply the minimum light levels required by standards. Shifting to LED these designs have to be reviewed, implying additional costs.
- The efficiency advantage of LEDs is much smaller for the typical NRES lamps (LFL, HID) than for the typical residential lamps (GLS, HL, CFL). Consequently payback times for an investment in LEDs are often longer in the NRES sector. After 2020, payback times are expected to become interesting for most NRES applications.

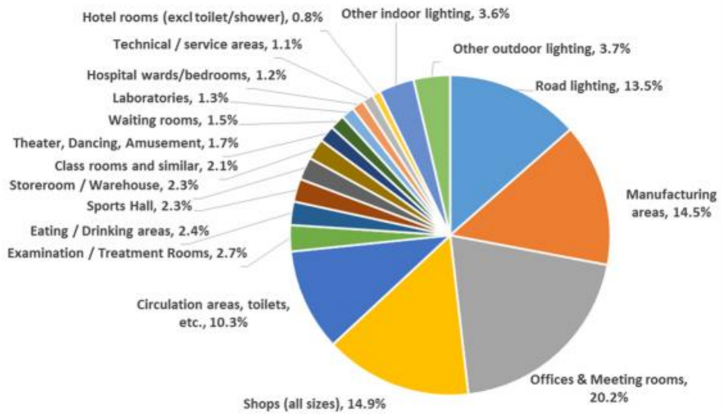
Major additional future energy savings on NRES lighting can be obtained in particular by:

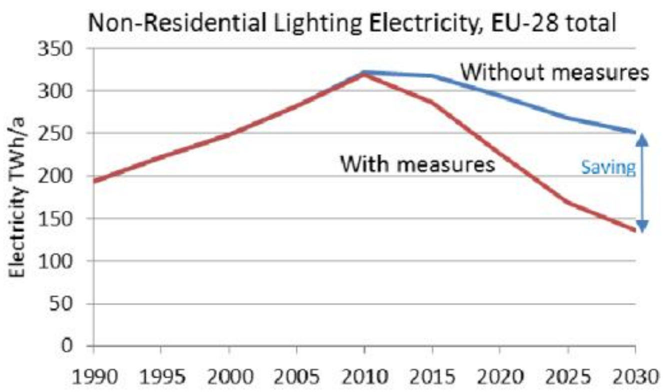
- Phasing-out LFL T8 with tri-phosphor coating. These are now the least efficient LFLs, and adequate and affordable LED replacements are available. This option is currently (December 2016) under discussion.
- Introducing measures on Lighting Systems in addition to those on Light Sources. This could be done in Ecodesign or in the context of e.g. the Energy-Performance of Buildings Directive (EPBD). These measures can promote improvement of lighting designs (more efficient luminaires, better distribution of luminaires in the room), and the installation of lighting controls that regulate the light in function of e.g. daylight availability and/or room occupancy. Lighting Systems are the subject of the ENER Lot 37 preparatory study that was completed in December 2016.

Non-Residential Lighting Electricity Shares per Technology

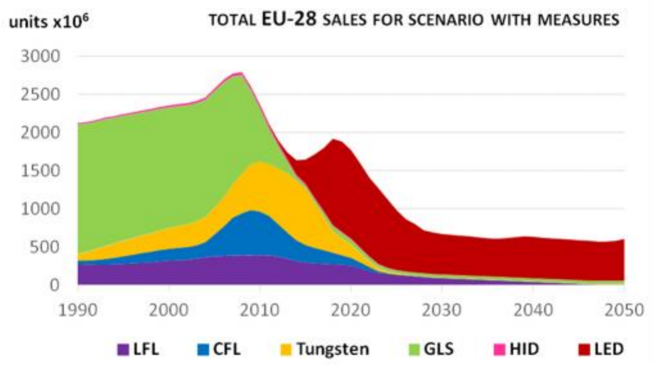


Non-Residential Lighting Electricity Shares per Application (source: VHK 2015)



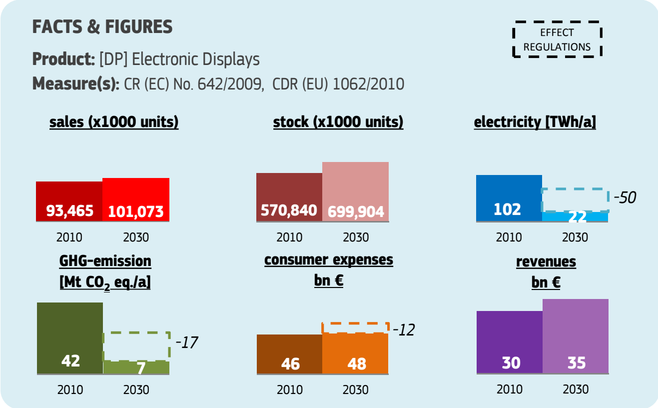


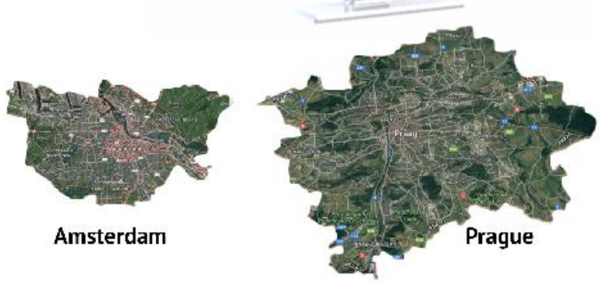
Decrease in light source sales due to longer lifetimes of LEDs as compared to conventional lamp types (sum of residential and non-residential)



ELECTRONICS

Electronic Displays



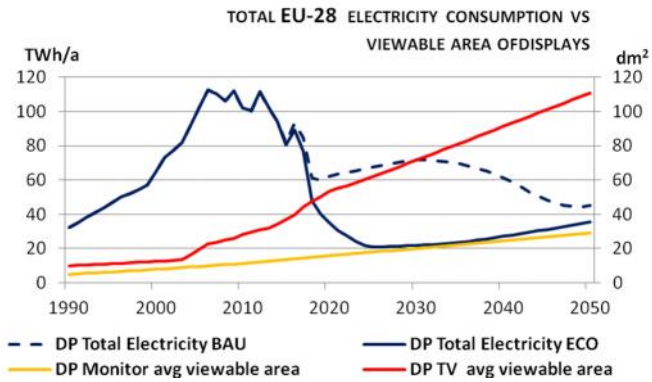


EU-28 load of displays expressed in surface area

GENERAL INFO

Currently, the regulation for televisions is under review and set to be expanded to electronic displays in general. The scope includes televisions, computer displays and digital photo frames used in the household or office environment. Excluded are visual displays where energy efficiency is of subservient interest, such as medical and emergency displays.

The total demand for displays in Europe is rapidly growing. The total viewing area of televisions and pc monitors in 2015 was 193 km^2, comparable to the surface area of the city of Amsterdam. In 2030, this viewing surface area is expected to increase to 471 km^2, almost 2.5 times more and comparable with the surface area of Prague.



SALES

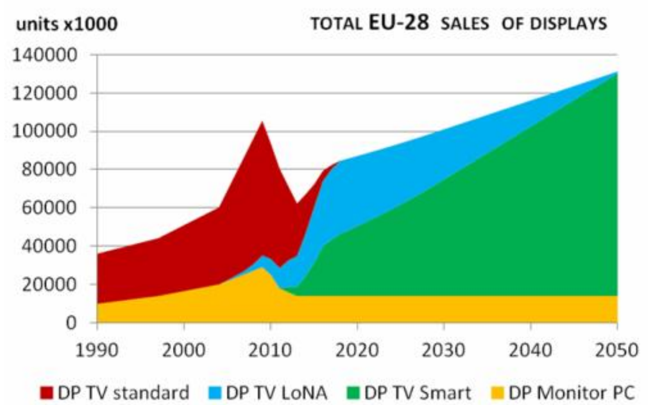
In EIA the displays are represented by three TV types and PC monitors. TVs are split up in standard, low network availability (LoNA) and medium network availability (MeNA or Smart) types. Sales of all types experienced a sharp increase in 2007-2008 with the introduction of new affordable LCD technology, followed by a decrease in 2011-2012. From 2005 onwards, the LoNA and Smart TVs have had significantly increasing sales numbers. LoNA TVs work with a complex set top box (CSTB) which provides the information content. In Smart TVs this technology is integrated, so that the device can be directly connected to a network to get its content.

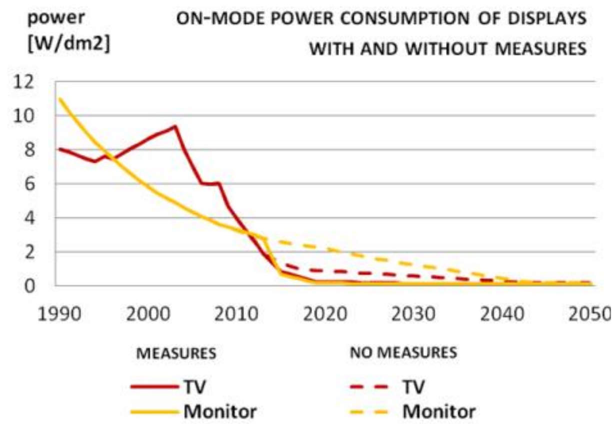
In 2015, 29.2 million LoNA TVs were sold and 17.5 million smart TVs. In 2030, the sales of LoNA TVs are expected to decrease to 26.1 million units (-11%), while those of Smart TVs will increase to 60.9 million (+248%). PC monitors are expected to have constant sales of 14 million units from 2013 onwards. With the declining sales of desktops and the multi-functionality of TV displays (which can be used as an external screen for a laptop or desktop as well) the functionality of displays becomes more interchangeable.

EFFICIENCY

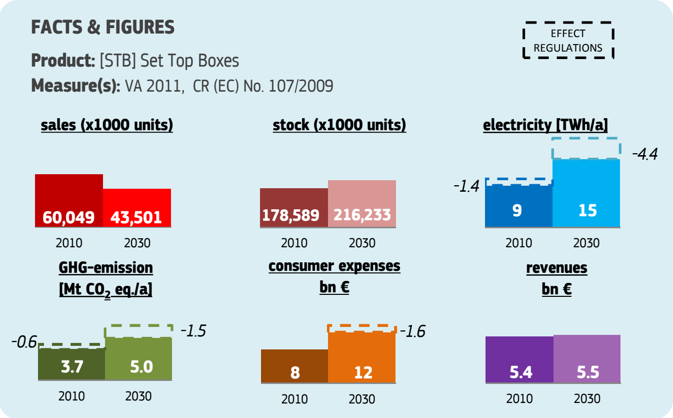
Despite the increasing stock and size of displays and the addition of functionalities, their total electricity consumption is expected to decrease from 80 TWh/a in 2015 to 22 TWh/a in 2030. Over the past decades, the power consumption (in on-mode) per unit display area has been rapidly decreasing. In 2000, TVs consumed 8.6 W per dm^2 display surface and PC monitors 5.8 W/dm^2. In 2015 this dropped to 0.8 W/dm^2 and 0.7 W/dm^2 respectively. The prognosis for 2030 and later is that specific power consumption will further reduce to 0.1 W/dm^2 for both display types.

As the power consumption in on-mode drops, the power consumption in standby-mode becomes relatively more important. In 2015, 11% of the overall energy consumption of displays was consumed in standby-mode, but this is expected to increase to 41% in 2030. Also due to the regulations, the standby power consumption of smart TVs is expected to decrease from 6 W in 2015 to 2 W in 2030.





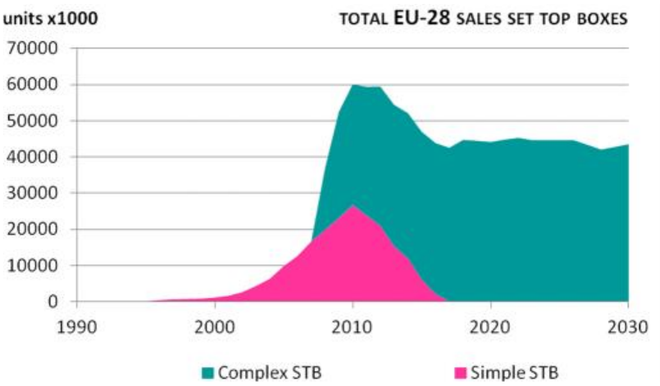
Set Top Boxes



GENERAL INFO

Older TV-sets were designed to process and display analogue video and audio signals. However, modern broadcasting uses digital signals. A Simple Set Top Box (SSTB) is a standalone device that converts free-to-air digital broadcast signals to analogue signals suitable for analogue television or radio. However, SSTBs do not have a 'conditional access' function. If the STB has, amongst others, also the functionality to decrypt signals for which a user has to pay or to be authorized, it becomes a Complex Set Top Box (CSTB). (details on SSTB-CSTB differences are given in the VA, see http://cstb.eu/).

SSTBs are subject to Ecodesign regulation 107/2009, while for CSTBs there is an Ecodesign Voluntary Agreement (VA).

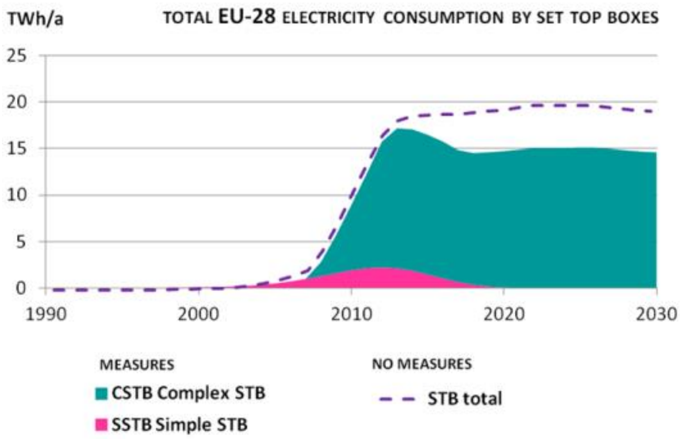


SALES

SSTBs have been sold in an analogue-to-digital transition period, from 2000 to 2016, with a peak of 27 million units in 2010. They are disappearing from the market because their functions are already integrated in modern TVs.
CSTB sales started around 2008, quickly increased to 30 mln units per year, and in EIA are assumed to remain more or less stable around 40 mln units per year over 2016-2030.

ELECTRICITY CONSUMPTION

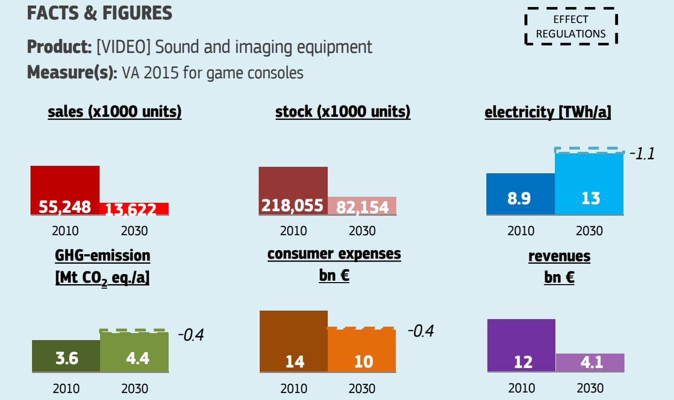
In 2015, CSTBs consumed 17 TWh/a of electricity, saving 2.1 TWh/a with respect to the situation without the VA. From 2020 onwards, the positive effect of the VA is expected to stabilize around 4-5 TWh/a (-25%).



Video

FACTS & FIGURES

Product: [VIDEO] Sound and imaging equipment
Measure(s): VA 2015 for game consoles

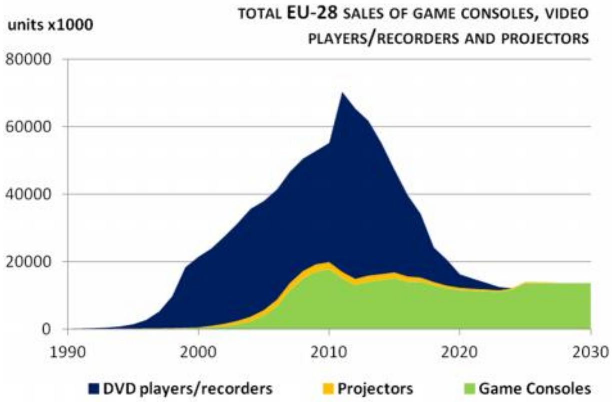


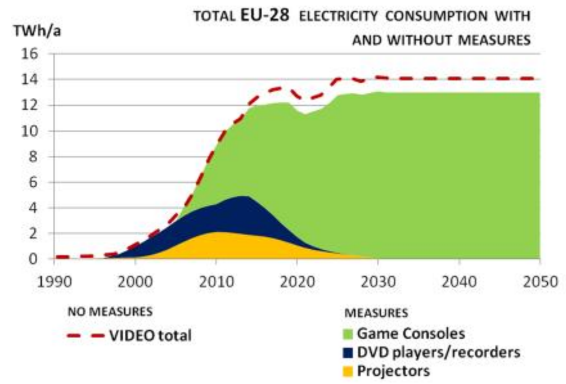
GENERAL INFO

Under the heading 'VIDEO', EIA groups the information from studies on Ecodesign ENTR Lot 3 'Sound and Imaging Equipment'. This includes video players and recorders (e.g. from DVD, Blu-Ray), video projectors (as used in schools, offices, homes) and game consoles.
Game consoles are regulated under the 2015 Ecodesign Self-Regulatory Initiative. This SRI sets requirements for the auto-power down (APD) function and for the maximum power during console operation in navigation or media-playback mode. The power in gaming mode is currently not regulated but this will be reviewed in 2017. The power consumption of game consoles in standby mode is subject to Ecodesign regulations 801/2013 (networked standby) and 1275/2008 annex II (standby). Video recorders/players and projectors are not regulated as energy use is small and decreasing.

SALES

Video recorders/players had peak sales of 53 mln units in 2011, but are now rapidly disappearing from the market, being replaced by downloading/streaming from internet. Projectors had 2 mln unit peak sales in 2010, but are now increasingly being replaced by large-size electronic displays. For this reason no Ecodesign measures were taken for these products.
Sales of game consoles are expected to remain stable at 14-17 mln units per year. Every few years new models are introduced and many consumers tend to substitute their 'old fashioned' product with an upgraded version.



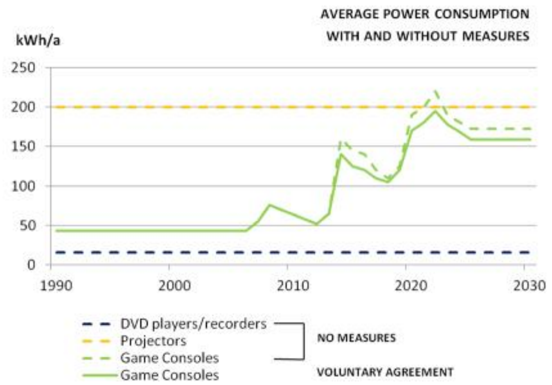


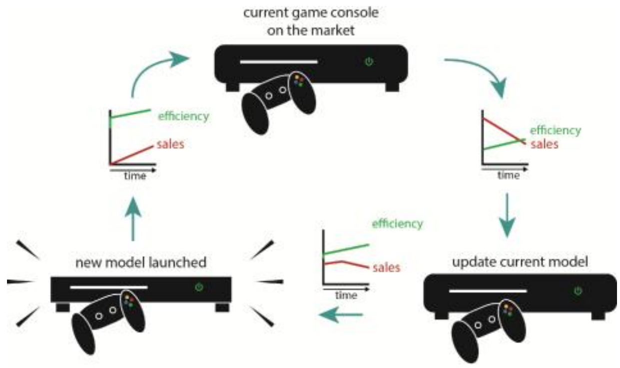
ELECTRICITY CONSUMPTION

Video-players, -recorders and -projectors have no associated efficiency improvements and consequently their electricity consumption follows the stock, increasing until 2013/2014 (peak around 5 TWh/a) and then rapidly decreasing.
The electricity consumption by game consoles is increasing, from 7 TWh/a in 2010, to 10 TWh in 2015 and expected 12 TWh in 2030. This is partly due to an increase in stock, but also to an increase in functionality (and thus power) of new models (see below). Estimated savings due to SRI and standby regulations are around 1 TWh/a (≈10%), but this has to be confirmed in coming years through the SRI-related compliance reports.

GAME CONSOLES

The increase in electricity consumption by game consoles is caused by additional functionality and enhanced computing power. As a general trend, manufacturers launch a new version of their product every 6-8 years. In the gaming world, older consoles are soon 'old fashioned', no longer delivering the desired performance. New technologies, better graphics and faster processing speed can be offered, but at the price of higher electricity consumption. Hence, new models initially tend to consume more. In the years following a new product launch, efficiency is then often gradually improved. This repeating product development cycle explains the ups and downs in the graph showing the average annual electricity consumption per console.





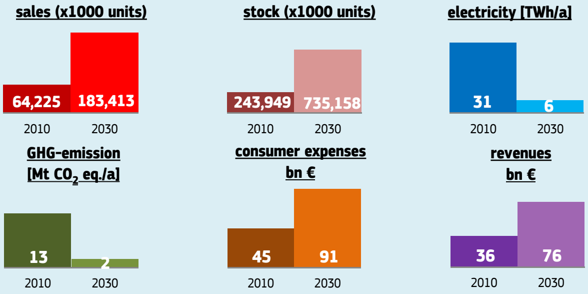
Computers

FACTS & FIGURES

EFFECT REGULATIONS

Product: [PC] Personal Computers

Measure(s):): CR (EU) No. 617/2013

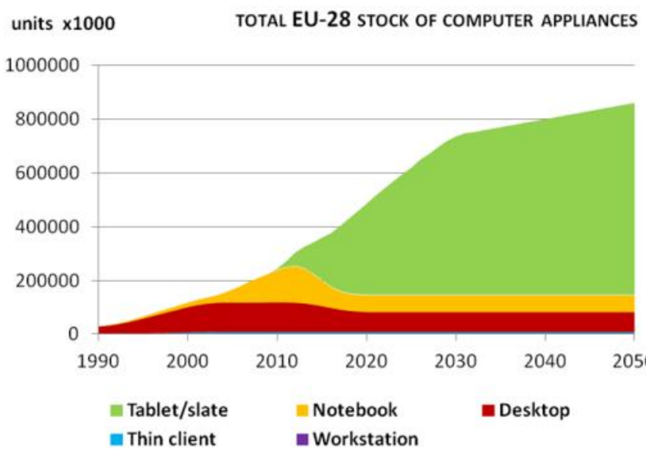


GENERAL INFO

Personal computers (PCs) comprise desktops, notebooks, tablets, thin clients and workstations. Technology and consumer habits in this product group are changing very quickly, making it difficult to regulate. Currently energy efficiency measures are implemented amongst others through Ecodesign and the voluntary EU Energy Star programme where the EU works together with the USA. In the past many desktops have been replaced by notebooks and more recently tablets are replacing them or employed as a secondary device.

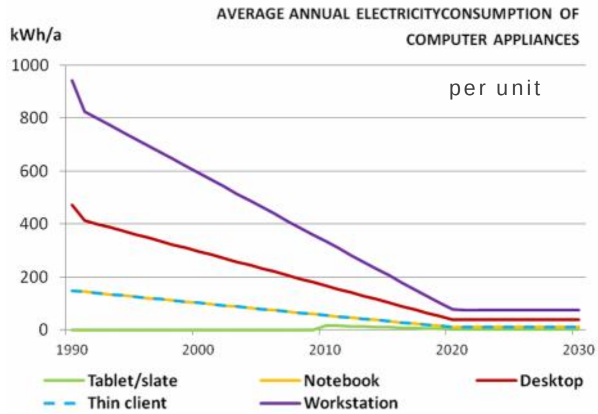
STOCK

It is estimated that in 2015 there were around 350 million PCs in use, of which 27% desktops, 27% notebooks and 44% tablets. Thin clients, i.e. terminal-like computers that largely or exclusively depend on central computing, and workstations, high-end computers for advanced computing, are very specific niche markets for less than 10 million users (2% of PCs). For comparison: In 1990, roughly the start of public internet use in Europe, less than 30 million (mainly desktop) PCs were in use.
By 2030 the stock of products is expected to double vs. 2015. The share of tablets will increase up to 80% of all products. Desktops (10%) and laptops (8%) will have a relatively smaller share, since their sales numbers remain constant while tablet sales are growing. Workstations and thin clients will have stable sales numbers as well, leaving their stock share in 2030 at only 0.4%.



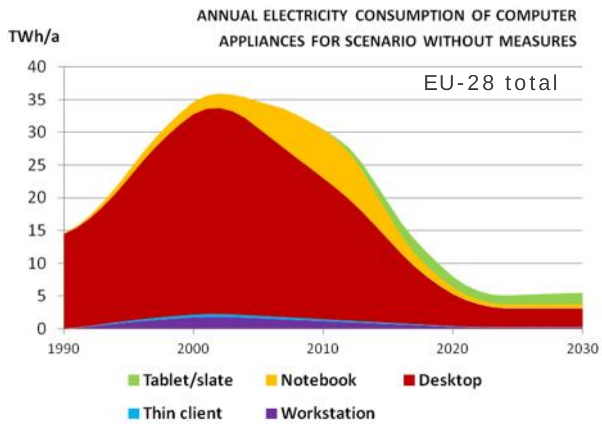
ELECTRICITY

The annual electricity consumption throughout the years is an interaction between the sales numbers of a specific base case and the average energy consumption per base case. In the years from 1990 to the early 2000s, the sales of desktop computers increased up to its peak. After this peak in desktop sales, laptops gained popularity. Since the average energy consumption of laptops is approximately 1/3rd of a desktop, the total electricity consumption is decreasing. A similar situation occurs in the 2010-2030 period, where laptops are replaced by tablets, again reducing the average electricity consumption to only 1/3rd. This explains the decrease in electricity consumption up to 2030, even without the effects of Ecodesign measures included.

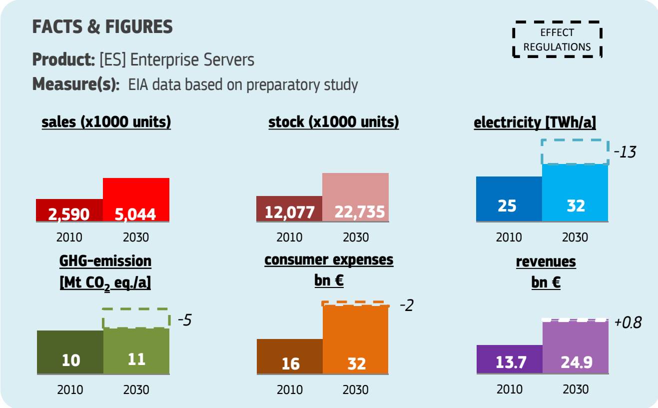


EFFICIENCY

Energy-efficiency improvement of PCs, currently including a large share of battery-operated hardware, has been spectacular (see above graph showing annual electricity consumption per device).
Despite a 10-fold growth in numbers, as mentioned above, the total EU-28 electricity consumption in 2015 (19 TWh/a) is barely 26% more than in 1990 (15 TWh/a). For 2030 a further drop to 6 TWh/a electricity consumption is foreseen.

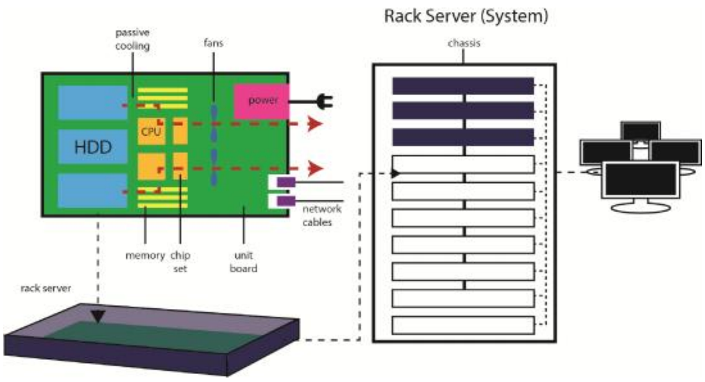


Enterprise Servers

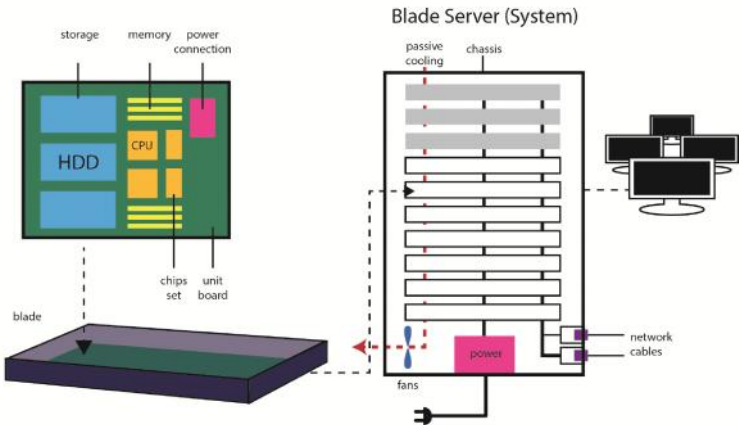


GENERAL INFO

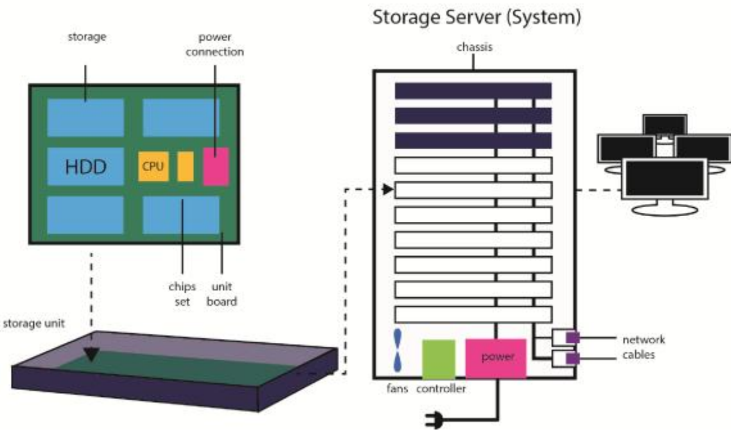
Enterprise servers (ES) deliver computing power and manage network connections for multiple clients; this is what distinguishes them from the personal computers (PCs). In EIA, data for three configurations are presented: the rack server, the blade server, and servers focusing on storage of files. These types are shortly and schematically explained below.



Rack servers are stand-alone devices, comprising all necessary components to operate. The rack servers can be stacked in a standardized U-rack (hence their name), for ease of management and interconnection for combined computing power.



Blade servers consist of a single chassis and multiple blades. Blades comprise only part of the essential server components, such as CPUs, memory and storage. Other components, e.g. power supply, cooling and interconnectivity, are mounted in the chassis, and shared by the various blades The blades are inserted in the chassis and directly coupled to the shared components. Only then they can actually operate.

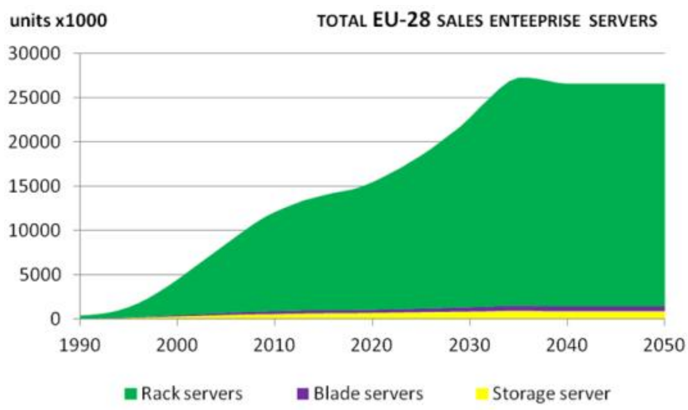


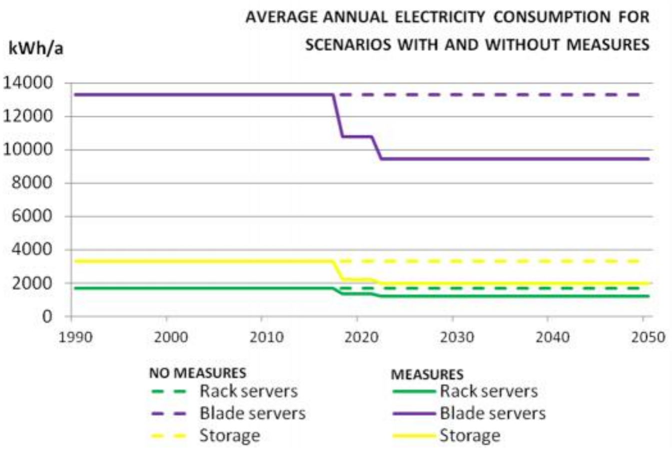
An enterprise storage server does not have a computational function. Its function is to store data of multiple clients and give access to those data.

STOCK

The need for computational and storage capacity in enterprises has grown rapidly over the past 25 years. At the onset of enterprise servers in 1990, there were 413 thousand installed units. During the 1990's, this quantity increased by a factor 10, reaching 4.5 million installed units by 2000. Afterwards the growth continued at a slower pace, reaching 12 mln installed by 2010 and 14 mln by 2015, so the stock tripled between 2000 and 2015. This growth is expected to continue, reaching 22.7 mln units in 2030 (+63% vs. 2015).

In number of units, rack-type servers account for more than 90% of the stock, but this is misleading considering that they are much smaller units than blade- and storage-servers. Based on definitions in the preparatory study, the functionality of 8 rack-servers is more or less equivalent to that of a single blade-server. This scale-difference also explains the differences in unit price and unit power (see below).





EFFICIENCY

The Ecodesign preparatory study shows large saving potential for ES. The annual electricity consumption of single servers could be decreased by 29% for rack-servers (from 1.7 to 1.2 MWh/a) and blade-systems (from 13.3 to 9.4 MWh/a). Single storage systems could use 40% less electricity than they do now (from 3.3 to 2.0 MWh/a).

Inevitably, due to the fast increasing stock, the total electricity consumption of ES will increase. In 2015, enterprise servers in EU-28 consumed 28 TWh/a of electricity. Without measures this is expected to increase to 45 TWh/a in 2030. Introducing adequate Ecodesign measures the 2030 consumption could be reduced to 32 TWh/a (-13 TWh/a, or -29%).

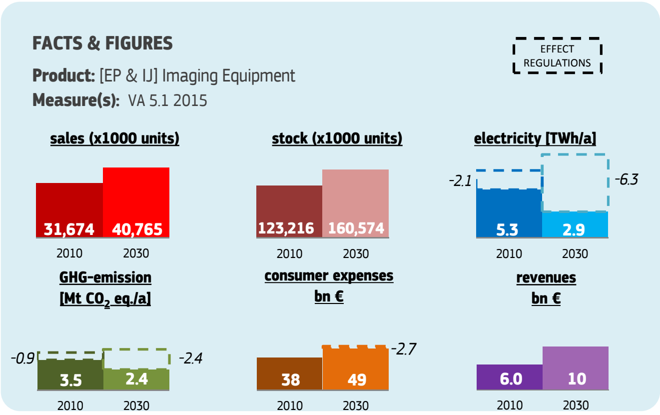
ACQUISITION AND EXPENDITURE

The reported potential energy savings require more efficient equipment, which has a higher upfront cost. For Rack servers the unit price increase would be 2.2%, for blade servers only 0.2%, but for storage systems the unit price is expected to increase by 11.4%.

For storage systems this implies 0.56 billion Euros additional acquisition costs in 2030 at EU-28 level, while savings on running costs (electricity, maintenance and installation) would only be 0.24 billion Euros. This would entail 0.32 billion Euros additional consumer expenses.

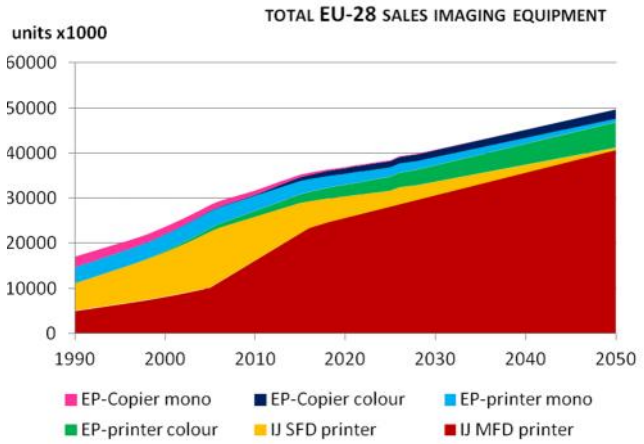
For rack- and blade-servers, the energy cost savings do compensate the additional acquisition costs and would result in 2.4 billion euros savings on consumer expenditure.

Imaging Equipment



GENERAL INFO

Imaging equipment includes single functionality devices (SFDs) such as printers and copiers as well as multi-functional devices (MFDs). Main printing technologies are Electrophotography (EP or 'laser') and inkjet (IJ). Imaging equipment is subject to an Ecodesign Voluntary Agreement (www.EuroVAPrint.org) and part of the (voluntary) EU Energy Star labelling programme. The global market for this equipment is dominated by a handful of Japanese and US manufacturers and thus a voluntary agreement aiming at saving energy and paper resources was deemed an adequate solution.

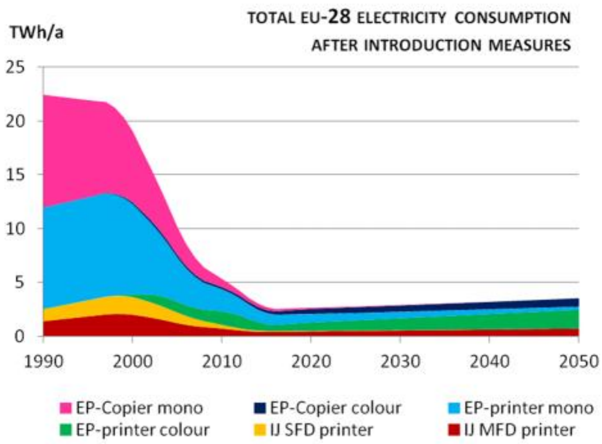


SALES

Of the six product types included in EIA, the multifunctional inkjet printers show by far the highest increase in sales: from 22 million units in 2015 to expected 30 million by 2030 (+36%). Mono-coloured printers and copiers have decreasing sales numbers, with mono copiers eventually disappearing from the market.

ELECTRICITY CONSUMPTION

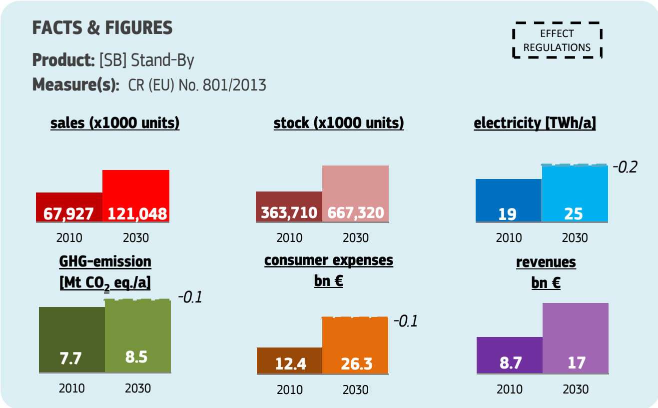
Despite the continuously growing stock, the EU-28 electricity consumption of imaging equipment has been decreasing, in particular since year 2000. Pushed by policy measures and enabled by advancements in electronics and printing technology, the electricity consumption has dropped from 22 TWh/a in 1990 to a mere 3 TWh/a in 2015, a level that is expected to be continued until 2030 and beyond.
The annual number of prints ('images per year') increased from 711 billion in 1990 to 801 billion in 2015 (+13%). Through increased duplexing and N-print the paper consumption over that period stayed the same, i.e. at 2.2 Mt/a. The energy for paper production, even taking into account recycling, represents the highest energy impact at an estimated 24.4 TWh/a in primary energy in 2015. In that sense, the paper reduction due to measures saves 3.4 TWh/a in paper production versus a Business-as-Usual scenario without those measures.



OPERATIONAL COSTS

The agreement will also benefit the consumer in terms of costs on resources. The total costs for paper and ink/toner in 2015 were 32.6 billion Euros. On average, with 136 million products in use, this is 238 € per year per appliance. In 2030 this will be slightly less with 231 €/a. Compared to the situation without agreement, this would be 244 €/a (2015) and 238 €/a (2030).

(Networked) Standby

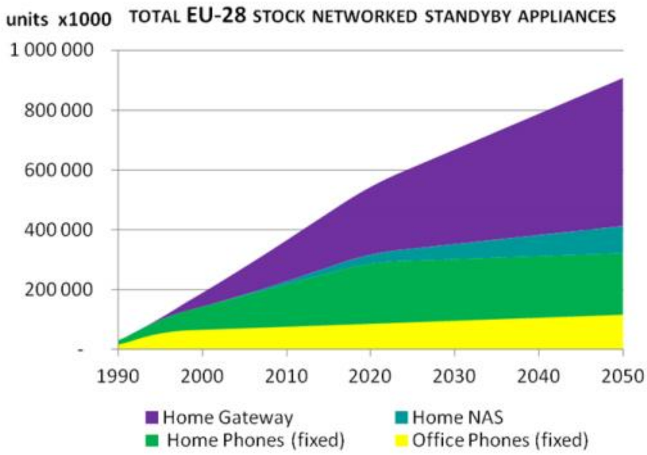


GENERAL INFO

The 2009 Ecodesign regulation on energy consumption in ‘off’ and various ‘standby’ modes was designed as a horizontal piece of legislation, covering a myriad of relevant electronic and electrical products. In 2013 the regulation was updated to include also ‘networked standby’ and add rules on standby of household coffeemakers. In parallel, the policy on standby regulation has changed from a horizontal to a vertical approach. This means that in principle the requirements on ‘standby’ should now be made part of product-specific Ecodesign regulations when available and the appropriate parts from the standby-regulation are then to be repealed.

SCOPE AND STOCK

The EIA-report anticipated this trend of product specific Ecodesign regulations and has already partitioned the standby energy to e.g. displays and coffeemakers. What remains in the EIA-report under ‘standby’ are mainly home gateways (e.g. modems), Network Attached Storage (NAS) devices and fixed-line phones.
The stock of these products is expected to grow in the future. The number of home gateways will increase by 74% in the 2015 – 2030 period, whilst for NAS devices a growth of 150% is expected. The stock of fixed phones will grow by 18-19%.

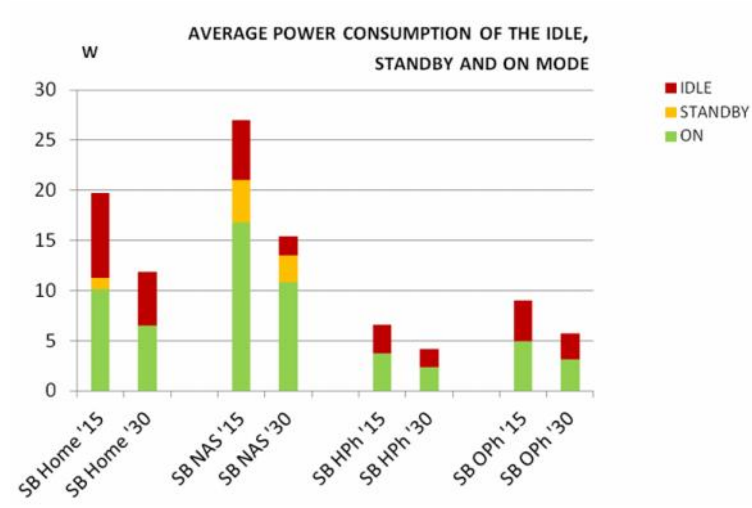


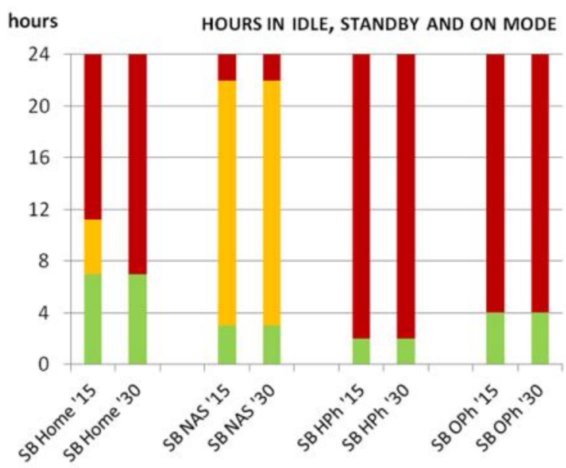
EFFICIENCY

The electricity consumption of the four ‘standby’ products included in EIA comprehend the on-mode, standby-mode and idle- or off-mode. Only the standby and idle mode are regulated. The on-mode is added since the group consumed a significant 22 TWh annually in 2015 (all modes combined). The graphs below show both the operational hours and power consumption (in Watts) for each appliance and mode, comparing the 2015 and 2030 values.
The power usage of home gateways in idle mode decreases from 8.4 W to 5.4 W (-36%). For fixed phones, both home (HPh) and office (OPh), the decrease is 36%. Power of NAS systems in idle mode is expected to drop by 68%.

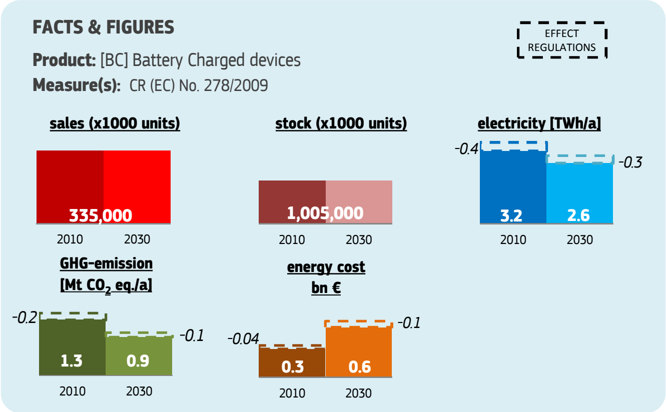
In 2030 the home gateways are expected not to include a standby mode (and thus electricity consumption) anymore. For NAS devices the power usage in standby-mode will decrease from 4.2 W to 2.7 W (-36%). Although the on-mode of these products is not regulated, their power is expected to decrease over time. In total, the power of the four devices in 2015 was 35.5 W in on-mode while in 2030 this is only 22.7 W.

The aggregated electricity savings at EU-28 level in 2030 will be 0.2 TWh/a with respect to the scenario without measures. Cumulative savings in 2015 – 2030 are expected to be 4.7 TWh.





External Power Supplies



GENERAL INFO

External Power Supplies (EPS) take as input alternating current (AC) from the mains power source (typically 230 V) and convert this into lower voltage direct current (DC) or AC output. A large variety of electrical and electronic equipment requires the use of EPS, e.g. computers, monitors, printers, shavers, electric tooth brushes, mobile phones, MP3 players, just to name a few. In particular EPS are used for battery chargers.

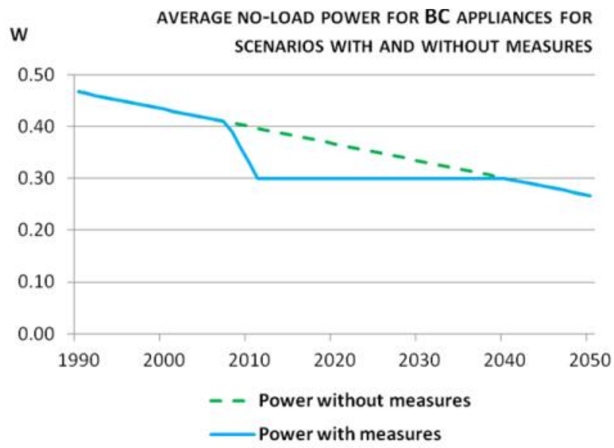
Ecodesign regulation 278/2009 sets requirements for EPS, in particular as regards the electric power consumption in no-load condition (EPS attached to the 230 V mains but not supplying power to the equipment), and the average active efficiency (power-output/power-input) when supplying power to the equipment. The regulation does not cover the charge/discharge efficiency of the batteries that may be contained in the equipment.

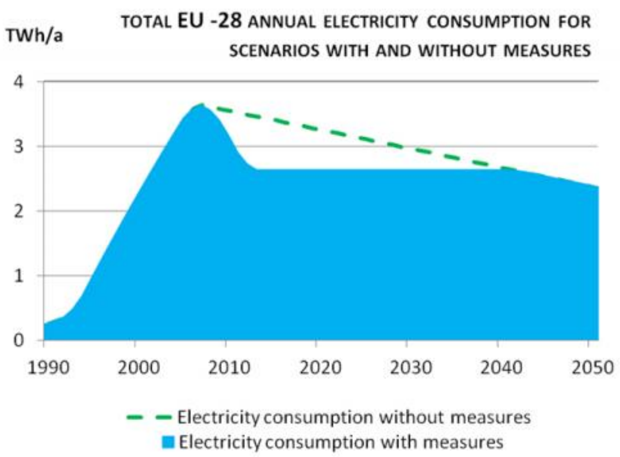
This horizontal regulation was the easiest way for the EU to follow legislation from other continents that aims—at a global level—to reduce the energy consumption of these ubiquitous devices.

EFFICIENCY AND ELECTRICITY

Without the 2009 measures, the no-load power consumption of EPS is assumed to improve linearly from 0.47 W in 1990 to 0.30 W in 2040. Due to the Ecodesign measures the 0.30 W value is already required from 2011 and then assumed to remain constant (see graph).

The total EU-28 electricity consumption of EPS (i.e. the additional electricity not already accounted under other products) directly follows the above variation of unit power, multiplying by 8760 hours per year and 1 billion devices. The result is an electricity use of 3.6 TWh/a in 2008 that would linearly decrease to 2.7 TWh/a in 2040 in absence of measures. Due to Ecodesign regulation the 2.7 TWh/a is reached already in 2011, with cumulative savings over the 2008-2040 period around 13.7 TWh of electricity.



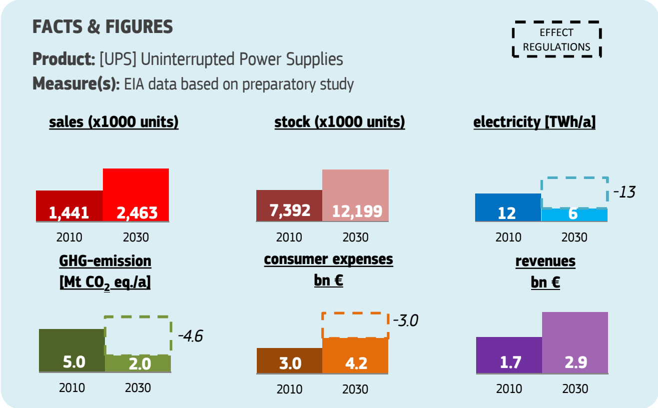


EPS IN ECODESIGN IMPACT ACCOUNTING

Similar to the situation for standby (see earlier section), the EPS energy consumption is already taken into account in the EIA data for the equipment to which they supply power, e.g. computers, displays, imaging equipment. To avoid double counting, this energy is not accounted again under EPS. In addition, for many products the EPS is used few hours per year, leading to a negligible annual electricity consumption.

The rough energy estimates in EIA are therefore based on the assumption that there are 1 billion devices in EU-28 (approximately 5 per household) that continuously (8760 hours per year) have the EPS attached to the mains power supply. EIA focuses on the energy consumption in no-load mode.

Uninterruptible Power Supplies



GENERAL INFO

The ENER Lot 27 Ecodesign preparatory study defines an Uninterruptible Power Supply (UPS) as "a combination of electronic power converters, switches and energy storage devices (such as batteries) constituting a power system for maintaining the continuity of power to a load in the case of input power failure."

Less formally, a UPS is a large battery with associated electronics to protect (mainly) computers from irregularities in the power supply (voltage instabilities) and from complete black-outs.

A UPS is typically placed between the mains power supply and the equipment to protect. When power is available, the UPS filters out irregularities and then passes it on to the equipment, loading the UPS batteries in parallel. When power lacks, the UPS supplies the equipment with power from its batteries (or other storage), thus ensuring power continuity (for a limited time, until batteries are exhausted). A UPS cannot generate electricity by itself, e.g. an engine with generator that is used as power backup is not a UPS.

The applications of UPS are closely linked to the continuous and expanding deployment of electronic facilities that must have security of function. These include e.g. data centres, internet service providers, ICT equipment, retailer money and card processing tills, and equipment in security and safety systems. EIA data are based only on information from the preparatory study. The Commission still has to decide on final measures for UPS (if any).

LOAD AND EFFICIENCY

UPS are often over-dimensioned (anticipating that attached equipment will increase) or redundant (ensuring availability of a UPS also when another one is temporarily unavailable). This entails that UPS often operate at part load, e.g. at 25%, 50% or 75% of their nominal capacity, where their efficiency is lower. The average efficiency for each power class has been established considering the variation of efficiency with the load level and the times spend on each load level.

The average efficiency increases with the nominal power, ranging from 88% for the smallest models to 93% for the largest ones. In the scenario without Ecodesign measures these efficiencies are assumed to remain constant (freeze scenario). Introducing measures, the preparatory study expects that for the smaller models efficiency can increase from 88% to 99% (i.e. losses would reduce from 12% to 1%!), while for the larger models efficiency could increase from 93% to 95-96% (losses decreasing from 7% to 4-5%).

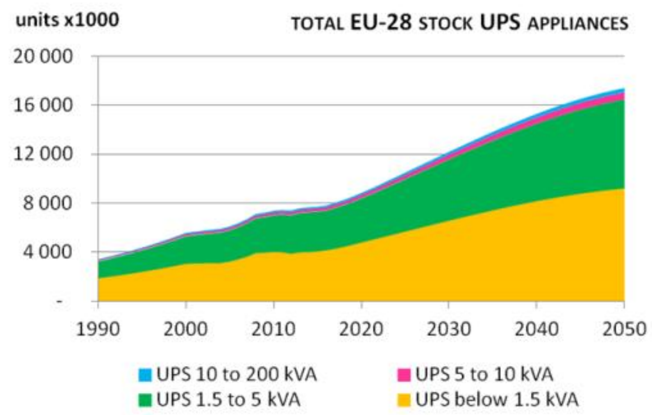
The load, i.e. the user demand for UPS output power, has been derived from the nominal input powers, taking into account part-load operation and current efficiencies. The output loads for the four classes are respectively 0.3, 1.9, 4.3 and 43.8 kW output. These loads are assumed to remain constant over the years.

SALES AND STOCK

Four UPS base cases are distinguished based on their nominal input power: below 1.5 kVA, 1.5 to 5 kVA, 5 to 10 kVA and 10 to 200 kVA. UPS larger than 200 kVA are usually custom-made and were not included in the analyses.

Annual sales quantities are expected to increase from 1.5 mln units in 2015 to 2.5 mln units in 2030. The installed stock increases correspondingly, from 7.7 mln units in 2015 to 12.2 mln in 2030. The growth regards all four power classes.

The largest quantities are found for the lowest power models, e.g. in the 2015 stock 4.1 mln UPS (53%) had power < 1.5 kVA, 3.2 mln (42%) had a power between 1.5 and 5 kVA, 0.26 mln (3%) between 5 and 10 kVA and 0.16 mln (2%) was in the highest power class.

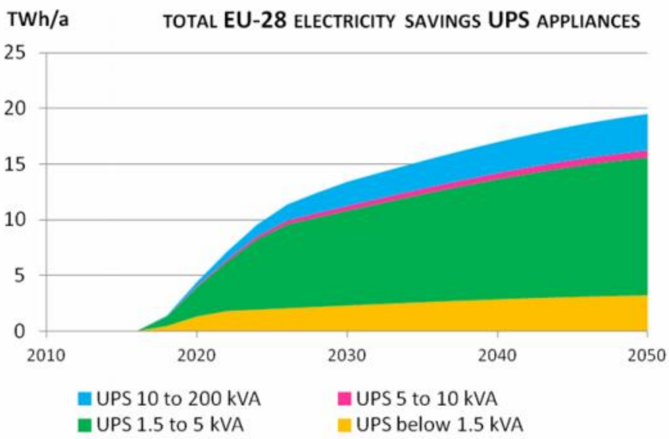


ENERGY AND SAVINGS

For UPS, EIA considers as energy consumption only the energy losses, i.e. the difference between energy input and energy output. The energy output is passed on by the UPS to other equipment and hence not 'consumed' by the UPS.

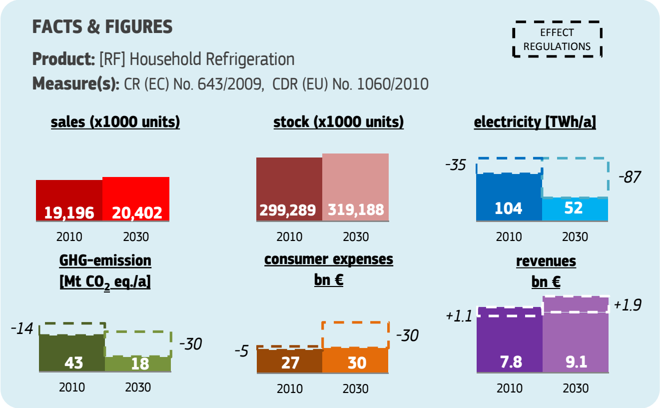
In 2015, the 7.3 mln smaller UPS (sufficient to cover 3 mln workstations and the smaller server systems) consumed 8 TWh/a of electricity. In the same year the 0.4 mln larger UPS (used in data centres and large server systems) consumed another 5 TWh/a, for a total of 13 TWh/a.

Without measures this is expected to increase to 19 TWh/a in 2030 due to an increase in stock. According to the preparatory study there is a significant savings potential: the 2030 electricity consumption could be brought down to only 6 TWh/a, i.e. a 13 TWh/a or 68% reduction of losses. This is still to be confirmed by an Impact Analysis of the Commission.



APPLIANCES

Household Refrigeration

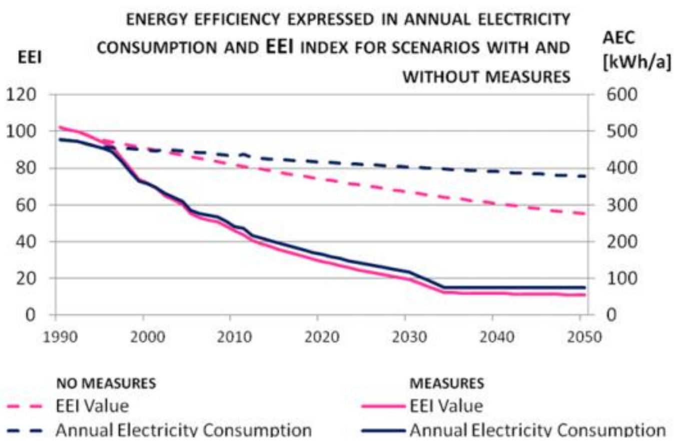


GENERAL INFO

In 1995, household refrigerators and freezers were the first product group for which 'Brussels' prescribed a mandatory Energy Label. The measure for energy efficiency, an index with base value of 100, was derived from the average efficiency of fridges and freezers in 1992. Today, in 2016, this index is lower than 40, implying an energy efficiency improvement of 60% over what was believed to be a technically 'mature' and efficient product in 1992.

EU-LOAD

The total EU load for household refrigeration is expressed as the demand for cooling or freezing volume. This demand has ever been rising and will continue to rise. In 2015 the total EU-load for freezing was 18.7 million m^3. This volume equals approximately 7.5 times the Great Pyramid of Giza. This volume is expected to increase by 27% to 23.7 million m^3 in 2030. The refrigerating demand is even higher: 66.2 million m^3 in 2015, so over 3 times larger than the freezing volume. In 2030 this is projected to be 90.5 million m^3 (+27%).
The increased cooling demand is a result of increasing EU population and comfort standards. The number of appliances in use rose from 269 million in 1990 to 305 million in 2015 (+13%), and is expected to grow further to 319 million units in 2030 (+5%).



EFFICIENCY

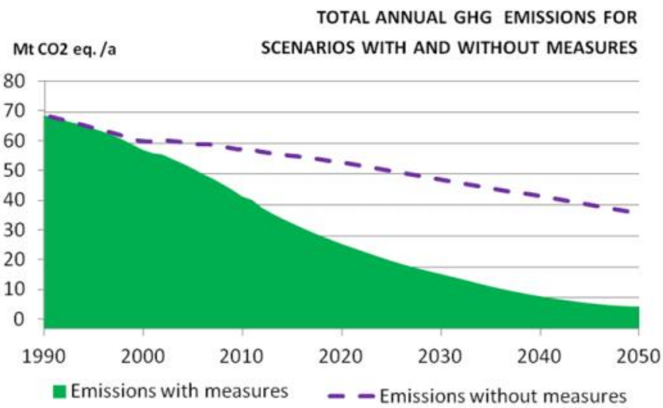
The energy efficiency of refrigerator appliances is expressed as the Energy Efficiency Index (EEI). Both Ecodesign regulation and Energy Labelling schemes have stimulated lower EEI values for refrigerating appliances.

The ECO scenario in EIA represents the situation from the moment of introduction (1992) of the first energy efficiency requirements Directive. It shows the combined effects of these initial measures and of the ones that followed. In this scenario, the average EEI of refrigerating appliances was 36 in 2015, which corresponds to an annual electricity consumption (AEC) of 196 kWh/a/unit. If no measures would have been introduced, the EEI value would have been 78, corresponding to 424 kWh/a/unit.
As a consequence the 2015 total EU-28 electricity use was 86 TWh/a instead of the 139 TWh/a that would have been reached without measures (-53 TWh/a).

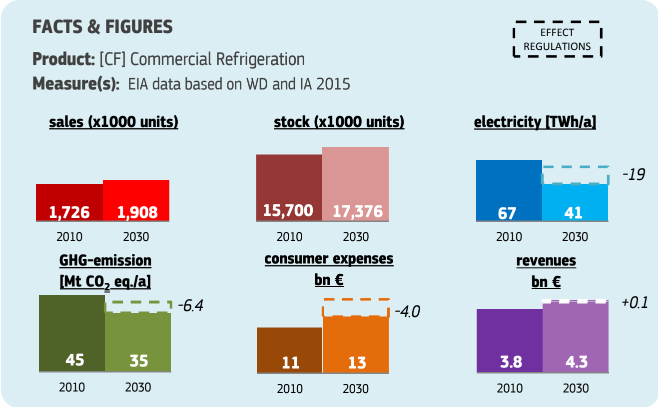
The projected EEI value for 2030 is 19, equalling an A^{+++} label, and corresponding to 117 kWh/a, 40% less than in 2015. Total electricity consumption in EU-28 in 2030 is expected to be 52 TWh/a. This is 34 TWh/a less than in 2015 and 87 TWh/a less than the 2030 consumption in a scenario without measures.

EMISSIONS

The increased efficiency of refrigeration appliances compensates for the increased product stock. The total GHG emissions for refrigerating are decreasing since the 1990s, but introduction of measures accelerated the reduction.
In 2015 total EU-28 GHG-emissions due to household refrigeration were 34 $MtCO_2$equivalent (with the effect of measures included). By 2030 this is expected to be halved (17 Mt). Without measures, the 2030-emissions were projected to be 47 $MtCO_2$eq./a. Hence, the effect of Ecodesign and Energy Labelling measures is 63% less emissions in 2030.



Commercial Refrigeration



PRODUCT SCOPE

Commercial refrigeration appliances [CF] are those used to display refrigerated or frozen foods or drinks. Typically they can be accessed directly by the consumers in e.g. supermarkets, public indoor spaces and offices.

Many supermarket models are vertical cabinets with various shelves from which people take e.g. their milk, butter, cheese. Others are more like horizontal chests, e.g. for ice-cream, pizzas, meat. Refrigerated models can be open (direct access) or closed (typically by glass doors or lids); freezers are usually closed. EIA distinguishes 3 supermarket models: the 'open chilled vertical multi deck' (RVC2), the 'open horizontal frozen island' (RHF4) and 'other supermarket display (non-BCs)'. For space, noise and efficiency reasons, supermarket models can have a remote configuration (R), meaning that the condensing unit (CU), which releases the heat extracted from the cabinets to the environment, is not integrated in the display but located elsewhere. The energy consumption of a remote CU is anyway counted as part of that of the CF-appliance. CUs are also regulated (and reported in EIA) as separate products (see professional refrigeration, PF), but double counting of energy and savings is avoided when computing PF-totals.

CF-appliances used in public indoor spaces and offices are mostly 'plug-in' (with integrated CU). The user puts money in the appliance, chooses the desired snack or beverage, and then collects it from the drawer. EIA reports data for 'beverage coolers' and 'spiral vending machines'. The last EIA product group is 'plug-in horizontal ice-cream freezers'.

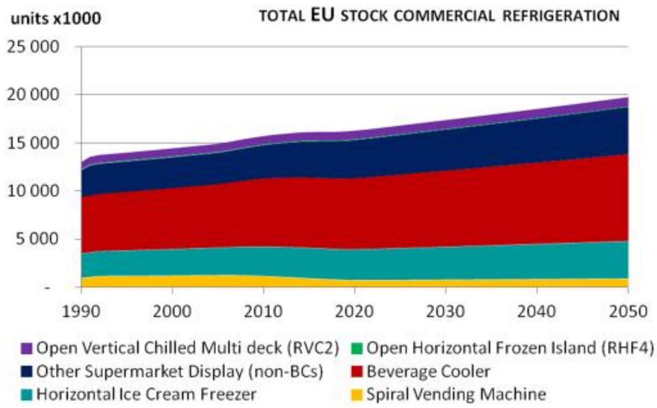
The data in EIA are based on various preparatory studies and impact assessments. Draft Ecodesign regulation and Energy Labelling for CF-appliances have been proposed by the Commission, but not yet officially approved (Nov. 2016).

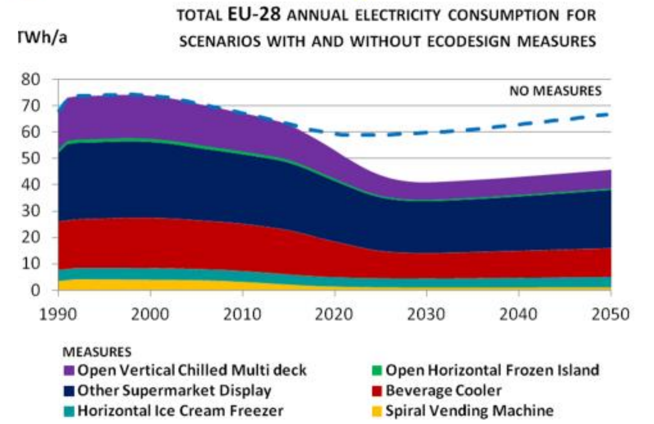
GHG EMISSIONS

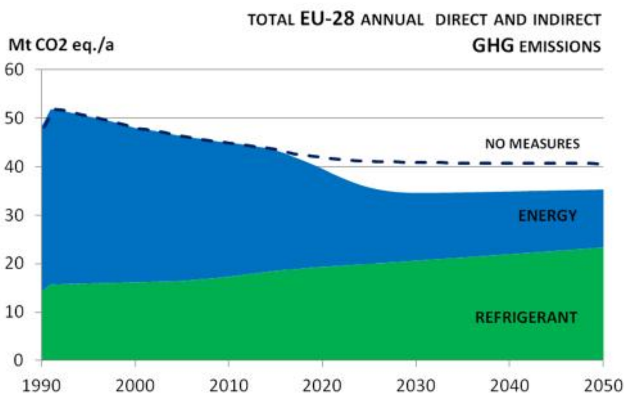
Refrigerators employing the vapour compression cycle use refrigerants that can leak from the appliance or enter the atmosphere at product end-of-life, thus causing GHG-emissions (see also section on space cooling). In addition, EIA considers the GHG emissions related to the generation and distribution of the electricity consumed by CF-appliances. In 2015, total EU-28 GHG-emissions due to use of CF-appliances amounted to 43 Mt CO_2 equivalent, of which 40% refrigerant-related. By 2030 this is expected to decrease to 41 Mt CO_2 eq/a, notwithstanding the increasing stock. Introducing Ecodesign and Labelling measures the total 2030 GHG-emissions can be further reduced to 35 Mt (-15%), due to lower electricity use. In the projections for refrigerant-related emissions the impact of the recent Kigali-agreement (Oct. 2016) on the phase-out of HFCs is not yet included and thus the graph still shows an increase.

STOCK AND ENERGY

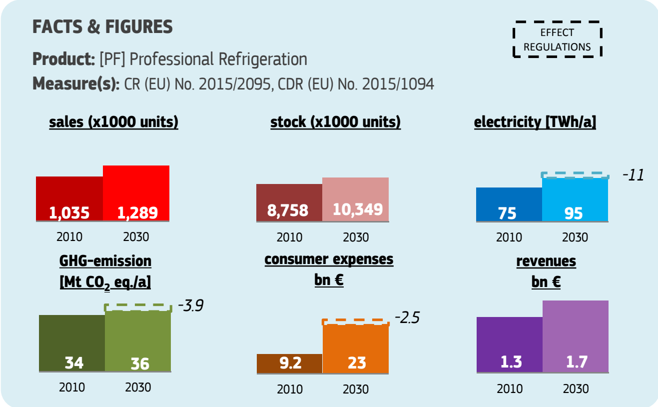
In 2015, 16.1 million CF-appliances were installed in EU-28 and this number is expected to increase to 17.3 mln (+8%) by 2030. Around 45% are beverage coolers. A minority (30%) of the appliances is installed in supermarkets. However, this minority is responsible for 64% of the CF electricity consumption. Total EU-28 electricity use by CF was 63 TWh/a in 2015. Without measures this is expected to decrease to 60 TWh/a (-5%) in 2030, notwithstanding the 8% stock increase. The introduction of Ecodesign and Labelling measures could reduce this further to 41 TWh/a (-19 TWh/a, -32%). This corresponds to 4 billion euros savings on consumer expenditure in 2030, due to lower electricity costs.







Professional Refrigeration



In 2015 around 660 thousand MT/LT condensing units were sold in EU-28 (expected 820 thousand by 2030) and 5.2 million units were installed (expected 6.2 million by 2030).
In EIA, the energy used by CUs is first reported fully, but when determining totals for Professional Refrigeration, the estimated 60% of CU-energy that is already considered in other EIA products is not taken into account, thus avoiding double counting.

GENERAL INFO

Professional refrigeration (PF) includes refrigerators, chillers and freezers that are used and/or accessed by professionals in non-household environments. Their only purpose is to preserve goods or cool processes, as opposed to commercial refrigeration products that also have a display and consumer-access function.
The 2015 Ecodesign regulation applies to three PF-appliance groups: storage cabinets, condensing units, and process chillers. Storage cabinets also have Energy Labelling.
Blast cabinets (used to quickly cool or freeze hot food) are subject to information requirements only, while Walk-in cold rooms are not regulated yet, so these two PF-types do not appear in EIA.

PRODUCT TYPES, SALES AND STOCK

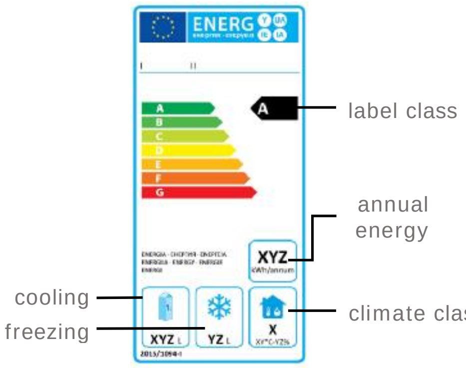
Storage cabinets are used to preserve food or other goods. They come in horizontal or vertical configuration, and can be refrigerators (between –1°C and 5°C) or freezers (below -15˚C). They are used in e.g. restaurants, bars, canteens, hospitals and supermarkets (but in locations not accessible to customers). In 2015 around 400 thousand storage cabinets were sold in EU-28 (expected 460 thousand by 2030) and 3.5 million units were installed (expected 4.0 mln by 2030).

A Chiller is a refrigerating machine (with a refrigerant circuit) that cools a liquid (water, water/glycol, brine) in a separate circuit. The Ecodesign regulation applies to chillers with a heat exchanger outlet temperature that is medium (MT,-8°C) or low (LT,-25°C) (cooled liquid will be somewhat warmer). Cooling liquids at these temperatures are used mainly in industrial processes, hence the name Process Chiller.
High temperature chillers (HT,+7˚C) are excluded here, because they are mainly used in non-comfort space cooling, e.g. in data centres (see section on 'Space Cooling').
In addition to MT/LT, EIA distinguishes between Process Chillers that release their heat on the condenser side to water or to air as cooling medium (WC/AC). In addition, a capacity distinction is made between small (S) or large (L), for a total of 8 process chiller base cases.
In 2015 around 7 thousand MT/LT process chillers were sold in EU-28 (expected 10 thousand by 2030) and 91 thousand units were installed (expected 129 thousand by 2030).

Condensing units (CUs) are components of a refrigerating, chilling or freezing system that release the heat extracted by the system to ambient air or to another cooling medium. The Ecodesign regulation applies to MT and LT CUs that are sold as separate products, and that are typically installed as separate remote units for commercial- or professional refrigeration appliances that do not have an integrated CU (see also section 'Commercial Refrigeration'). A single CU can serve more than one refrigerating appliance. In addition to the MT/LT division, EIA distinguishes 4 capacity sizes (S, M, L, XL).

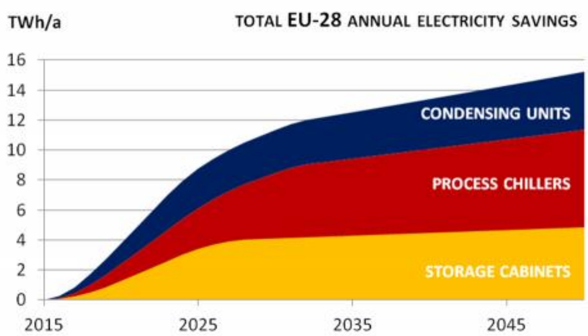
EEI AND LABEL FOR STORAGE CABINETS

The energy efficiency of storage cabinets is defined using an energy efficiency index (EEI), just as for commercial and household refrigerators. The EEI thresholds for label classes range from >95 (G) to <25 (A) or <5 (A+++). Label 1 (G-A) is mandatory from July 2016. Label 2 (G-A+++) is optional from that date but mandatory from July 2019. Besides the EEI class, the label provides chilling and freezing volumes, annual energy consumption and climate class (range of temperature and humidity in which the product will work properly).
In 2015, the average storage cabinet has an EEI of 98 (label class G). By the time of the first Ecodesign phase (2017) the average EEI is expected to improve to 82 (class E), by 2019 to 66 (class D) and the Ecodesign improvement effects are expected to end in 2020 at an EEI of 58 (class D).

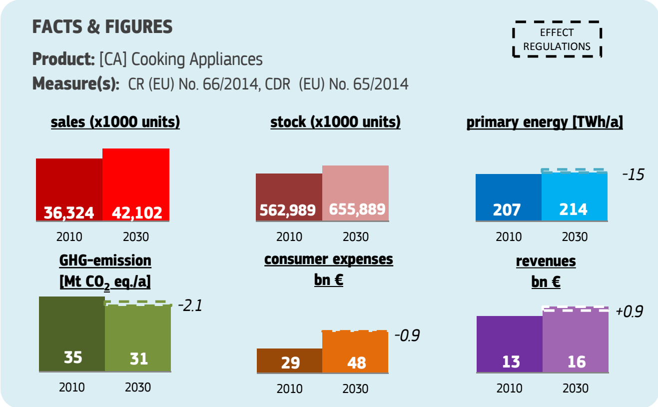


SAVINGS

In 2015, the total EU-28 electricity consumption for PF (excluding CU-energy already counted in other products) was 81 TWh/a. Without measures, this would have increased to 107 TWh/a in 2030, due to the increasing stock. Ecodesign and Energy Labelling measures are expected to lower this to 95 TWh/a in 2030 (-12 TWh/a, -11%).
The reduction in GHG emissions is 4 $MtCO_2eq/a$ in 2030.
PF-users will save 2.5 billion Euros in 2030, due to lower electricity costs.



Cooking Appliances



GENERAL INFO

Ecodesign regulation 66/2014 covers domestic ovens and hobs (gas and electric) and range hoods (electric). Energy labelling is mandatory for ovens and range hoods. In EIA these products are grouped under cooking appliances (CA).

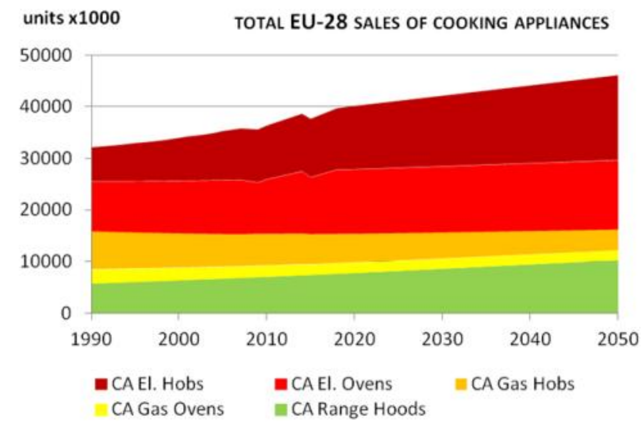
SALES

In 2015, 244 million hobs were installed in EU-28 of which 62% electric and 38% gas. In the 2015 – 2030 period, sales of electric hobs are expected to increase by 21% from 11.3 to 13.6 million, while those of gas hobs are decreasing by 14%, from 5.9 to 5.1 mln. The result is an increase in the stock to 272 mln in 2030 (+11%), and an increase in the electric share (70% of installed hobs in 2030).

For ovens the picture is similar, with 243 mln installed in 2015 (83% electric and 17% gas). Sales of electric ovens are increasing from 11.0 mln in 2015 to 12.8 mln in 2030 (+16%), while those of gas ovens decrease from 2.0 to 1.9 mln (-5%). The result is an increase in the stock of ovens to 271 mln in 2030 (+11%), and an increase in the electric share (86% of installed ovens in 2030).

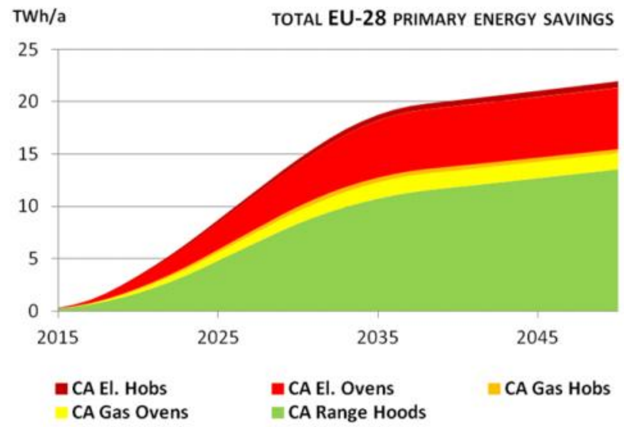
In 2015, there were 98 mln electric range hoods. Also here sales are increasing from 7.4 mln in 2015 to 8.6 mln in 2030 (+16%), raising the stock to 113 million units in 2030.

Overall, the cooking appliance stock is expected to increase by 12% from 584 million in 2015 to 656 million in 2030.



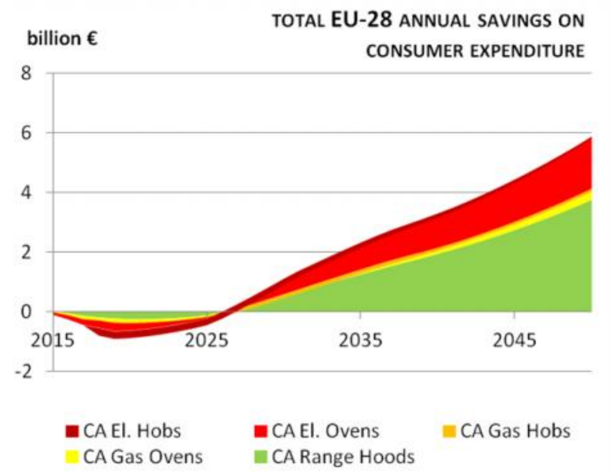
SAVINGS

The Ecodesign regulation sets gradually more severe energy efficiency requirements in 3 tiers, in 2015, 2016 and 2019. Energy Labelling for ovens and range hoods is compulsory from January 2015.
The total primary energy consumption by CAs (gas consumed plus fuel needed to generate the consumed electricity) was 211 TWh/a in 2015. Without measures, the energy consumption in 2030 is expected to be 229 TWh/a. With measures this is expected to drop to 214 TWh/a (-15 TWh/a, -7%). The major part of these savings is due to range hoods (57%) and electric ovens (28%).
Due to the lower primary energy use, the 2030 GHG-emissions related to the use of cooking appliances decrease from 33 $MtCO_2eq/a$ (without measures) to 31 $MtCO_2eq/a$.

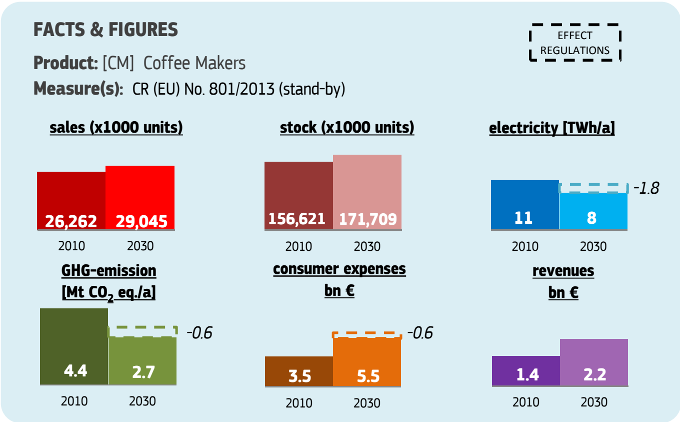


CONSUMER EXPENSES

Increasing the energy efficiency of cooking appliances leads to a higher unit price. Consequently consumers initially spend more on product acquisition, and this investment is payed back over later years due to lower energy costs.
The variation in consumer expenses due to the Ecodesign measures on cooking appliances shows additional expenses up to 2025, with a peak of nearly 1 billion euros extra around 2020 (EU-28 total). Following 2025, consumers will start to save money, in particular due to lower energy costs for electric ovens and range hoods.



Coffee Makers



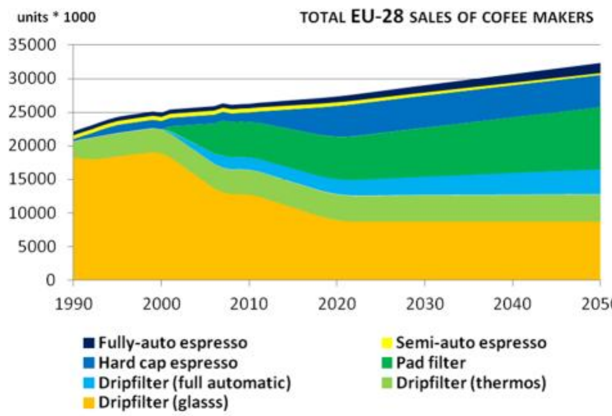
GENERAL INFO

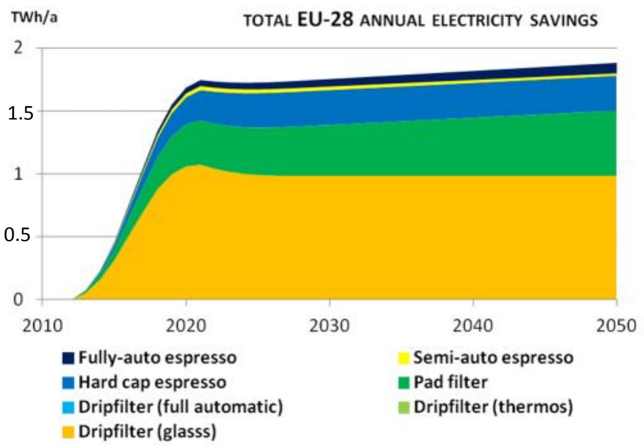
Coffee is incorporated in Europe's culture, being the most coffee consuming continent. There are coffee specialities all over Europe, from Italian espresso to Austria's wiener melange and Dutch filter coffee. Coffee is both tradition and a trend, since brewing methods once used in specific countries only are now common in the multiple coffee houses which arise in European cities.

A common method of brewing in Europe is drip filter coffee; in 2015, 40% of the sales were drip filter machines with a glass jug. These machines use a hot plate to keep the coffee warm. The glass jug does not have optimal insulating properties, which makes this an energy inefficient method. Furthermore, brewing methods including large jugs tend to produce more coffee than needed in a session, entailing losses in coffee, water and energy. Spilling coffee is very inefficient in itself, since beans require a water intensive production procedure.

SALES

In year 2000, 90% of coffeemaker sales were drip filter appliances. In 2015 this share is down to 62% and expected to slightly decrease further until 2020 and then stabilize around 55%. The decrease in drip filter sales is more than compensated by an increase in sales of pad filter and hard cap espresso machines. Overall, sales of coffee machines are expected to rise by 8% from 26.8 million appliances in 2015 to 29.0 million in 2030.

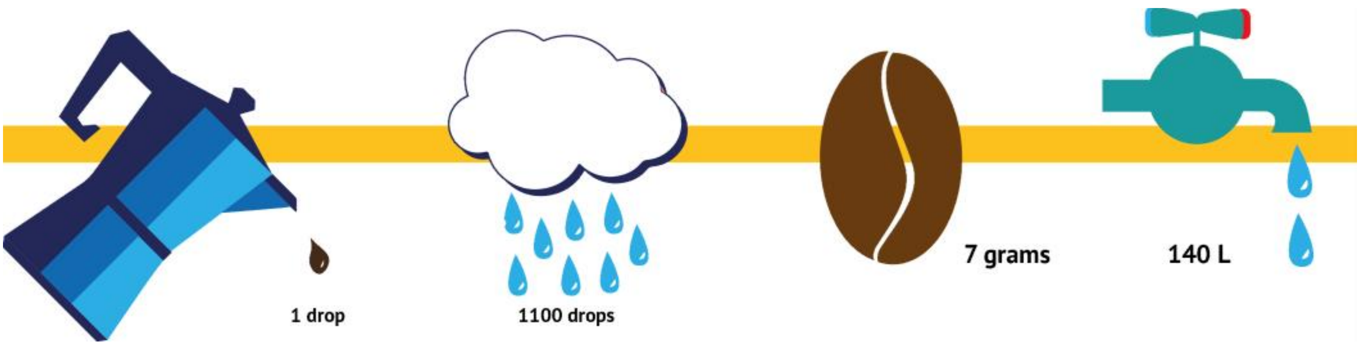




ELECTRICITY SAVINGS

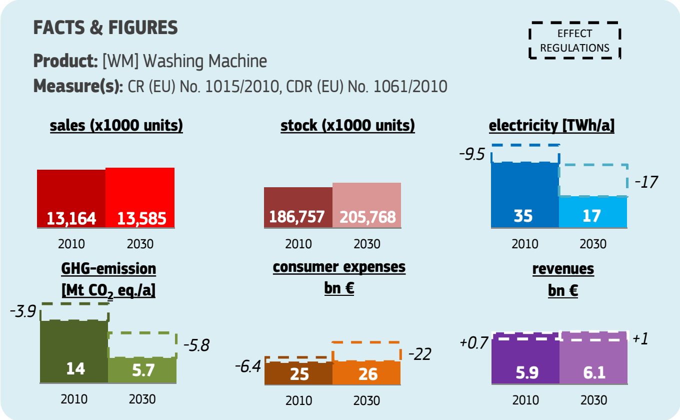
In 2015, coffeemakers consumed 10.3 TWh/a of electricity, of which 6.5 for making the coffee, and 3.8 for standby and keep-warm. Only the latter aspect of coffeemakers is regulated, in regulation 1275/2013 on standby products. Consequently, savings in EIA for the coffee-making-part are zero.

The electricity savings on coffeemakers due to the standby regulation were around 0.5 TWh/a in 2015 and are expected to stabilize from 2020 on 1.7-1.8 TWh/a. Cumulative savings over the 2015 -2030 period then amount to 24.2 TWh. Most savings are obtained from the drip filter with glass jug combo, by limiting the time the hot plate functions. For other devices, a limited standby time and power provides the energy savings.



The most important ingredient for coffee is rain. Coffee-beans are the most water-intensive crop in the world. One drop of coffee requires 1100 drops of rain or irrigation water. One cup of coffee, 7 g of roasted coffee beans, requires 140 litres of water. Europeans drink some 350 billion cups (1.88 per capita per day) of coffee per year (2015) and this number is only increasing. This means at least 49 billion m^3 water for production.

Washing Machines

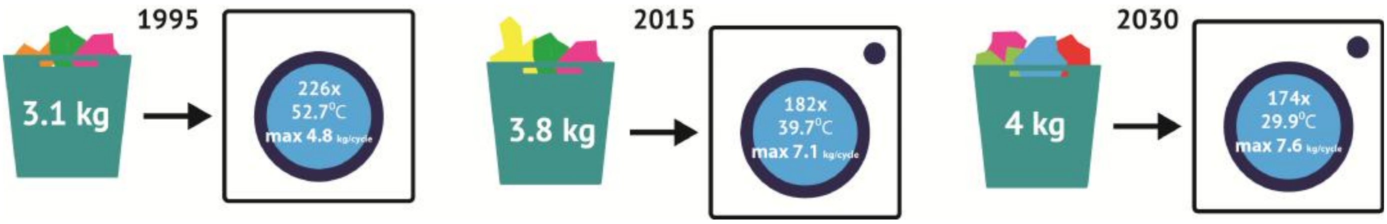


GENERAL INFO

The first labelling measures for washing machines (WM) came into force in 1995. Since then, the product group made big improvements in terms of energy efficiency, requiring an update of the labelling scheme in 2010. Ecodesign measures were also introduced in the same year. Currently a review study is in progress to update requirements according to the state of the WM technology.

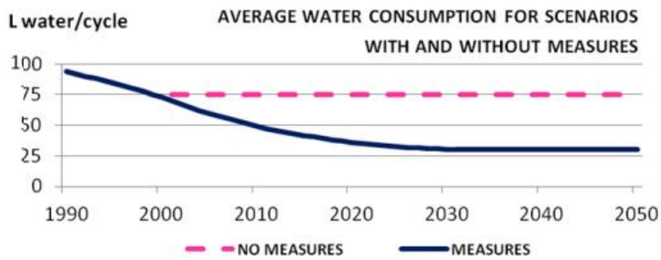
LOAD

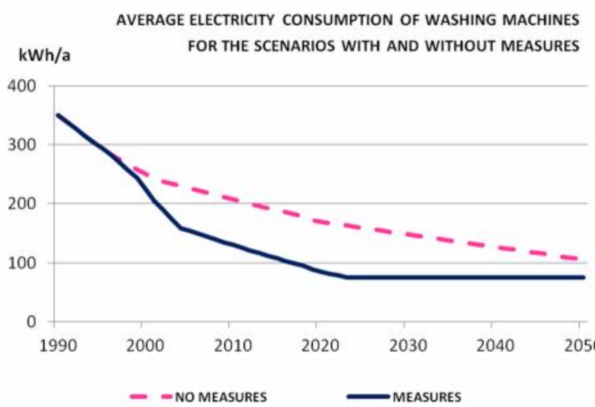
The average rated capacity (maximum kg of laundry per cycle) of EU washing machines is continuously increasing, from 4.8 kg in 1995, to 7.1 kg in 2015 and expected 7.6 kg by 2030. The real average amount of laundry washed per cycle is much lower than the capacity, and increasing more slowly: from 3.1 kg/cycle in 1995 (65% of capacity), to 3.8 kg in 2015 (54%) and expected 4.0 kg by 2030 (50%). In parallel, the average number of washing cycles per year per WM decreased from 226 in 1995, to 182 in 2015 and expected 174 by 2030. Combining these data with an increase in installed WMs (200 mln units in 2015), the total quantity of laundry washed yearly in EU-28 (EU-Load) increased from 92 Mton (92 billion kg) in 1995 to 139 Mton in 2015 and expected 143 Mton by 2030. This laundry is washed (on average) at ever lower temperatures: 53˚C in 1995, 40˚C in 2015, and expected 30˚C by 2030. Obviously, this trend has a positive effect on electricity consumption.



WATER CONSUMPTION

The 2010 Ecodesign regulation also set limits on the water consumption of WMs. In 1995, the average WM consumed 84 litres of water per washing cycle. Without measures this was projected to drop to 75 l/cycle from 1999 onwards. Due to the measures this was further reduced to 41 l/cycle in 2015 and expected 30 l/cycle by 2030.
At EU level this enabled saving 1906 million m^3 of water per year in 2015 and expected 2466 million m^3 per year in 2030, the latter approximately equalling a 1 m deep pool with the size of the state of Luxemburg (2586 km2).



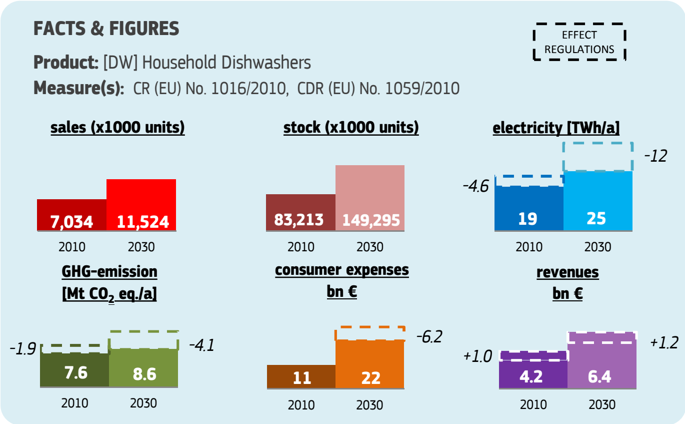


EFFICIENCY AND ENERGY

In 1995, before the first measures, the average newly sold WM consumed 294 kWh/a of electricity. Without measures, this was projected to be 189 kWh/a in 2015 and 148 kWh/a in 2030. Due to the combined measures, this has been reduced to 108 kWh/a in 2015 (-81 kWh, -43%) and expected 75 kWh/a by 2030 (-73 kWh/a, -49%).

At EU-level, considering also the increasing quantity of installed WM, this enabled a reduction of total WM electricity consumption from 43 to 28 TWh/a in 2015 (-35%), and from expected 34 to 17 TWh/a in 2030 (-50%).

Dishwashers



GENERAL INFO

Energy labelling measures for household dishwashers (DW) came first into force in 1997, and were updated in 2010. Ecodesign measures were also introduced in 2010. Currently a review study is in progress to update requirements according to the state of the DW technology.

LOAD ASPECTS

The capacity of dishwashers is expressed in place settings (ps), which is a defined set of crockery, glass and cutlery for use by one person. The average rated capacity of EU dishwashers is fairly constant, varying from 12.2 ps in 1997 to 12.8 ps in 2030. The average amount of place settings actually washed per cycle is lower: 7.5 ps/cycle in 1997 (61% of capacity), 9.1 ps in 2015 (72%) and expected 9.3 ps by 2030 (73%). On average a DW is used for 210 cycles per year.

The EU-28 stock of installed DW is strongly increasing from 50 mln units in 1997, to 99 mln in 2015 and expected 206 mln by 2030.

Combining the above data, the total quantity of place settings cleaned yearly in EU-28 (EU-Load) increased from 79 billion ps in 1997 to 189 billion in 2015 and expected 291 billion by 2030. The average temperature at which these dishes are washed is slightly decreasing with the years, from 60.2˚C in 1997 to expected 53.6˚C by 2030.

WATER CONSUMPTION

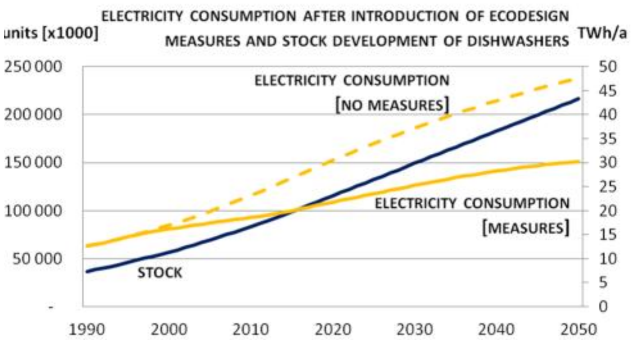
The Ecodesign regulation does not explicitly set limits on the amount of water that a DW is allowed to use, but the limits on electricity consumption indirectly also lead to lower water use. In addition, the declaration of the annual water consumption on the label has had a positive effect on reducing water consumption.

In 1997, the average DW consumed 24 litres of water per cycle, and without measures this was expected to remain constant. Due to the measures, the consumption was reduced to 12 l/cycle in 2015 and expected 9 l/cycle by 2030.

At EU level this enabled saving 254 million m^3 of water per year in 2015 and expected 476 million m^3 per year in 2030, the latter approximately equalling 190 thousand Olympic swimming pools (of 2 meters deep) or a swimming pool with the size of the city of Amsterdam.

Amsterdam

Water savings on dishwashers are equivalent to the content of 190 thousand Olympic swimming pools of 2 meters deep: a pool with the size of Amsterdam



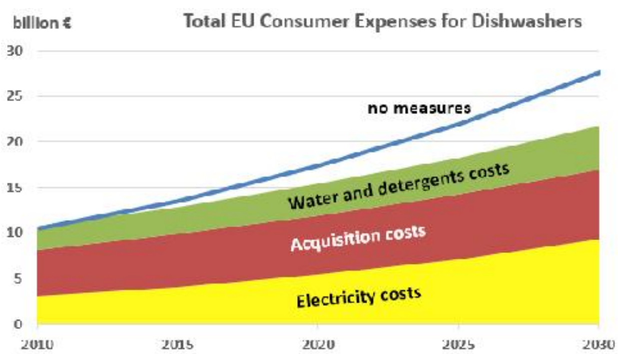
EFFICIENCY AND ENERGY

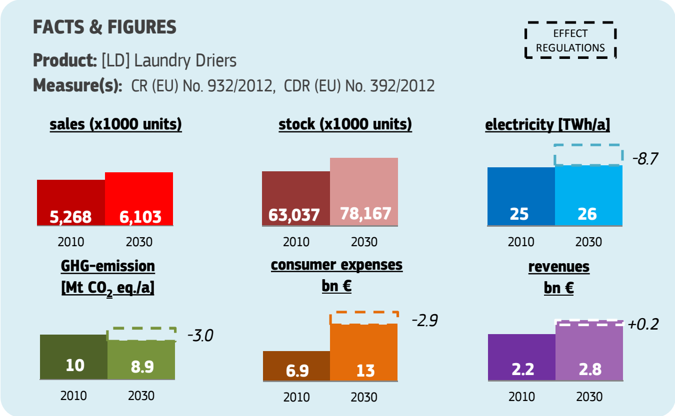
In 1997, before the first measures, the average newly sold DW consumed 288 kWh/a of electricity. Without measures, this was projected to be 262 kWh/a in 2015 and 239 kWh/a in 2030. Due to the combined measures, this has been reduced to 183 kWh/a in 2015 (-79 kWh, -30%) and expected 159 kWh/a by 2030 (-80 kWh/a, -33%).

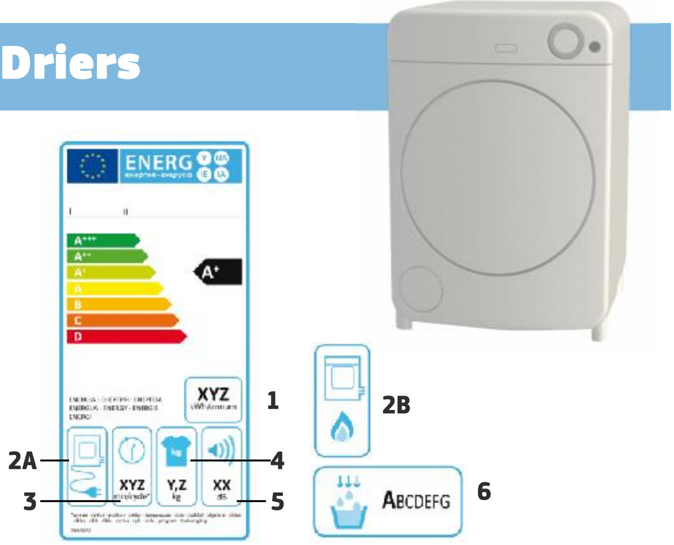
At EU-level, considering also the strongly increasing quantity of installed DW, this enabled a reduction of total DW electricity consumption from 27 to 20 TWh/a in 2015 (-26%), and from expected 37 to 25 TWh/a in 2030 (-33%).

EXPENSES

More efficient DWs have higher acquisition cost. In 2015 EU-consumers spent 1.4 bn euros extra buying DWs, but this was compensated by 1.4 bn euros lower electricity costs and 1.1 bn euros lower water and detergent costs, for net expenditure savings of 1.1 bn euros. In 2030, these savings are expected to be 6.2 billion Euros, of which 3.3 bn on water and detergents.







GENERAL INFO

Energy labelling measures for household laundry tumble driers (LD) came first into force in 1995, and were updated in 2012. Ecodesign measures were also introduced in 2012.
There are two main types of LD: Air-vented dryers and Condenser dryers. Air-vented dryers draw air from the room in which they are installed, heat it and lead it through the humid clothing in the drum to evaporate the moisture. The humid air is then expelled to the external environment. Air-vented dryers thus require an exhaust to the outside, making them less practical. Condenser dryers use a similar process but have an additional heat exchanger to cool the humid air, thus condensing the water. The liquid water is stored in a tray or fed into the drain. Condenser dryers do not require an exhaust to the outside, but due to the additional components they are more costly. Condensing requires additional energy, but the technology has the potential for efficiency improvement by heat recovery from the outgoing air (in particular when applying heat pump technology).

LOAD

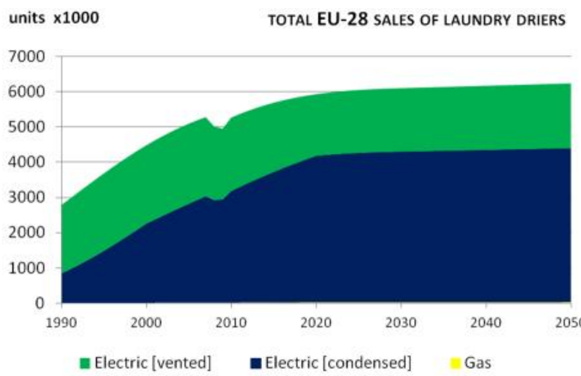
The average moisture content of the clothing to be dried is decreasing (65% in 2000; expected 55% in 2030) due to an increase in spin-speed of washing machines. This facilitates the task of the LDs. On the other hand, the capacity of LDs is increasing, from 5.0 kg/cycle in 2000 to 7.1 kg/cycle in 2015, and LDs are also increasing their spin-speed. On average consumers run their LD 160 times per year, using 71% of its capacity. Combining these data with the installed stock, the total EU-load of LDs is increasing from 25 Mton laundry in 2000, to 55 Mton in 2015 and 65 Mton in 2030.

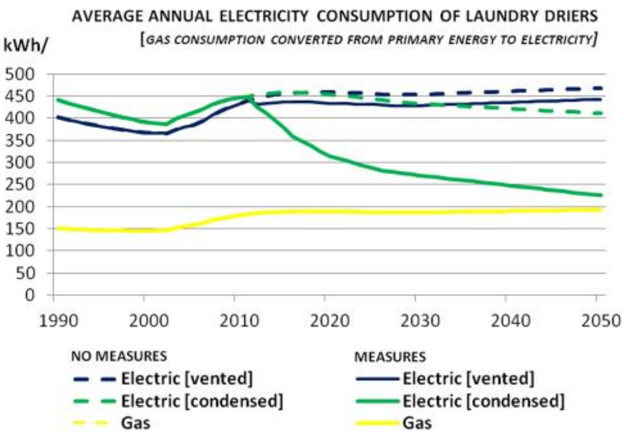
LABELLING

The energy label for LDs stimulates manufacturers to make more efficient products and stimulates consumers to buy them. This pulls the average efficiency of newly sold products upwards. Ecodesign removes the worst performing products from the market. The 2013 requirements phase out the class D appliances. The 2015 requirements for condenser driers phase out class C products.
In addition to the energy efficiency class, the label provides: the dryer type (electric [2a] or gas [2b]), the cycle time of a standard cotton program (in minutes) [3], the rated capacity in kilogram [4], and the emitted noise [5]. Specifically for condenser types, the condensation efficiency class is presented [6].

APPLIANCES IN USE

In 2015, 5.7 million LDs were sold in EU-28 of which 35% electric air-vented dryers and 65% condenser dryers. Gas-fired air-vented dryers accounted for less than 0.5% of the sales. Sales of condenser types are increasing while those of vented dryers are decreasing, but the net effect is a small increase to 6.1 mln units by 2030. The installed stock is expected to increase from 68 mln units in 2015 to 78 mln in 2030.





EFFICIENCY AND ELECTRICITY

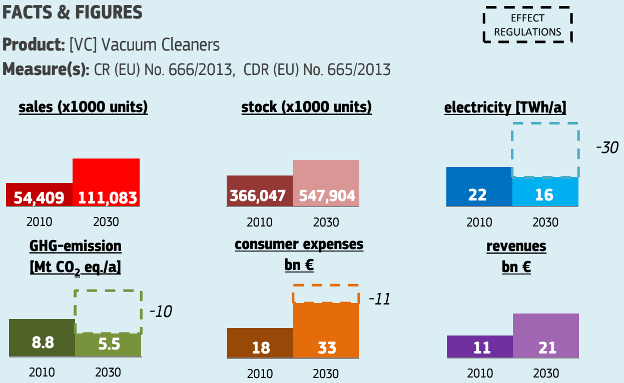
The largest energy efficiency improvements can be obtained for condenser type LDs. The heat pump laundry drier was a major energy-saving innovation, whose commercial success was mainly due to the ambitious energy labelling scheme. Due to the measures, the 2015 annual electricity consumption per unit has been improved from 458 to 378 kWh/a (-17%). By 2030 this is expected to further reduce to 271 kWh/a. Improvements for electric vented dryers are much smaller: a reduction from 455 to 437 kWh/a/unit in 2015 (-4%) and then to 429 kWh/a in 2030.
Without measures, the overall EU-28 electricity consumed by LDs was expected to be 29.3 TWh/a in 2015 and 34.9 TWh/a in 2030. Due to the measures this reduces to respectively 28.4 (-3%) and 26.1 (-25%).

Vacuum Cleaners

FACTS & FIGURES

Product: [VC] Vacuum Cleaners

Measure(s): CR (EU) No. 666/2013, CDR (EU) No. 665/2013



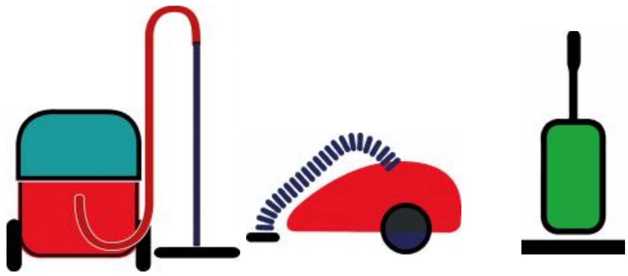
GENERAL INFO

Until some years ago, consumers tended to select their vacuum cleaner (VC) based on its input power, assuming that higher power equals better cleaning performance. Manufacturers stimulated this by producing VCs with ever higher power and advertising with this. This trend led to an increase in VC power from 1275 W in 1990 to 2000 W in 2015, and, without measures, expected 3000 W by 2030. However, a higher input power does not always imply better cleaning performance.

Considering that this situation was largely induced by a lack of information and communication, the 2013 Energy Labelling for VCs prescribes a label that informs consumers not only on the energy efficiency of VCs, but also on their cleaning performance on carpet and hard-floor, on the dust re-emission, and on generated noise.
In parallel, the 2013 Ecodesign regulation limits the maximum power and annual energy consumption of VCs (max 1600 W, 62 kWh/a from 2014; max 900 W, 43 kWh/a from 2017), while contemporaneously requesting an improvement in the cleaning performance.

EU-LOAD

The EU-load represents the total demand for vacuum cleaner 'output'. It is expressed in the annual floor surface area to be cleaned. In 2015, this was 1.2 million km^2, which equals the combined land surface areas of Portugal, Spain, France, Germany, Denmark and the Benelux. In 2030, this surface area is expected to increase by 14% to 1.3 million km^2.



Tub   Cannister/cylinder   Upright

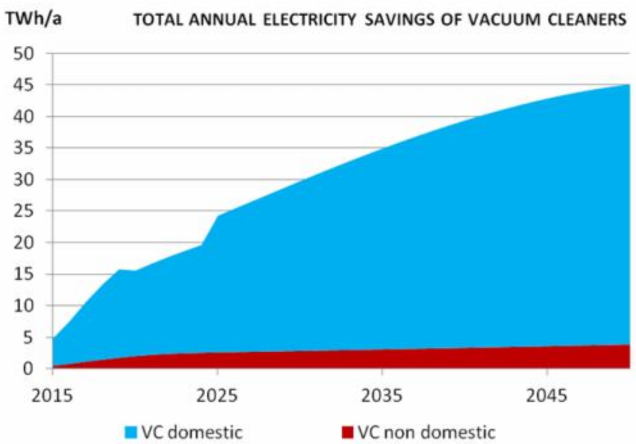
TYPES AND STOCK

Several types of vacuum cleaners, both domestic and non-domestic, are included in the scope of the regulation. The cylinder type vacuum cleaner is most common in European households. The upright type is preferred in England. The tub type is generally used for non-domestic applications.
In 1990, 158 million VCs were in use in EU-28, increasing to 390 mln in 2015. A further increase to 548 mln units is expected by 2030.

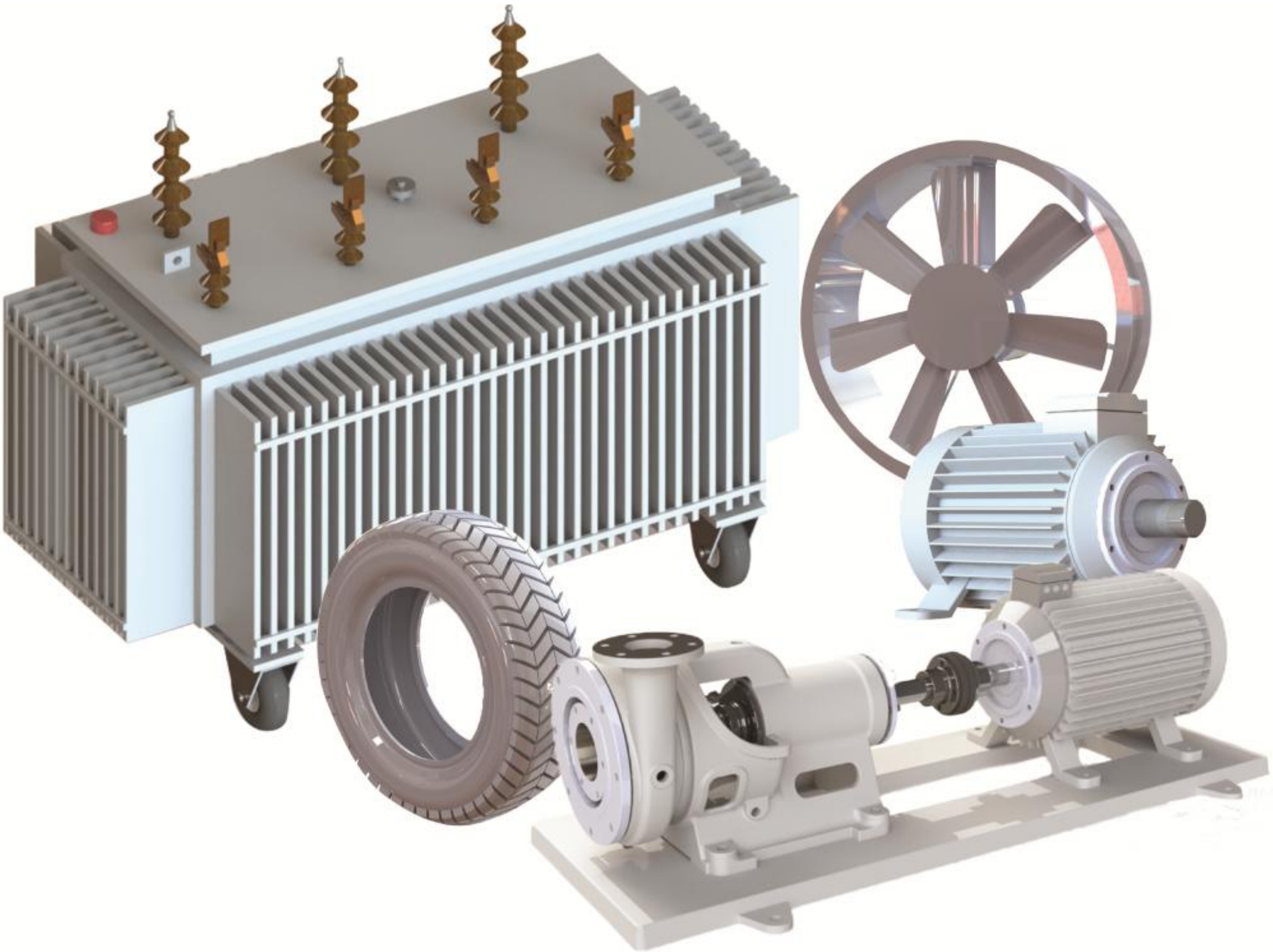
SAVINGS

Without measures, average power of domestic VCs would have been around 2000 W in 2015 and 3000 W in 2030. Due to the measures this decreased to 1200 W in 2015 and expected 900 W by 2030. Combining this with the increasing large quantities of VCs, the energy savings are significant.

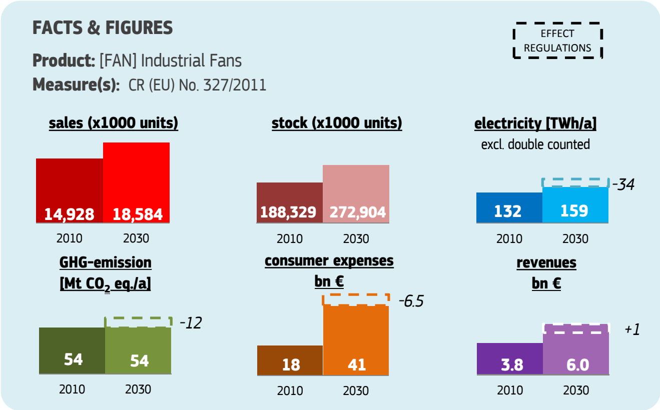
Without measures, total EU-28 electricity consumption by VCs would have been 28 TWh/a in 2015 and 46 TWh/a in 2030. Due to measures this was reduced to 23 TWh/a in 2015 (-18%) and expected 16 TWh/a in 2030 (-65%).



INDUSTRIAL AND OTHER



Fans

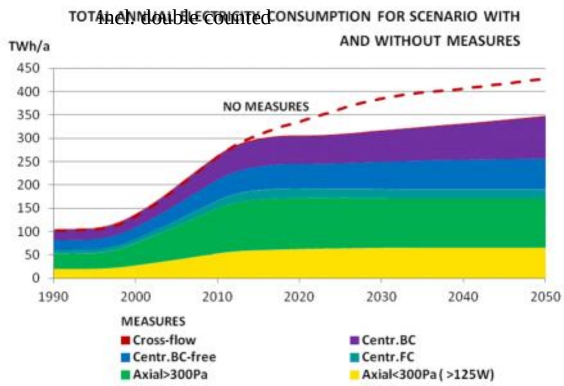


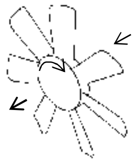
GENERAL INFO

Fans typically blow air and have a low output pressure. This distinguishes them from compressors (higher output pressure) and from pumps (act on liquids).
Ecodesign regulation 327/2011 applies to industrial fans driven by an electric motor with an input power between 125 W and 500 kW. This range covers only around 10% of the 4.3-4.5 billion fans in use in EU, but they are responsible for 80% of the electricity consumption by fans.
Smaller fans (< 125 W) are 90% of the installed units but use only 10% of total fan electricity. The average household is estimated to use 20 small fans, in e.g. ovens, fridges, laundry dryers, dishwashers, computers, hair dryers, comfort fans, air conditioners, range hoods, space heating, car ventilation, etc. They are often integrated in products that are already regulated (or for which regulation is judged not effective), and therefore excluded here.
Very large fans (> 500 kW) are sold in less than 1000 units per year, but anyway account for 10% of total fan electricity. They are applied in e.g. cogeneration and power plants and industrial processes. The energy awareness of their end-users is very high and market forces are assumed to ensure use of energy-efficient solutions; therefore they are also excluded here.
Different types of fans (for different applications) have different efficiencies and are therefore separately addressed in the regulation. Main types with their associated 2015 sales and efficiencies are shown in the illustration.

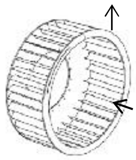
ELECTRICITY

In 2010, fans in scope of the regulation consumed 264 TWh/a of electricity. Without measures, this was expected to increase to 337 TWh/a in 2020 and 386 TWh/a in 2030. Due to the measures this can be reduced to 306 TWh/a (-9%) in 2020 and 317 TWh/a (-18%) in 2030. (these figures include double counted electricity)
Half of the 2030 savings derives from improvements on axial fans. Another 35% comes from centrifugal backward curved fans, 10% from centrifugal forward curved fans and 4-5% from cross-flow fans.

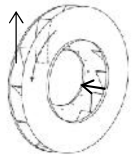




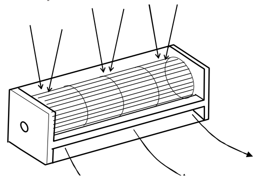
Axial-propeller
2015 sales: 12 mln (73%)
Efficiency: 31-37%
Improvable to: 39-44%



Centrifugal forward curved
2015 sales: 2.4 mln (14%)
Efficiency: 32%
Improvable to: 45%



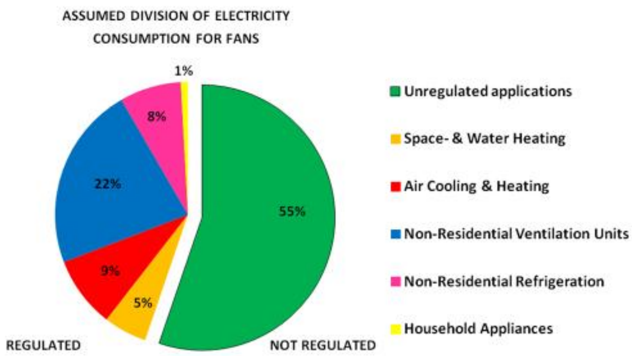
Centrifugal backward curved
2015 sales: 1.5 mln (9%)
Efficiency: 54-56%
Improvable to: 65-67%



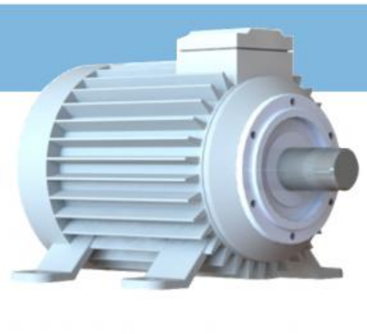
Cross-flow
2015 sales: 0.6 mln (4%)
Efficiency: 7%
Improvable to: 21%

DOUBLE COUNTING

The fans in the scope of the fan-regulation may be included in products for which a separate regulation exists. In that case energy and savings in EIA could be counted twice. To resolve this, EIA first reports the full data for each fan type (for transparency reasons and to enable comparison with the original studies), but then considers only the non-double-counted share when computing the fan-group total and the totals over all product groups.
Recent detailed studies show that 45% of the fan-electricity is already counted in other EIA-products, such as non-residential ventilation units, air heating and cooling, and non-residential refrigeration (see graph). This increases to approximately 50% if the interaction with the motor regulation is also taken into account. EIA therefore counts only 50% of fan energy and savings when computing totals.



Electric Motors

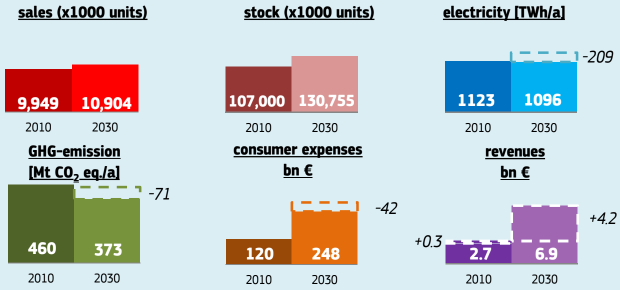


FACTS & FIGURES

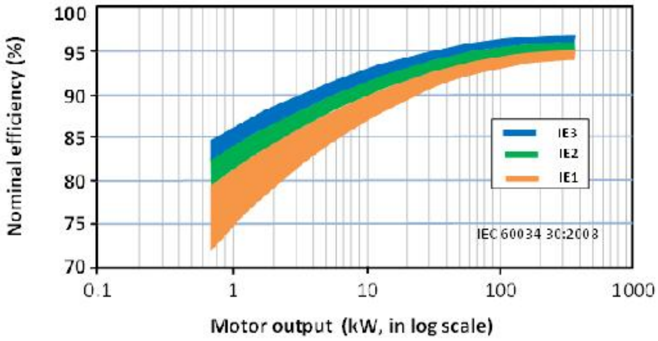
EFFECT REGULATIONS

Product: [MT] Motors 0.75-375 kW

Measure(s): CR (EC) No. 640/2009, CR (EU) No. 4/2014 (amendment)



The efficiency of electric motors is indicated using classes (IE1, IE2, IE3) according to IEC600034-30: 2008. In the same class, the efficiency depends on the motor output power, e.g. an IE3 motor of 1 kW output has an efficiency around 85%, but an IE3 motor of 100 kW output has an efficiency around 96%.

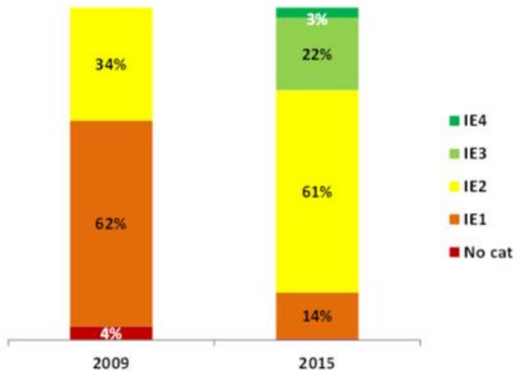


GENERAL INFO

Regulation 640/2009 applies to 3-phase AC induction motors with powers between 0.75 - 375 kW and input voltage < 1000 V. In 2015 this regarded 117 million installed motors that consumed around 1150 TWh/a of electricity. This is 42% of all electricity consumed in EU-28 (Eurostat Energy Balance Sheet for 2014: 232701 ktoe =2706 TWh).

Regulation 640/2009 provides manufacturers with two options to reduce the energy consumption of a motor system. Either the motor complies with efficiency class IE3, or an IE2 motor (lower efficiency) is combined with a Variable Speed Drive (VSD). As shown in the graph, the regulation had a strong positive effect on the motor market: the sales share of motors in the lowest efficiency class (IE1) dropped from 62% in 2009 (before the regulation) to 14% in 2015. Sales shifted to the higher efficient IE2 and IE3 motors.

EU market share motor efficiency classes 2009 and 2015



A revision of the regulation is currently (2016) under discussion, proposing a scope extension:

- Powers from 0.12 to 1000 kW
- 1-phase and 3-phase motors
- Special purpose motors (submersible, brake-motors, motors for explosive atmospheres)
- Input voltage up to 6000 V (optionally)

With this extension the 2015 stock to consider would increase more than 3 fold, from 118 mln to 390 mln. The corresponding electricity consumption would increase by 33% from approximately 1200 to 1600 TWh/a. This scope extension is not considered in EIA yet.

VARIABLE SPEED DRIVES

Most electric motors run at a constant speed and this determines the output of the application in which the motor is used, e.g. the amount of liquid pumped, air ventilated or air compressed. If the load of the application is more or less constant, and the motor is of the correct size/speed, this is no problem. Otherwise, the output has to be controlled by switching the motor on and off, or by throttling the output of the application. In that case large losses occur because the motor runs at full power/speed while this would not be necessary.
These losses can be avoided by controlling the power supply to the motor using a Variable Speed Drive (VSD). Although VSDs themselves consume some additional power and may also have a small negative effect on motor efficiency, the avoided losses are much higher so that large electricity savings can be obtained.
Regulation 640/2009 therefore promotes the use of VSDs in variable load applications.

DOUBLE COUNTING

A part of the electric motors in the scope of the motor-regulation is used in products for which a separate regulation exists. In that case energy and savings in EIA could be counted twice. To resolve this, EIA first reports the full motor data (for transparency reasons and to enable comparison with the original studies), but then considers only the non-double-counted share when computing the totals over all product groups.
For the scope of the current regulation the double-counted share, as now applied in EIA to both energy and savings, is estimated to be 50%.

A detailed estimate of the double counted part is performed in the 2016 impact assessment accompanying the proposal for regulation revision, but for the extended motor scope.

EFFICIENCY AND SAVINGS

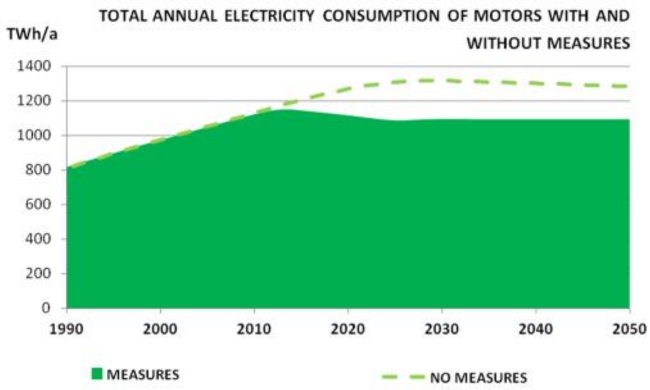
In 2009 the average motor efficiency (mechanical output power divided by electrical input power) was around 79%. Without measures, this was expected to increase to 81% by 2030. Due to regulation 640/2009 this can become 86%. The increased use of VSDs is expected to have an additional positive effect of 10%, so that an average efficiency of 96% is expected in 2030.

Without measures the total EU-28 electricity consumption by motors would have grown from 1123 TWh/a in 2010 to 1305 TWh/a in 2030. Due to the measures the latter value is expected to drop to 1096 TWh/a (-209 TWh, -16%), notwithstanding an increase in installed motors from 107 mln (2010) to 131 mln (2030). Note that these savings represent 7.7% of the total EU-28 electricity consumption in 2014.

The electricity savings entail a reduction of GHG emissions by 71 $MtCO_2eq$/a in 2030.

In 2030, considering 4 bn euros additional acquisition costs for higher efficiency motors and for VSDs, and 46 bn euros lower electricity costs, the net savings on total EU-28 expenses for electric motors in scope of the regulation are 42 bn euros.

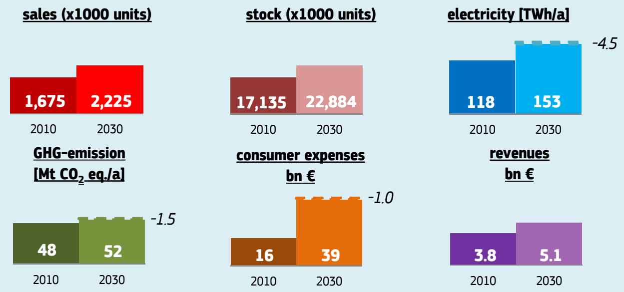
(full figures, including double counted)



FACTS & FIGURES

Product: [WP] Water Pumps
Measure(s): CR (EU) No. 547/2012

EFFECT REGULATIONS



GENERAL INFO

Ecodesign ENER Lot 11 includes (small) clean water pumps and circulators, Lot 28 is for wastewater pumps, and Lot 29 addresses pumps for private and public swimming pools, ponds, fountains and aquariums, as well as clean water pumps larger than those of Lot 11.

Regulation 547/2012 is limited to pumps for clean water (Lot 11), and only their data are currently reported in EIA. The scope includes rotodynamic pumps that move clean water (as defined in the regulation; temperatures -10° to 120°C) using hydrodynamic forces. Excluded are: displacement pumps (that enclose a volume of clean water and force this volume to the outlet), self-priming pumps (that can start and/or operate also when only partly filled with water) and pumps designed only for fire-fighting applications.

The regulation applies to 'glanded' pumps, meaning that there is a sealed shaft connection between the impeller in the pump body and the motor: The driving motor component remains dry (except for MSS, see below). This distinguishes the pumps from the 'glandless' circulators that are subject of regulation 641/2009 (am. 622/2012).

Regulation 547/2012 specifically addresses end suction (ES), submersible multistage (MSS) and vertical multistage (MS-V) pumps. Each of these types is defined very strictly within certain performance boundaries in terms of flow rate, pressure, fluid temperature and even discrete rotary speeds or borehole diameters, thus limiting the applicability.

The most important use of clean water pumps is in the agricultural sector (41% of total energy consumption by pumps), where ES and MSS pumps are used for irrigation and drainage. ES pumps are used for pumping from surface water and shallow wells. MSS pumps are used (submersed) in deep wells. MS-V pumps are typically used as pressure boost in high-rise buildings above 3-4 floors. Other clean water pump applications include garden irrigation, public drinking water production (including purification) and cleaning and cooling in the industrial sector.

EFFICIENCY

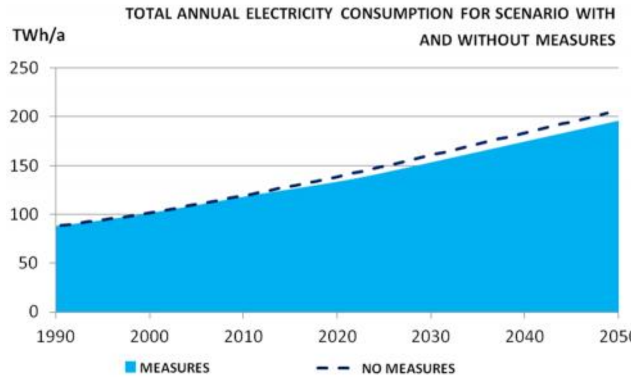
Ecodesign requirements apply to the hydraulic pump efficiency, which is the ratio between the mechanical power transferred to the liquid during its passage through the water pump and the mechanical input power transmitted to the pump at its shaft. This means that the efficiency of the motor driving the pump is not covered by this regulation, i.e. the regulation requires an efficient pump to be used but would allow it to be driven by an inefficient motor. Consequently the separate motor regulation (see previous section) is complementary here.

The minimum required efficiency depends on the flow rate (m^3/h), on the 'head' (the column of water in meters that the pump is able to produce), on the working point (best efficiency point, part load or overload) and on a Minimum Efficiency Index (MEI, a dimensionless scale unit for hydraulic pump efficiency). MEI=0 indicates poor design and manufacturing quality. MEI>0.7 is not practically attainable in mass production and can only be achieved by special hydraulic design (aiming only at high efficiency and neglecting e.g. good cavitation performance), and by exceptional measures in mechanical design and manufacturing. From 1st January 2015, regulation 547/2012 requires MEI=0.4, meaning that 40% of the products on the market will need to improve their efficiency level.

In 2008 the average hydraulic efficiency of clean water pumps in scope of the regulation was 66.5% and without measures this was not expected to change. Due to Ecodesign measures the efficiency is expected to increase to 68.5% from 2015 onwards.

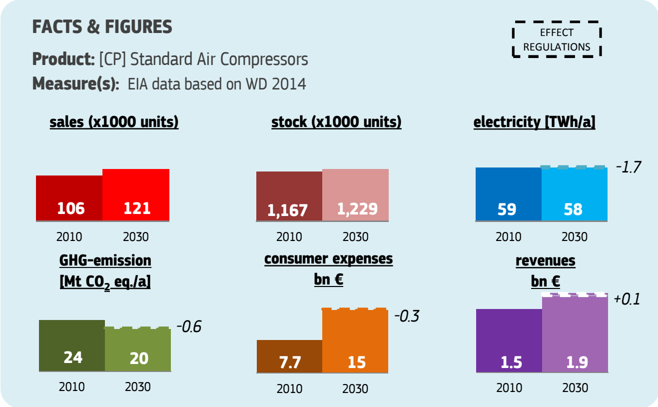
SAVINGS

In 2010, clean water pumps consumed 118 TWh/a of electricity (input energy to motors driving the pumps), corresponding to 48 $MtCO_2$eq./a of GHG emissions. Due to an increasing stock this would have increased to 157 TWh/a and 54 $MtCO_2$eq./a in 2030. Due to the measures, savings of 4.5 TWh/a and 1.5 $MtCO_2$eq./a are expected in 2030.



A review study on pumps is ongoing and expected to be complete in February 2017. In addition to reviewing the Lot 11 clean water pumps, this study took also into account the wastewater and pool pumps of Lots 28/29. The study proposes an extension of the scope of the regulation, but more importantly introduces the concept of 'Extended Product Approach' (EPA). The EPA considers not only the hydraulic efficiency of the pump itself, but the entire system of pump, motor, drive and controls. The aim is to ensure that the most energy efficient combination of components is used for each pumping application (intended flow-time water pumping profile). Instead of the 5 TWh/a savings of the current regulation this approach, with extended scope, is expected to deliver 43 TWh/a savings by 2030.
Review study data are not considered in EIA yet.

Compressors



GENERAL INFO

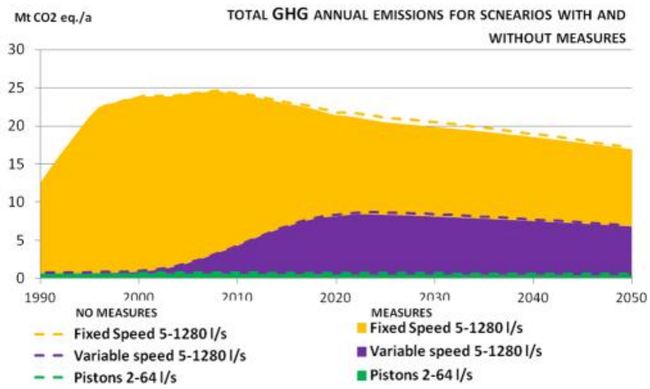
Compressed air is so widely used in industry that it is often regarded as the fourth utility after electricity, natural gas and water. Some of the benefits of using compressed air when compared to other utilities are easy storage, no sparks or fire hazards, a high power density, no interference with electronic monitoring equipment, or simply because no other utility would be able to do the task (air as soft transport medium, air for breathing). But compressed air is also more expensive when evaluated per unit of energy delivered. Therefore the production and use of compressed air needs to be prudent, especially from an environmental point-of-view.

Most compressed air for industrial purposes is produced by "standard air" compressor packages. A draft EU-regulation for these products has been proposed (2014) but is not finally accepted yet. EIA data are based on this proposal.
Minimum energy efficiency requirements for "standard air" compressors have already been implemented in China in 2009, and a regulation has been proposed in the USA in May 2016 (partially based on the EU Lot 31 study). These extra-EU regulations more or less constrain the EU to take action as well, to avoid becoming a dumping ground for under-performing air compressors.

Meanwhile a follow-up study is being conducted for the application ranges "low pressure air" (up to max 5 bar(a) indicatively) and "oil-free air" (without oil in the compression chamber). This study will be finished in March 2017.

STOCK AND ELECTRICITY

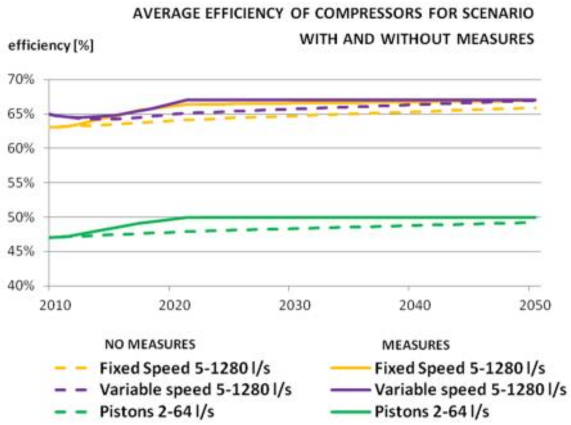
In 2015, annual sales of "standard air" compressors were 109 thousand units, and a total of 1.15 million was operating in EU-28. These compressors consumed 58 TWh/a of electricity, or 2% of the total EU-28 electricity consumption.
Piston compressors form 43% of the 2015 EU stock, but are relatively small and consume only around 2% of the overall compressor electricity. Fixed speed rotary compressors represent 48% of the stock, but are responsible for 71% of the electricity. Variable speed compressors represent 9% of stock and 27% of electricity.



EFFICIENCY AND TYPES

The (isentropic) efficiency of compressors is defined as the output power, in terms of pressure and volume flow rate of the compressed air, divided by the electric input power to the motor driving the compressor (so it includes also motor efficiency).
In general the efficiency increases with the capacity of the compressor (larger = more efficient); the requirements in the proposed regulation therefore vary with the volume flow rate (higher limits for larger compressors). In the 2nd tier (2020) the proposed regulation aims at removing from the market the compressors that are less efficient than the current average. The 1st tier (2018) phases out a smaller part of least efficient compressors.

For compactness reasons, EIA reports data for 3 aggregated compressor groups: fixed speed rotary, variable speed rotary, and piston compressors. The characteristics for these groups (including efficiency) are weighted averages of those for the various volume flow classes, and therefore rather 'artificial' values.
In 2010 the average efficiency of new fixed speed rotary compressors was 63.1%. Without measures this is expected to increase to 64.7% by 2030; with measures to 66.6%. For variable speed rotary compressors these values are 64.8% (2010), 65.7% (2030) and 67.0% (2030 with measures). Piston-types have lower average efficiency: 47.0% (2010), 48.3% (2030) and 50.0% (2030 with measures).



SAVINGS

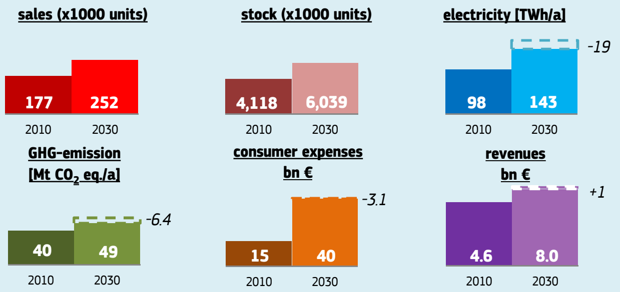
Without measures, the electricity consumption of "standard air" compressors is expected to increase to 60.2 TWh/a in 2030. Introduction of the measures could decrease this to 58.5 TWh/a (-1.7 TWh, -3%). Two-thirds of these savings are obtained on the fixed speed rotary compressors.
The savings could be increased if the measure promotes recovery of the heat generated during the compression.
The associated savings on greenhouse gas emissions are 0.6 $MtCO_2eq/a$ in 2030. Expected savings on consumer expenses are 0.3 billion euros in the same year.

Distribution Transformers

FACTS & FIGURES

EFFECT REGULATIONS

Product: [TRAFO] Utility Transformers
Measure(s): CR (EU) No. 548/2014



GENERAL INFO

Distribution transformers (or power transformers, TRAFO) transform an incoming alternating current (AC) power system into an outgoing AC power system, often converting from higher voltage to lower voltage or vice versa.

As TRAFOs essentially pass the upstream electricity (input) on to the downstream users (output), only the losses (input minus output) are accounted as electricity consumption in EIA.

TRAFOs are used in the transmission and distribution of electricity, between the point of generation and the point of use. The associated losses are already considered in EIA as part of the fixed 40% efficiency assumed for electricity generation and distribution. This 40% is used when determining the primary energy (fuel) necessary to supply a given amount of electricity to the end-user.

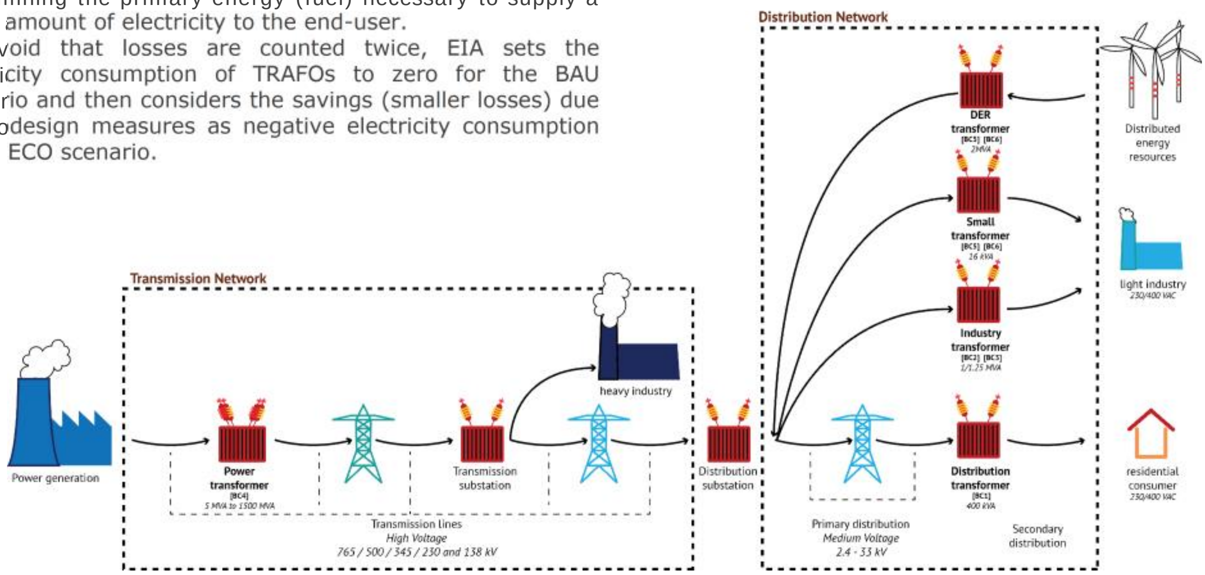
To avoid that losses are counted twice, EIA sets the electricity consumption of TRAFOs to zero for the BAU scenario and then considers the savings (smaller losses) due to Ecodesign measures as negative electricity consumption in the ECO scenario.

POWER GRID

TRAFOs are part of the system that transports electricity from power plant to customer (households, industries, tertiary sector clients). A transmission network transports high voltage electricity to a distribution network. In the transmission network, power transformers may be used to step up or step down the voltage. Only large industries may tap from this network; all other consumers will get electricity supplied by the distribution network. Distribution substations convert the high voltage input from the transmission network to medium voltage power, which is transported to the primary distribution system by different types of transformers.

Distribution transformers supply electricity for residential use (230 V). Higher power Industry transformers (either oil filled or dry) supply industrial consumers with low voltage electricity. DER-transformers (oil-filled or dry) connect Distributed Energy Resources (e.g. wind turbines, solar panels) to the distribution grid.

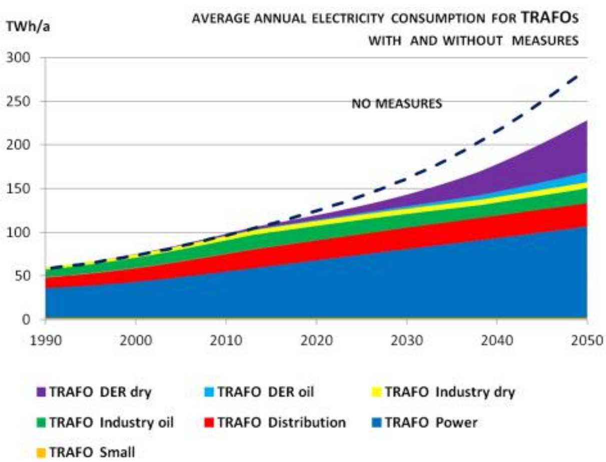
Dry or oil-filled refers to the cooling method of the transformer. Oil-cooled appliances have lower losses, but entail higher risks (fire). TRAFOs below 500 kVA are usually dry; those above 2.5 MVA usually oil-cooled.

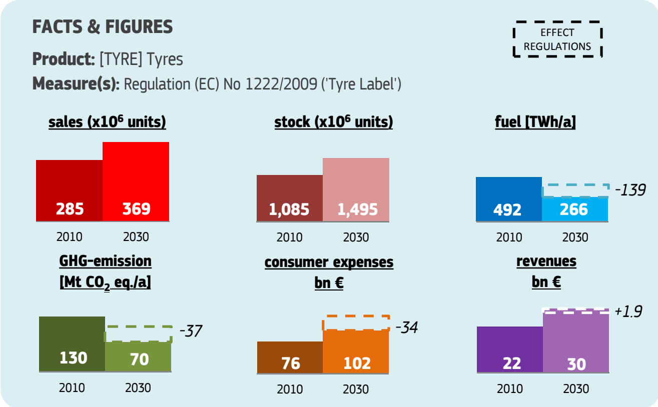


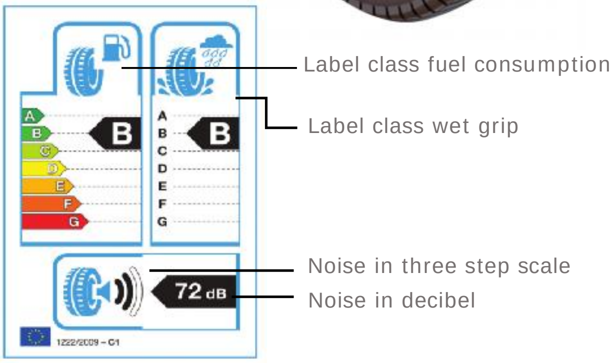
STOCK, LOSSES AND SAVINGS

The total EU-28 stock of TRAFOs in scope of regulation 548/2014 was 4.5 mln units in 2015 and had 111 TWh/a of electricity losses. The largest part (63%) are distribution TRAFOs (0.4 MVA) but they account for only 20% of overall TRAFO losses. Industry TRAFOs (oil and dry, 1-1.25 MVA) are 17% of the stock and responsible for another 20% of the losses. Small TRAFOs (0.016 MVA) are also 17% of the stock, but associated to only 2% of the losses. Power TRAFOs (100 MVA) are only 2% of the stock but cause 54% of the losses.

Small TRAFOs and Power TRAFOs have no associated electricity savings. The savings due to Ecodesign measures on the other TRAFO-types are 19 TWh/a in 2030, reducing their electricity losses from 83 TWh/a (without measures) to 64 TWh/a.







GENERAL INFO

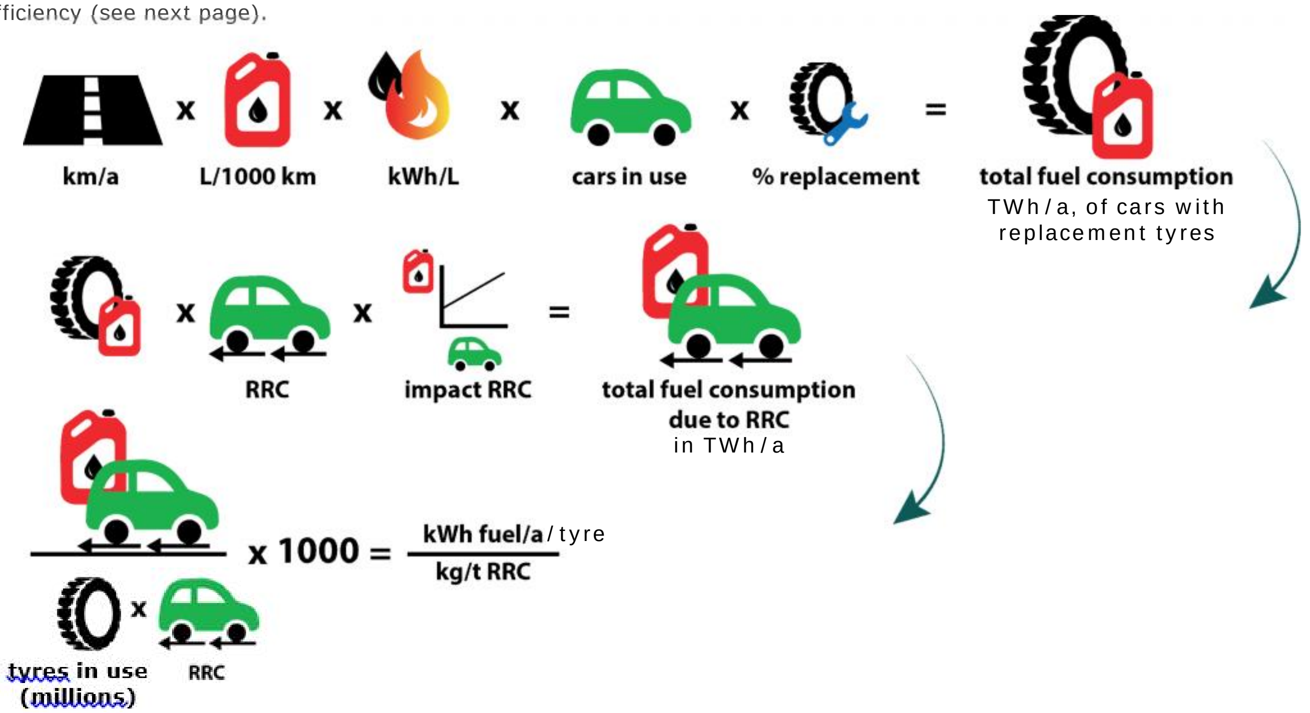
The rolling resistance of tyres accounts for 20-30% of the fuel consumption of vehicles. Therefore, improving the rolling resistance can realize significant savings on fuel consumption and CO_2 emissions. However, it is important that other properties of tyres, such as wet grip and durability, are not negatively affected when improving energy efficiency.
Labelling regulation 1222/2009 (entered into force in 2012) covers tyres for passenger cars (C1), light commercial vehicles (C2) and heavy duty trucks (C3). Labelling only applies to new tyres and not to retreaded tyres. Retreading of tyres is frequently applied for C3 tyres. It is a reworking process in which the worn tread of tyres is replaced. This method allows 90% of the tyre-material to be spared while costs are only 20% of the manufacturing costs of a new tyre. In line with underlying studies, EIA considers only replacement tyres; tyres that are sold together with new vehicles are currently not included.

ENERGY CALCULATION

For year 2010, the specific annual fuel consumption due to the rolling resistance of tyres is computed as indicated in text box and diagram, expressed in kWh fuel/a/tyre/(kg/t RRC).
To obtain the total EU-28 energy consumption by tyres for a given year, these specific values are multiplied by the stock of tyres in that year, the value of the RRC in that year, and a correction factor reflecting the improvement in motor efficiency (see next page).

The fuel efficiency label class is determined based on the 'rolling resistance coefficient' (RRC) which is measured according to UNECE Regulation 117 and subsequent amendments. The RRC is expressed in kg rolling resistance per ton of vehicle weight, kg/t.

The total EU-28 fuel consumption of vehicles mounting replacement tyres is calculated (see diagram) multiplying the average travelled distance per year (km/a) by the fuel consumption per 1000 travelled kilometres (L/1000km), the energy per litre fuel (kWh/L), the amount of vehicles in use, and the share (%) of vehicles mounting replacement tyres. The part of this fuel consumption that is due to the rolling resistance of tyres is determined by further multiplying by the average RRC (kg/t) in a given year and by the relative impact of the RRC on fuel consumption (%/(kg/t)).
Dividing the latter result by the number of replacement tyres in use, and by the RRC, the annual fuel consumption due to tyres is obtained, per tyre and per kg/t RRC (kWh fuel/a/tyre/(kg/t RRC)).
For year 2010 the values are 26 for C1 (car) tyres, 50 for C2 (van) and 561 for C3 (truck).



TYRE EFFICIENCY

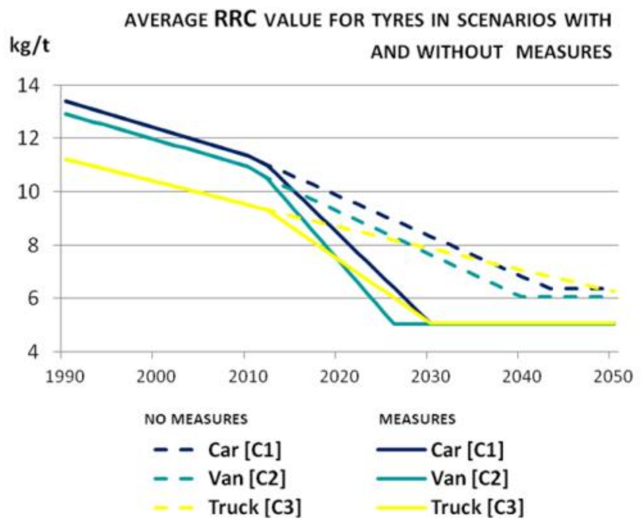
The "Rolling Resistance Coefficient" (RRC) is the resisting force by tyres (rolling friction) on a vehicle in motion related to its weight, expressed in kilograms resistance per ton of vehicle weight (kg/t). A lower value indicates a more energy efficient tyre. The RRC has been improving since 1990, but the labelling regulation accelerated the pace.

In 2012, the average car tyre (C1) had an RRC value of 11.02 kg/t, expected to drop to 8.33 kg/t (without measures) or to 5.06 (with measures, -39%) by 2030.

For van tyres (C2) the values are 10.53 kg/t (2012), 7.65 kg/t (2030 without measures) and 5.03 kg/t (2030 with measures, -34%).

For truck tyres (C3) the values are 9.32 kg/t (2012), 7.87 kg/t (2030 without measures) and 5.07 kg/t (2030 with measures, -36%).

Applying the current labelling scheme to these values, this means that tyres are expected to improve from class F (car tyres) and E (van and truck tyres) in 2012 to classes C (car and truck tyres) and B (van tyres) in 2030.

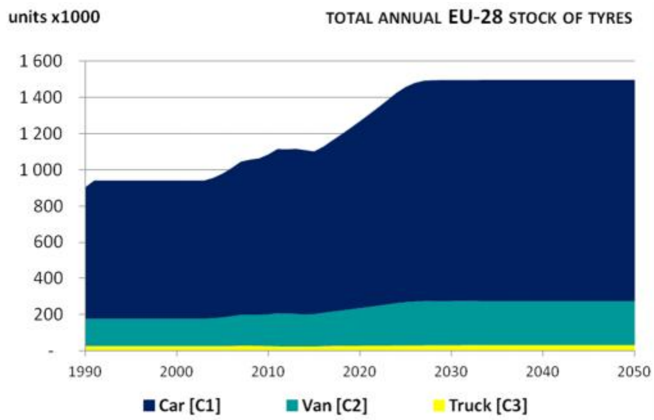


MOTOR EFFICIENCY

In parallel to the tyre efficiency, also the motor efficiency increases. Improvements on the tyres are less important if motor efficiency is higher. Therefore EIA considers a correction factor for the expected increase in motor efficiency. The factor is 1 for year 2010, and expected to be 0.82 in 2030, for all motor types.

STOCK

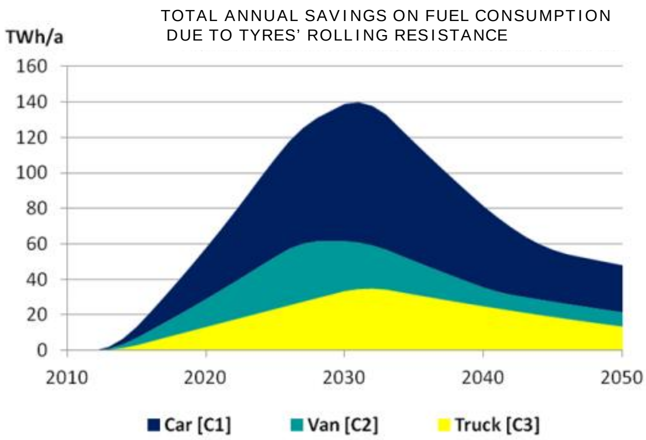
After light sources, 'Tyres' are the largest product group in EIA in terms of units in use. In 2015 there were 1.1 billion units 'installed', of which 81.5% car tyres (C1), 16.5% van tyres (C2) and 2% truck tyres (C3). In 2030, this is expected to increase to 1.5 billion units (+36%).



SAVINGS

The annual fuel consumption related to the rolling resistance of tyres was 492 TWh/a in 2010, before the introduction of measures. By 2030 this was expected to become 405 TWh/a in absence of measures. The labelling regulation is projected to reduce this to 266 TWh/a (-139 TWh, -34%).

These savings correspond to 37 $MtCO_2eq$/a lower GHG-emissions in 2030 and will save EU consumers 34 bn euros in tyre-related expenses in that year.



Annex: Key facts summary tables

WH dedicated Water Heater	unit	1990	2010			2020			2030		
Sales volume	'000	9,855	10,918			11,398			11,878		
Stock of units in use	'000	136,218	158,079			166,018			173,129		
Effective heat output per unit	kWh/a	1,392	1,524			1,629			1,735		
EU effective heat output	TWh heat/a	190	241			270			300		
EU hot water (60 °C) use	M m³/a	3,251	4,130			4,636			5,150		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	722	801	801	0	825	647	-177	828	535	-293
o/w electricity	TWh elec/a	225	250	250	0	257	202	-55	258	167	-91
o/w fuel	TWh fuel/a	159	176	176	0	181	142	-39	182	118	-64
GWP emissions	$MtCO_2/a$	146	140	140	0	136	107	-29	127	82	-45
Total expenditure	bn €	58	64	64	0	91	79	-12	130	94	-35
Revenue Total	bn €	9.2	11	11	0	12	16	4	12	17	4.6
Jobs Total	'000 jobs	110	131	131	0	139	195	56	151	216	65

CHC Central Heating combi, water heating	unit	1990	2010			2020			2030		
Sales	'000	3,624	6,065			6,946			7,826		
Stock	'000	42,753	82,237			95,497			108,145		
Effective heat output per unit	kWh/a	2,492	2,293			2,340			2,400		
EU effective heat output	TWh heat/a	107	189			223			260		
EU hot water (60 °C) use	M m³/a	1,826	3,233			3,831			4,450		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	259	416	416	0	460	387	-74	514	340	-173
o/w electricity	TWh elec/a	2	3	3	0	4	3	-1	4	3	-1
o/w fuel	TWh fuel/a	254	408	408	0	451	379	-72	503	333	-170
GWP emissions	$MtCO_2/a$	55	88	88	0	97	82	-16	108	72	-37
Total expenditure	bn €	16	32	32	0	51	50	0	78	63	-14
Revenue Total	bn €	4.4	7.9	7.9	0.0	9.4	14.8	5.4	10.1	17	7.2
Jobs Total	'000 jobs	57	102	102	0	122	198	76	131	232	102

CH Central Heating boiler, space heating	unit	1990	2010			2020			2030		
Sales	'000	4,802	6,987			7,951			9,508		
Stock	'000	69,520	111,531			128,929			148,980		
Effective heat output per unit	kWh/a	16,830	11,760			9,188			7,301		
EU effective heat output	TWh heat/a	1,170	1,312			1,185			1,088		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	2467	2318	2265	-53	1960	1492	-467	1796	1030	-766
o/w electricity	TWh elec/a	102	126	123	-3	121	115	-7	120	117	-3
o/w fuel	TWh fuel/a	2213	2004	1957	-47	1656	1206	-450	1496	738	-759
GWP emissions	$MtCO_2/a$	521	477	466	-11	398	300	-98	359	196	-162
Total expenditure	bn €	143	178	176	-2	227	219	-8	298	253	-44
Revenue Total	bn €	28	43	44	1	50	78	29	58	106	48
Jobs Total	'000 jobs	354	533	546	13	610	1019	409	720	1397	676

SFB Solid Fuel Boilers	unit	1990	2010			2020			2030		
Sales	'000	294	438			362			365		
Stock	'000	8,906	5,292			6,633			6,636		
Effective heat output per unit	kWh/a	15,978	17,973			16,882			15,576		
EU effective heat output	TWh heat/a	142	95			112			103		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	454	168	168	0	170	167	-3	144	138	-6
o/w fuel	TWh fuel/a	454	168	168	0	170	167	-3	144	138	-6
GWP emissions	$MtCO_2/a$	49	15	15	0	9	9	0	5	4	-0.2
Total expenditure	bn €	12	8	8	0	12	12	0	15	15	-0.1
Revenue Total	bn €	1.5	2.6	2.6	0.0	2.6	2.7	0.2	2.8	3.0	0.3
Jobs Total	'000 jobs	23	42	42	0	42	45	3	46	50	4

AHC central Air Cooling	**unit**	**1990**	**2010**			**2020**			**2030**		
Sales, Total Central Air Cooling	'000	146	595			697			769		
Stock comfort chillers & reversibles	'000	1735	7538			9957			11380		
	Scenario	**BAU**	**BAU**	**ECO**	**inc**	**BAU**	**ECO**	**inc**	**BAU**	**ECO**	**inc**
Primary energy	TWh prim/a	204	380	380	0	435	426	-9	438	404	-34
o/w electricity	*TWh elec/a*	*82*	*152*	*152*	*0*	*174*	*170*	*-4*	*175*	*162*	*-14*
o/w fuel	*TWh fuel/a*	*0.0*	*0.1*	*0.1*	*0.0*	*0.3*	*0.2*	*0.0*	*0.3*	*0.2*	*-0.1*
GWP emissions	$MtCO_2/a$	42	70	70	0	77	76	-1	73	69	-4.7
o/w from energy	*$MtCO_2/a$*	*40*	*59*	*59*	*0*	*60*	*59*	*-1*	*52*	*47*	*-4.7*
o/w from refrigerant loss	*$MtCO_2/a$*	*2*	*11*	*11*	*0*	*17*	*17*	*0*	*21*	*21*	*0.0*
Total expenditure	bn €	12	28	28	0	43	43	-1	61	58	-3.0
Revenue Total	bn €	3	12	12	0	17	17	0	22	22	0.0
Jobs Total	'000 jobs	35	160	160	0	228	228	0	292	292	0.0

AHC central Air Heating	**unit**	**1990**	**2010**			**2020**			**2030**		
Sales air heaters & rev. ACs	'000	210	426			486			507		
Stock	'000	2,459	5,706			6,710			7,373		
	Scenario	**BAU**	**BAU**	**ECO**	**inc**	**BAU**	**ECO**	**inc**	**BAU**	**ECO**	**inc**
Primary energy	TWh prim/a	260	291	291	0	259	252	-7	226	204	-22
o/w electricity	TWh elec/a	18	52	52	0	56	55	-1	54	50	-4
o/w fuel	TWh fuel/a	215	161	161	0	119	115	-4	92	79	-13
GWP emissions from energy	$MtCO_2/a$	55	58	58	0	51	50	-1	44	40	-4.0
Total expenditure (excl. acq & maint rev AC)	bn €	8	12	12	0	17	16	0	21	19	-2.0
Revenue Total	bn €	0.79	0.56	0.56	0.00	0.49	0.53	0.04	0.44	0.47	0.03
Jobs Total	'000 jobs	11	8	8	0	7	7	1	6	7	0.5

LH Local Heaters	**unit**	**1990**	**2010**			**2020**			**2030**		
Sales	'000	19,103	24,464			26,492			28,534		
Stock	'000	208,872	267,511			300,212			331,013		
	Scenario	**BAU**	**BAU**	**ECO**	**inc**	**BAU**	**ECO**	**inc**	**BAU**	**ECO**	**inc**
Primary energy	TWh prim/a	575	603	603	0	622	590	-32	635	581	-54
o/w electricity	TWh elec/a	169	168	168	0	165	154	-11	163	149	-14
o/w fuel	TWh fuel/a	152	182	182	0	209	205	-4	226	208	-18
GWP emissions from energy	$MtCO_2/a$	104	84	84	0	77	73	-5	69	63	-6
Total expenditure	bn €	43	50	50	0	71	70	-1	99	94	-5
Revenue Total	bn €	7.8	12.4	12	0.0	15.3	16.7	1.4	16.7	18	1.5
Jobs Total	'000 jobs	116	185	185	0	227	249	21	246	270	24

RAC Room Air Conditioner	**unit**	**1990**	**2010**			**2020**			**2030**		
Sales	'000	394	4,705			9,089			10,359		
Stock	'000	4,730	49,470			82,524			117,785		
	Scenario	**BAU**	**BAU**	**ECO**	**inc**	**BAU**	**ECO**	**inc**	**BAU**	**ECO**	**inc**
Primary energy (100% elec)	TWh prim/a	10.8	102	102	0	165	143	-22	217	181	-37
Electricity total	TWh elec/a	4.3	41	41	0	66	57	-9	87	72	-15
o/w electricity cooling	TWh elec/a	2.5	18	18	0	25	21	-4	34	27	-7
o/w electricity heating	TWh elec/a	1.8	22	22	0	41	36	-5	53	45	-8
GWP emissions	$MtCO_2/a$	2.5	20	20	0.0	31	27	-3	38	33	-5.0
o/w from electricity cooling	$MtCO_2/a$	1.3	7.6	7.6	0.0	9.6	8.1	-1.5	11.6	9.3	-2.3
o/w from electricity heating	$MtCO_2/a$	0.9	9.1	9.1	0.0	15.5	13.6	-1.9	18.0	15.3	-2.7
o/w from refrigerant loss	$MtCO_2/a$	0.3	3.4	3.4	0.0	5.7	5.7	0.0	8.1	8.1	0.0
Total expenditure	bn €	1	15	15	0	32	32	0	48	45	-2.5
Revenue Total	bn €	0.7	8.2	8.2	0.0	15.6	17.1	1.5	17.7	19.6	1.9
Jobs Total	'000 jobs	9	106	106	0	203	223	20	228	254	25

CIRC Circulator pumps <2.5 kW	**unit**	**1990**	**2010**			**2020**			**2030**		
Sales	'000	5,502	8,065			9,120			9,542		
Stock	'000	50,049	75,601			86,455			95,108		
	Scenario	**BAU**	**BAU**	**ECO**	**inc**	**BAU**	**ECO**	**inc**	**BAU**	**ECO**	**inc**
Primary energy	TWh prim/a	40	52	51	-2	55	27	-28	59	27	-33
o/w electricity	TWh elec/a	16	21	20	-0.6	22	11	-11	24	11	-13
GWP emissions	$MtCO_2/a$	8	9	8.3	-0.3	8	4	-4	8	3.6	-4.4
Total expenditure	bn €	3	4	4.2	0	6	4	-1	8	5.0	-3.0
Revenue Total	bn €	1.1	1.6	1.8	0.1	1.9	2.3	0.5	1.9	2.2	0.3
Jobs Total	'000 jobs	19	28	31	2	32	40	8	33	38	4

VU Ventilation Units (res & nonres)	unit	1990	2010			2020			2030		
Sales	'000	1,315	3,212			3,660			4,492		
Stock	'000	19,456	43,634			56,423			65,933		
Annual ventilation per unit	1000m3/a	1,555	1,555			1,555			1,555		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy (elec. & heat)	TWh prim/a	67	194	194	0	239	123	-116	256	43	-213
o/w electricity	TWh elec/a	27	78	78	0	96	85	-11	102	77	-25
o/w fuel for space heating (heat savings vs. BAU-VU)	TWh prim/a	0	0	0	0	0	-89	-89	0	-149	-149
GWP emissions (from electricity)	$MtCO_2/a$	13	32	32	0	36	32	-4	35	26	-8.7
Total expenditure	bn €	29	49	49	0	22	8	-13	-20	-71	-51
Revenue Total	bn €	32	77	77	0	86	89	2	97	99	2
Jobs Total	'000 jobs	429	1020	1020	0	1150	1181	31	1289	1320	31

LS Light Sources	unit	1990	2010			2020			2030		
		BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Sales	m	2,122	2,712	2,365	-346	2,464	1,769	-695	1,626	670	-956
Stock	m	5,554	10,255	10,011	-244	12,493	12,136	-357	14,057	13,954	-103
EU output capacity	Tlm	5	10	10	0	13	13	0	14	15	1
EU operating hours total	Th/a	5	9	9	0	11	11	0	13	13	0
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	661	1047	1017	-29	943	661	-282	729	373	-356
o/w electricity	TWh elec/a	265	419	407	-12	377	264	-113	292	149	-142
GWP emissions	$MtCO_2/a$	132	172	165	-7	143	100	-43	99	51	-48
Total expenditure	bn €	35	54	52	-2	69	47	-22	72	33	-40
Revenue Total	bn €	4.6	11	11	0	11	11	0	8.3	3.4	-4.8
Jobs Total	'000 jobs	82	188	192	3	196	187	-9	147	61	-86

DP electronic DisPlays	unit	1990	2010			2020			2030		
Sales	'000	36,180	93,465			87,144			101,073		
Stock	'000	229,140	570,840			578,337			699,904		
Viewable area per TV	dm^2	10	28			53			72		
Viewable area per monitor	dm^2	5	11			16			20		
EU total viewable area	km^2	22	131			272			451		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	81	254	255	0.57	156	88	-68	180	55	-125
o/w electricity	TWh elec/a	32	102	102	0.23	62	35	-27	72	22	-50
GWP emissions	$MtCO_2/a$	16	42	42	0.09	24	13	-10	24	7	-17
Total expenditure	bn €	18	46	46	0.02	46	41	-4	59	48	-12
Revenue Total	bn €	11	30	30	0.00	30	30	0	35	35	0
Jobs Total	'000 jobs	200	519	519	0.00	523	523	0	615	615	0

STB Set Top Boxes	unit	1990	2010			2020			2030		
Sales	'000	0	60,049			44,117			43,501		
Stock	'000	0	178,589			219,581			216,233		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	0	26	22	-3.5	48	37	-11	48	37	-11
o/w electricity	TWh elec/a	0	10	9	-1.4	19	15	-4	19	15	-4.4
GWP emissions	$MtCO_2/a$	0	4.2	3.7	-0.6	7.3	5.6	-1.7	6.5	5.0	-1.5
Total expenditure	bn €	0	8	8	0	11	10	-1	13	12	-1.6
Revenue Total	bn €	0.0	5.4	5.4	0.0	5.6	5.6	0.0	5.5	5.5	0.0
Jobs Total	'000 jobs	0	81	81	0	85	85	0	83	83	0

VIDEO	unit	1990	2010			2020			2030		
Sales	'000	69	55,248			16,225			13,622		
Stock	'000	129	218,055			125,735			82,154		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	0	22	22	0.000	32	29	-3	35	33	-2.7
o/w electricity	TWh elec/a	0	8.9	8.9	0.000	13	12	-1.1	14	13	-1.1
GWP emissions	$MtCO_2/a$	0.0	3.6	3.6	0.000	4.8	4.4	-0.4	4.8	4.4	-0.4
Total expenditure	bn €	0	14	14	0.000	9	8	-0.3	10	10	-0.4
Revenue Total	bn €	0.1	12	12	0.000	5.1	5.1	0.0	4.1	4.1	0.0
Jobs Total	'000 jobs	1	195	195	0.000	83	83	0	71	71	0.0

ES Enterprise Servers	unit	1990	2010			2020			2030		
Sales	'000	108	2,590			3,343			5,044		
Stock	'000	413	12,077			15,443			22,735		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	2	62	62	0	77	68	-10	112	79	-33
o/w electricity	TWh elec/a	1	25	25	0	31	27	-4	45	32	-13
GWP emissions	$MtCO_2/a$	0	10	10	0	12	10	-1	15	11	-5
Total expenditure	bn €	1	16	16	0	21	21	0	34	32	-2
Revenue Total	bn €	0.9	13.7	13.7	0.0	16.9	17.3	0.4	24.0	24.9	0.8
Jobs Total	'000 jobs	15	233	233	0	287	294	7	408	423	15

PC Personal Computers	unit	1990	2010			2020			2030		
Sales	'000	7,350	64,225			130,650			183,413		
Stock	'000	29,570	243,949			485,415			735,158		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	36	76	76	0	20	20	0	14	14	0
o/w electricity	TWh elec/a	15	31	31	0	8	8	0	6	6	0
GWP emissions	$MtCO_2/a$	7	13	13	0	3	3	0	2	2	0
Total expenditure	bn €	6	45	45	0	67	67	0	91	91	0
Revenue Total	bn €	3	36	36	0	56	56	0	76	76	0
Jobs Total	'000 jobs	61	626	626	0	976	976	0	1328	1328	0

EP & IJ imaging equipment	unit	1990	2010			2020			2030		
Sales	'000	17,000	31,674			36,876			40,765		
Stock	'000	64,383	123,216			145,858			160,574		
EU output images per year (ipy)	bn ipy	722	767			856			932		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy for electricity	TWh prim/a	56	19	13	-5.3	20	7	-13	23	7.3	-16
o/w electricity	TWh elec/a	22	7.4	5.3	-2.1	8.0	2.6	-5.4	9.2	2.9	-6.3
Primary energy for paper (toner negligible)	TWh prim/a	25	26	25	-1	29	25	-4	32	27	-4.9
GWP emissions	$MtCO_2/a$	13	4.5	3.5	-0.9	4.6	2.3	-2.3	4.8	2.4	-2.4
o/w GWP energy	$MtCO_2/a$	11	3	2.2	-0.9	3.0	1.0	-2.0	3.1	1.0	-2.1
o/w GWP paper production	$MtCO_2/a$	1.3	1.4	1.4	0.0	1.6	1.3	-0.2	1.7	1.5	-0.3
Paper resources (1 kg=200 sheets)	Mt/a	2.2	2.4	2.3	-0.1	2.6	2.2	-0.4	2.9	2.4	-0.4
Consumable resources	bn €	30	31	31	0	35	34	-1	38	37	-1.1
o/w paper	bn €	5.3	5.7	5.5	-0.2	6.3	5.3	-1.0	6.9	5.8	-1.1
o/w toner	bn €	24	26	26	0	29	29	0	31	31	0.0
Total expenditure	bn €	38	39	38	0	46	44	-2	52	49	-2.7
Revenue Total	bn €	5.3	6.0	6.0	0.0	8.8	8.8	0.0	10	10	0.0
Jobs Total	'000 jobs	94	106	106	0	156	156	0	181	181	0.0

SB (networked) Stand-By (rest)	unit	1990	2010			2020			2030		
Sales	'000	10,481	67,927			97,703			121,048		
Stock	'000	29,461	363,710			542,212			667,320		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	4	47	47	0.0	65	63	-1.3	63	62	-0.6
o/w electricity	TWh elec/a	2	19	19	0.0	26	25	-0.5	25	25	-0.2
GWP emissions	$MtCO_2/a$	1	7.7	7.7	0.0	10	10	-0.2	8.6	8.5	-0.1
Total expenditure	bn €	1.2	12.4	12.4	0.0	19.8	19.7	-0.1	26.4	26.3	-0.1
Revenue Total	bn €	1.0	8.7	8.7	0.0	13.0	13.0	0.0	16.8	17	0.0
Jobs Total	'000 jobs	16	135	135	0.0	201	201	0.0	258	258	0.0

BC Battery Charged devices	unit	1990	2010			2020			2030		
Sales	'000	24,886	335,000			335,000			335,000		
Stock	'000	61,736	1,005,000			1,005,000			1,005,000		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	1	8.9	7.9	-1.0	8.1	6.6	-1.5	7.4	6.6	-0.8
o/w electricity	TWh elec/a	0	3.6	3.2	-0.4	3.3	2.6	-0.6	3.0	2.6	-0.3
GWP emissions	$MtCO_2/a$	0.1	1.5	1.3	-0.2	1.2	1.0	-0.2	1.0	0.9	-0.1
Energy Cost	bn €	0.03	0.4	0.3	-0.04	0.5	0.4	-0.1	0.7	0.6	-0.1

UPS Total	unit	1990	2010			2020			2030		
Sales	'000	728	1,441			1,823			2,463		
Stock	'000	3,425	7,392			8,840			12,199		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	14	31	31	0	36	25	-11	48	15	-34
o/w electricity	TWh elec/a	6	12	12	0	14	10	-4	19	6	-13
GWP emissions	$MtCO_2/a$	2.8	5.0	5.0	0.0	5.4	3.7	-1.7	6.5	2.0	-4.6
Total expenditure	bn €	1.5	3.0	3.0	0.0	4.3	3.6	-0.7	7.1	4.2	-3.0
Revenue Total	bn €	0.8	1.7	1.7	0.0	2.1	2.1	0.0	2.9	2.9	0.00
Jobs Total	'000 jobs	12	25	25	0.0	31	31	0	42	42	0.00

RF Household Refrigeration	unit	1990	2010			2020			2030		
Sales	'000	17,588	19,196			19,799			20,402		
Stock	'000	269,340	299,289			309,540			319,188		
EU freezer net volume RF	Mm^3 @ -18C°	12	17			20			24		
EU refrigerator net volume RF	Mm^3 @ 5C°	43	60			72			84		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	344	347	260	-87	348	180	-168	347	129	-218
o/w electricity	TWh elec/a	138	139	104	-35	139	72	-67	139	52	-87
GWP emissions	$MtCO_2/a$	69	57	43	-14	53	27	-26	47	18	-30
Total expenditure	bn €	32	32	27	-5	43	28	-15	60	30	-30
Revenue Total	bn €	6.2	6.7	7.8	1.1	6.9	8.8	1.9	7.2	9.1	2
Jobs Total	'000 jobs	110	120	139	19	124	157	33	128	162	34

CF Commercial Refrigeration	unit	1990	2010			2020			2030		
Sales	'000	1,474	1,726			1,785			1,908		
Stock	'000	12,960	15,700			16,266			17,376		
EU freezer net volume CF	M m3 @ -18/-15°C	2			2			2			2
EU refrigerator net volume CF	M m3 @ -1/+7°C	8			10			11			11
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	170	168	168	0	149	133	-16	150	102	-47
o/w electricity	TWh elec/a	68	67	67	0	60	53	-6	60	41	-19
GWP emissions	$MtCO_2/a$	48	45	45	0	42	40	-2	41	35	-6.4
Total expenditure	bn €	11	11	11	0	13	12	-1	17	13	-4.0
Revenue Total	bn €	3.3	3.8	3.8	0.0	3.9	4.2	0.3	4.2	4.3	0.1
Jobs Total	'000 jobs	44	50	50	0	52	56	4	55	57	2

Professional refrigeration	unit	1990	2010			2020			2030		
Sales	'000	1,108	1,035			1,134			1,289		
Stock	'000	9,173	8,758			9,137			10,349		
EU freezer net volume Storage cabinets	Mm^3 @-18C°	0.36	0.49			0.54			0.59		
EU refrigerator net volume Storage cabinets	Mm^3 @ 5C°	0.85	1.18			1.29			1.41		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy*	TWh prim/a	148	188	188	0	224	214	-9	267	238	-28
o/w electricity *	TWh elec/a	59	75	75	0	89	86	-4	107	95	-11
GWP emissions *	$MtCO_2/a$	33	34	34	0	37	35	-1	40	36	-3.9
o/w due to refrigerant leakage	$MtCO_2/a$	3	3	3	0	3	3	0	3	3	0.0
Total expenditure *	bn €	8	9	9.2	0	15	14	0	25	23	-2.5
Revenue Total	bn €	1.2	1.3	1.3	0.0	1.5	1.6	0.1	1.7	1.7	0
Jobs Total	'000 jobs	19	22	22	0	25	26	1	28	28	0

* Condensing Units double counting excluded

CA Cooking Appliances	unit	1990	2010			2020			2030		
Sales	'000	32,107	36,324			40,126			42,102		
Stock	'000	509,084	562,989			608,154			655,889		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	184	207	207	0	216	212	-3	229	214	-15
o/w electricity	TWh elec/a	54	67	67	0	72	71	-1	79	74	-5
o/w fuel	TWh fuel/a	49	39	39	0	35	35	0	31	30	-1.6
GWP emissions	$MtCO_2/a$	37	35	35	0	34	34	-1	33	31	-2.1
Total expenditure	bn €	24	29	29	0	37	38	1	49	48	-0.9
Revenue Total	bn €	10	13	13	0	15	16	1	15	16	0.9
Jobs Total	'000 jobs	184	239	239	0	260	278	18	263	279	16

CM household Coffee Makers	unit	1990	2010			2020			2030		
Sales	'000	22,138	26,262			27,365			29,045		
Stock	'000	127,442	156,621			162,465			171,709		
EU cups of coffee drunk in households	bn cups/a	279	343			356			376		
EU volume of coffee drunk in households	Mm^3/a	0.037	0.043			0.042			0.044		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	28	27	27	0	24	20	-4	24	20	-4.4
o/w electricity	TWh elec/a	11	11	11	0	10	8	-2	10	8	-1.8
o/w fuel	TWh fuel/a	0	0	0.0	0	0	0	0	0	0	0.0
GWP emissions	MtCO$_2$/a	6	4	4	0.0	4	3	-0.6	3	3	-0.6
Total expenditure	bn €	3	3	3	0.0	5	4	-0.4	6	6	-0.6
Revenue Total	bn €	0.7	1.4	1.4	0.0	1.9	2.0	0.0	2.2	2.2	0.0
Jobs Total	'000 jobs	13	25	25	0	35	35	0	39	39	0.1

WM household Washing Machine	unit	1990	2010			2020			2030		
Sales	'000	9,045	13,164			14,151			13,585		
Stock	'000	121,605	186,757			201,809			205,768		
EU weight of laundry washed	Mt laundry/a	83	132			140			143		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	132	110	87	-24	99	59	-40	84	42	-42
o/w electricity	TWh elec/a	53	44	35	-9.5	40	24	-16	34	17	-17
GWP emissions	MtCO$_2$/a	26	18	14	-3.9	15	9	-6	11	5.7	-5.8
Total expenditure	bn €	24	31	25	-6.4	39	26	-14	49	26	-22
Revenue Total	bn €	3.4	5.2	5.9	0.7	5.4	6.8	1.4	5.1	6.1	1.0
Jobs Total	'000 jobs	60	93	106	13	96	121	24	91	108	18

DW Household Dishwashers	unit	1990	2010			2020			2030		
Sales	'000	3,216	7,034			9,280			11,524		
Stock	'000	36,816	83,213			115,611			149,295		
EU place settings (ps) washed	bn ps/a	52	154			225			291		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	32	58	46	-11	76	54	-22	93	63	-30
o/w electricity	TWh elec/a	13	23	19	-4.6	30	22	-9	37	25	-12
GWP emissions	MtCO$_2$/a	6	9.5	7.6	-1.9	11.6	8.3	-3.3	13	8.6	-4.1
Total expenditure	bn €	5	11	11	0	18	15	-2	28	22	-6.2
Revenue Total	bn €	1.4	3.2	4.2	1.0	4.2	5.4	1.3	5.2	6.4	1.2
Jobs Total	'000 jobs	26	57	75	18	75	97	22	93	114	22

LD household Laundry Drier	unit	1990	2010			2020			2030		
Sales	'000	2,783	5,268			5,932			6,103		
Stock	'000	23,505	63,037			72,160			78,167		
EU laundry dried	Mt laundry/a	13	47			60			65		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	25	63	63	0	81	72	-9	87	65	-22
o/w electricity	TWh elec/a	10	25	25	0	32	29	-4	35	26	-8.7
GWP emissions	MtCO$_2$/a	5	10	10	0	12	11	-1	12	8.9	-3.0
Total expenditure	bn €	3	7	6.9	0	11	11	-1	16	13	-2.9
Revenue Total	bn €	1.1	2.2	2.2	0.0	2.5	2.8	0.3	2.6	2.8	0.2
Jobs Total	'000 jobs	19	39	39	0	45	50	5	46	50	4.1

VC Vacuum Cleaners	unit	1990	2010			2020			2030		
Sales	'000	17,856	54,409			92,069			111,083		
Stock	'000	157,518	366,047			421,504			547,904		
EU surface vacuumed	1000 km^2/a	913	1,182			1,281			1,381		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	33	54	54	0	74	35	-39	115	40	-74
o/w electricity	TWh elec/a	13	22	22	0	30	14	-16	46	16	-30
GWP emissions	MtCO$_2$/a	7	9	8.8	0	11	5	-6	16	5.5	-10
Total expenditure	bn €	8.3	18	18	0	30	27	-3	43	33	-11
Revenue Total	bn €	4	11	11	0	17	18	0	21	21	0
Jobs Total	'000 jobs	71	186	186	0	310	319	9	373	373	0

FAN Industrial Fans >125W	unit	1990	2010			2020			2030		
Sales	'000	4,837	14,928			18,275			18,584		
Stock	'000	72,551	188,329			241,065			272,904		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	131	329	329	0	421	383	-39	482	396	-85
o/w electricity	TWh elec/a	53	132	132	0	168	153	-15	193	159	-34
GWP emissions	$MtCO_2/a$	26	54	54	0	64	58	-6	66	54	-12
Total expenditure	bn €	8	18	18	0	30	29	-1	48	41	-6.5
Revenue Total	bn €	1.3	3.8	3.8	0.0	4.7	6.0	1.3	5.0	6.0	1.0
Jobs Total	'000 jobs	19	54	54	0	67	87	21	70	86	16

MT Motors 0.75-375 kW	unit	1990	2010			2020			2030		
Sales	'000	6,753	9,949			10,904			10,904		
Stock	'000	72,643	107,000			124,553			130,755		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	2044	2810	2807	-3	3147	2794	-353	3263	2740	-523
o/w electricity	TWh elec/a	818	1124	1123	-1	1259	1118	-141	1305	1096	-209
GWP emissions	$MtCO_2/a$	409	461	460	-0.5	478	425	-54	444	373	-71
Total expenditure	bn €	99	120	120	0.2	190	174	-16	290	248	-42
Revenue Total	bn €	1.6	2.4	2.7	0.3	2.7	7.4	4.7	2.7	6.9	4.2
Jobs Total	'000 jobs	4	6	7	1	7	53	46	7	49	42

WP Water pumps	unit	1990	2010			2020			2030		
Sales	'000	1,233	1,675			1,935			2,225		
Stock	'000	12,589	17,135			19,830			22,884		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	220	296	295	-0.3	342	334	-8	395	384	-11
o/w electricity	TWh elec/a	88	118	118	-0.1	137	134	-3	158	153	-4.5
GWP emissions	$MtCO_2/a$	44	49	48	-0.1	52	51	-1	54	52	-1.5
Total expenditure	bn €	13	16	16	-0.01	25	24	0	40	39	-1.0
Revenue Total	bn €	2.8	3.8	3.8	0.001	4	4	0	5.1	5.1	0.0
Jobs Total	'000 jobs	35	48	48	0.0	55	55	0	64	64	0.0

CP Standard Air Compressors	unit	1990	2010			2020			2030		
Sales	'000	101	106			113			121		
Stock	'000	685	1,167			1,141			1,229		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	63	147	147	0.0	143	141	-2	150	146	-4.2
o/w electricity	TWh elec/a	25	59	59	0.0	57	56	-1	60	58	-1.7
GWP emissions	$MtCO_2/a$	13	24	24	0.0	22	21	0	20	20	-0.6
Total expenditure	bn €	4	8	7.7	0.0	10	10	0	15	15	-0.3
Revenue Total	bn €	1	2	1.5	0.0	2	2	0	2	1.9	0.1
Jobs Total	'000 jobs	14	21	21	0.0	23	25	0	26	27	0.4

TRAFO Utility Transformers	unit	1990	2010			2020			2030		
Sales	'000	122	177			205			252		
Stock	'000	2,734	4,118			4,998			6,039		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	151	246	246	0.00	315	299	-16	405	358	-47
o/w electricity	TWh elec/a	60	98	98	0.00	126	120	-6	162	143	-19
GWP emissions	$MtCO_2/a$	30	40	40	0.00	48	45	-2	55	49	-6.4
Total expenditure	bn €	10	15	15	0.00	24	24	0	43	40	-3.1
Revenue Total	bn €	2.8	4.6	4.6	0.0	5.5	6.2	0.7	7.0	8.0	1.0
Jobs Total	'000 jobs	50	82	82	0.00	99	111	12	126	145	18

TYRE Replacement Tyres	unit	1990	2010			2020			2030		
Sales	m	232	285			328			369		
Stock	m	903	1,085			1,268			1,495		
	Scenario	BAU	BAU	ECO	inc	BAU	ECO	inc	BAU	ECO	inc
Primary energy	TWh prim/a	597	492	492	0	450	392	-58	405	266	-139
GWP emissions	$MtCO_2/a$	158	130	130	0	119	104	-15	107	70	-37
Total expenditure	bn €	59	76	76	0	106	97	-9	136	102	-34
Revenue Total	bn €	19	22	22	0	25	26	1	29	30	2
Jobs Total	'000 jobs	292	345	345	0	399	409	10	450	480	30