Topten Product Criteria Paper on

Room Air Conditioners

Revised by Tobias Schleicher, Oeko-Institute e.V., April 2013

Revision based on the criteria paper of 11.2011 from
Cyrielle Mignard, ADEME, Anne Lefranc, ADEME, Sophie Attali, SOWATT, Anette Michel, Bush Energie

Co-funded by the Intelligent Energy Europe Programme of the European Union

Coordinated by

The Project in brief

Topten is part of the international Euro-Topten-Max initiative supported by the European programme Intelligent Energy Europe and several national institutions (energy agencies, WWF, consumer associations, research institutes). On global level, Topten is coordinated by TIG, the Topten International Group. This association promotes to the Topten Charter, TIG statutes and Rules of Procedure (www.topten.eu).

Topten is a service that supports the market for energy efficient products. It aims at making energy efficient products the first choice for consumers, by offering them a user-friendly tool for product comparison and selection. The key element is an online information platform for consumers presenting the most energy efficient appliances currently available in various product categories, including household appliances, office equipment, consumer electronics and cars. Information on energy consumption and performance of products as well as several other characteristics (i.e. brand, model, price, picture) is provided. Product data is based on labels and standardized declarations as well as tests from accepted well-known institutions. The service is independent of manufacturers and retailers.

Consortium

The project is co-ordinated by the Agence de l'Environnement et de la Maitrise de l'Energie (ADEME). The other 20 project partners are:

Project Partner	Country
Austria : Austrian Energy Agency	AT
Belgium: Bond Beter Leefmilieu Vlaanderen vzw,	BE
Croatia; REGEA,	HR
Czech Republic: SEVEn, o.p.s	CZ
Finland: Motiva Oy	FI
France, Guide Topten	FR
Germany: Oeko-Institut e.V.	DE
Germany: Wuppertal Institute	DE
Germany: ICLEI, European Secretariat	DE
Greece: WWF Greece	GR
Italy: WWF Italia Onlus	IT
Lithuania: LNCF, consumer federation	LT
Luxemburg: Oeko-Zenter, asbl	LU
Norway: Norges Naturvernforbund	NO
Poland: FEWE Polish Foundation for Energy Efficiency	PL
Portugal: Quercus	PT
Romania: ICEMENERG	RO
Spain: ADENA / WWF	ES
Sweden : Swedish Society for Nature Conservation,	SE
United Kingdom; Waste Watch	UK

Contact

Therese Kreitz (project leader)
500-Route des Lucioles –
06560 VALBONNE
, France
+33.(0)4.9395.7984
therese.kreitz@ademe.fr

Sophie Attali
SOWATT
45 rue Bichat
75010
+331 8394 8209
sattali@sowatt.net

Dr. Eric Bush
Rebweg 4
7012 Felsberg
Schweiz
+41 81 252 63 64
info@topten.info

Tobias Schleicher
Öko-Institut e.V.
Merzhauserstraße 173
79100 Freiburg
Deutschland
+49 761 45295 277
t.schleicher@oeko.de

Criteria Paper for Room Air Conditioners

Contents

1. Introduction 5

2. Product Definition 6

2.1. Product Category 6

2.2. Product Types 7

2.3. Best Available Technology 11

2.4. Legislations and Labels 12

2.4.1. Definitions 12

2.4.2. International 13

2.4.3. Europe 19

3. Test Standards 24

3.1. Tests standards in Europe 24

3.2. Test standards in other countries 24

4. Economic and Market Analysis 27

4.1. Market and Stock data 27

4.2. Manufacturers and Distributors 32

5. Topten Selection Criteria 33

5.1. Euro-Topten selection criteria 33

5.1.1. Input for possible revision of criteria 33

5.2. National Topten selection criteria 34

5.3. Topten product features 35

6. Additional Considerations 36

7. Bibliography 37

1. Introduction

The criteria papers are meant to help the national partners to collect and analyse data about a product and establish a national Topten selection. Once these selections are on-line, consumer oriented information on very efficient products will be available and published. Appropriate selection criteria and respective technical specifications are a crucial precondition for meaningful and well accepted Topten websites. The purpose of this criteria paper is to provide a common basis for the definition of technical specifications. Obviously, the market offer differs significantly in European member States in terms of price level, configuration, energy classes and energy consumption corresponding to levels of purchasing power and behavioural aspects (mentality, customs, etc.).

Within the European wide Topten project, an aligned approach for technical specifications for all national Topten websites is aimed at, as far as possible. A high level of uniformity and congruency of the different national websites will enhance the awareness amongst manufacturers. Providing and publicising good quality data at national level allows to analyse the situation at European level and make policy recommendations which are shown on www.topten.eu.

Below is the product specification for Topten qualified room air conditioners. A product should meet all identified criteria in Chapter 5 (as far as national context allows) in order to be a Topten product.

2. Product Definition

This chapter provides an overview of *room air conditioners.* It also gives a technical analysis of the product and explains EU and national relevant product and test standards.

2.1. Product Category

Definition of air conditioner

There are different classification schemes for air conditioners. In this paper, we refer mainly to the Eurovent certification programme (Eurovent is European Association of Air Handling and Refrigerating Equipment Manufacturers).
An air conditioning appliance is a device capable of cooling and/or heating indoor air. Several devices are on the market, but they do not offer same technologies, price, efficiency level, applications, etc.

Principle

Air conditioners are thermodynamic devices where a gas or liquid refrigerant fluid circulates between an evaporator, a compressor, a condenser and a pressure regulator.

Air conditioners can be separated into:

- Individual types: each room has its own air conditioner device
- Semi individual types: each device can condition 2 or 3 rooms
- Central types, where the air conditioning of the whole house / flat, is centrally managed

They can be separated in capacity levels (according to Eurovent):

- 0 to 12 kW
- 12 to 45 kW
- 45 to 100 kW

Room Air Conditioner

In this paper, we will focus on residential air conditioners with a maximum cooling capacity of 12 kW because these are the ones covered by:

- Directive n° 2010/30/EU on the indication and standard product information of the consumption of energy and other resources by energy related products, and
- (Recast) Directive n° 2010/31/EU on Energy Performance of Buildings (EPBD).

12 kW is also the limit used by the Eurovent certification programme. More in the details, Eurovent separates air conditioners which capacity is lower than 6 kW and those which capacity is between 6 and 12 kW, CECED (European Committee of Domestic Equipment Manufacturers) and the current Topten definition separates air conditioners which capacity is lower than 4 kW and those which capacity is higher than 4 for split devices. Moreover, Topten.eu lists compact and mobile split as well as multi-split devices.

2.2. Product Types

According to the Eco-Design (lot10) documents, the different types of air conditioners are the following:

- **Split and multi split packaged units**: Factory assembly of components of refrigeration system fixed on two mounting or more in order to form a discreet matched functional unit; this type of air conditioning is most efficient.
- **Single ducts units**: a condenser intake air is introduced from the space containing the unit and discharged outside this space; as much of the waste heat stays inside this type of air conditioning is relatively inefficient. **Double duct units**: device placed near a wall, condenser intake air is introduced from the outdoor environment by a simple small duct and rejected air by another small duct; this type of air conditioning is more efficient than single duct units.
- **(Single package units**: windows air conditioners - generally not used in Europe).

All of these different types can be for cooling only, or so-called "reversible", i.e. they have a heating function too.

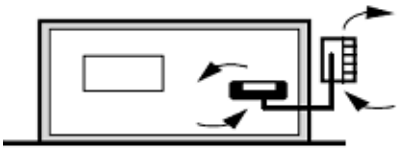
Single package units, single and double ducts units can be grouped together and called "compact room air conditioners".

Split-packaged units

This type of appliance comprises two packages: one indoor unit and one outdoor unit connected only by the pipe that transfers the refrigerant.
Indoor unit(s) can be ducted or non-ducted. In the non-ducted case, the air conditioner cannot operate in the reverse cycle to supply heating.

Split system: non-ducted fixed package units

Indoors units can be fixed on a wall, on the floor or on the ceiling. The indoor unit includes the evaporator and a fan, while the outdoor unit has a compressor and a condenser.

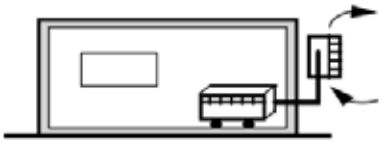


Indoor units:

Outdoor unit:

Mobile split:

The outdoor unit containing the condenser, while the indoor unit has the compressor.

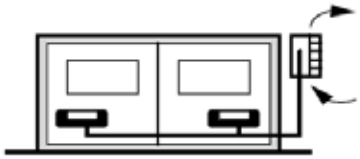


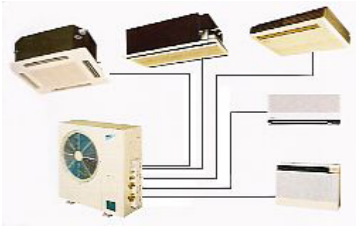
Indoor and outdoor mobile split:

Multi-Split-packaged units

Multi-split packaged units comprise several interior units (up to 4) connected to one exterior unit.
These units are similar to split interior and exterior units. Indoor units can be ducted or non ducted.

Each indoor unit is separately connected at the outdoor unit.



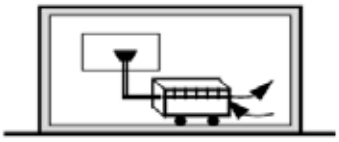


Single-packaged units

Single-duct units

Compact system

Air used to cool the condenser is taken inside the room and rejected outside by a duct through on open window or wall. They are generally movable, but have to be set close to a window or a door.

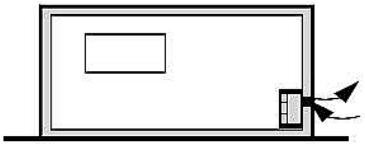


This type of equipment are noisy and generally used with an open windows to evacuate hot air, so performances are debatable and it is difficult to properly measure the thermal effect.

Double-duct units

Compact system

Air used to cool the condenser is taken outside the room and rejected outside by two ducts, through the wall or like the single duct through an open window.

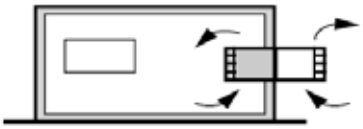


By blowing the air outside through its duct, a single duct actually creates a low pressure in the room, and – usually warm – air from other rooms or outside flows into the room. Double ducts do not have this problem and the airflow into the room is better controlled thanks to their intake hose. They are generally more powerful (and therefore require a second hose), and usually fixedly installed through the wall, while single ducts are usually used as "moveable" (simply placed next to a window), and not fixedly installed.

Window or through the wall air conditioners: compact system

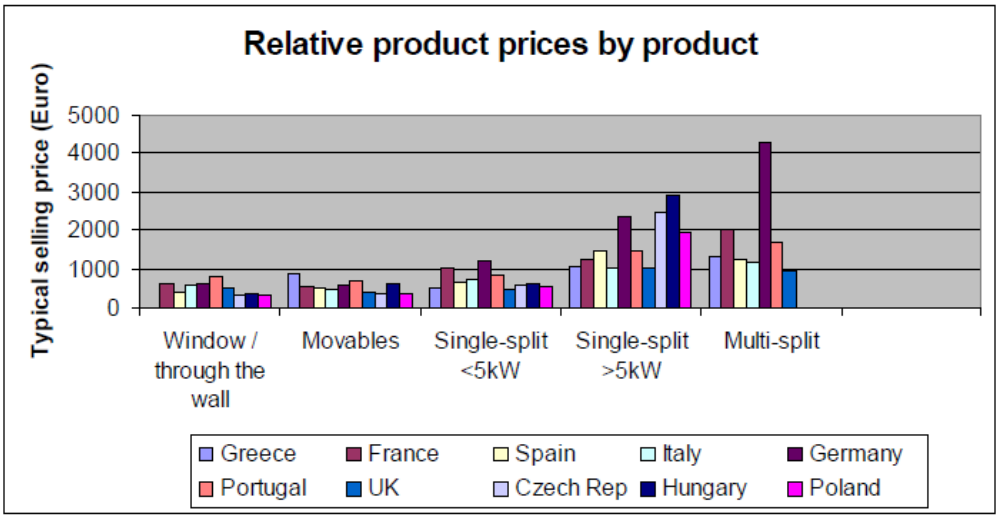
This type is of no relevance to Europe but is often found in other regions of the world, for example in the USA.

One single unit is placed in the wall or in the windows. The inconvenience of this system is the noise and deterioration of home front.



This type of equipment comprises a single package, one side of which is in contact with the outside air heat release outside, while the other side provides direct cooling to the air inside.
The two sides of the appliance are separated by a dividing wall, which is insulated to reduce heat transfer between the two sides.

Price Information



Relative prices by products for several European countries (source : Eco-design – Lot10-Task2 – final report, 2008)

The Eco-design preparatory studies list the following values for some appliances (these are only examples):

	Life time	Price (€)	Maintenance (€/years)	Installation (€)	Energy consumption (kWh) over the life time or ??
Reversible split air conditioners					
3,5 kW	12 years	683	67	1 000	1 489
7,1 kW	12 years	1 385	95	1 000	3 150
Cooling only split air conditioners					
3,5 kW	12 years	683	67	1 000	445
7,1 kW	12 years	1 385	95	1 000	969
Single duct air conditioners					
	12 years	389,4	15,6	0	394

Cost and consumption of air conditioners (source: Eco-design report, 2008)

2.3. Best Available Technology

Variable frequency drive and permanent magnet motor

Most energy efficient air conditioners on today's EU market are split air conditioners with a variable frequency drive (VFD, also called variable speed drive or inverter) and a permanent-magnet motor. The VFD technology allows the air conditioner's compressor to run at variable speed, and to thus only provide the cooling intensity that is required. Most other air conditioners can only work at full capacity and reach a certain temperature level by switching On and Off. Staged air conditioners can at least work at two or three different capacities. These variable speed air conditioners have multiple advantages:

- They keep the temperature more stable, increasing thermal comfort
- They can initially cool a warm room faster to a convenient temperature
- They are more energy efficient

To obtain better air conditioners with a higher Coefficient of Performance (COP), some components can evolve.

Compressors are the most interesting component for further improving energy efficiency. Two technologies of compressors are used for this product and can both be improved - scroll compressors and rotary compressors (0 kW to 12 kW).
A Japanese Study (ECCJ 2006, *in* Eco-design preparatory study) estimates that shifting from rotary to scroll compressors could be one of the main ways to achieve higher COP.

Another important component is the **motor**: losses and volumes can be reduced by respectively 20% and 30% (in the case of permanent magnet motors).

Regarding **heat exchangers**, the two main improvements come from the increase of the heat transfer-area and the increase of the heat transfer performance.
A new technology already applied in the car industry which relies on micro-channels offers great performances and could be applied in particular to reversible split products.

Progresses with **refrigerant fluids** are hoped for: the goal would be to develop products with CO2 or propane, with the same performances than R410A.

A great job could be done regarding noise, which is an important selection criterion for consumers, but so far there has been no real technological innovation. It is actually very important because in order to tackle the noise issue, manufacturers reduce the airflow speed at the heat exchanger. This reduces the noise but also the energy efficiency. Fans, motors, and other components should be optimized for generate as little noise as possible.

2.4. Legislations and Labels

2.4.1. Definitions

Type of air conditioner: split, multi-split, mobile-split or compact air conditioner.
Variable speed drive models, also known as inverters are capable of functioning at partial load and reach higher degrees of efficiency.

Cooling capacity (W): Maximum cooling capacity in Watt, according to producers' declarations.

For the cooling function: EER (Energy Efficiency Ratio) according to EN 14511: Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling, under conditions T1 (moderate climate).
EER = cooling capacity (W) / power input (W).
The higher the EER, the more efficient the product.

Heating capacity (W): If a heating function is present: maximum heating capacity in Watt, according to producers' declarations.

For the heating function: COP (Coefficient Of Performance) according to EN 14511 under conditions T1 , (moderate climate) + 7C.
COP = heating capacity (W) / power input (W).
The higher the COP, the more efficient the product.

EER for the cooling function and COP for the heating function are measured at full load and do not account for the efficiency gains achievable thanks to the use of variable speed (inverter) drives which are able to work at part load.

Seasonal efficiency indicators: **SEER** for cooling and **SCOP** (or Heating Seasonal Performance Factor – **HSPF**) for heating consider the different cooling and heating needs during the year and thus include part load operation of air conditioners.

The latest energy efficiency legislation by the EU (Minimum Energy Performance Standards: Regulation No 206/2012 and Labelling: Regulation No 626/2011) also takes into account **seasonal efficiency indicators**.
In the USA, the efficiency indicators (EER and COP, SEER and SCOP/HSPF) are not indicated in W/W, but **BTU/Wh**. A BTU (British Thermal Unit) is defined as the amount of heat required to raise the temperature of one 1 pound (0,454 kg) of liquid water by 1 °F (0,556 °C) at a constant pressure of one atmosphere (it approximately equals to 1055 joules).
The transformation factor is 3,41: EER (W/W) = EER (BTU/Wh)/3,41

Water cooled air conditioners
Water cooled air conditioners are directly connected to a water line and permanently use (large amount of) water for providing their service. For residential air conditioning, this type is common in certain dry areas in the USA ("evaporative" or "swamp cooler"), but not in Europe. In Europe, some single duct models have a water tank which needs to be regularly filled. They are based on the normal air to air cooling, but with the additional water evaporation heat they increase their efficiency - as long as there is water in the tank.

2.4.2. International

For air conditioners, the most important legislations framing the market (labels and minimum energy performance standards) are those used in Australia, China, Japan, USA and Europe.

- **Australia / New Zeeland**

Current and future MEPS requirements are set out in AS/NZS 3823.2:2011.

It specifies the energy labelling requirements for single-phase non-ducted air conditioners of the vapour compression type within the scope of AS/NZS 3823.1.1. It also specifies the minimum energy performance standard (MEPS) requirements for single-phase and three-phase air conditioners of the vapour compression type up to a rated total cooling capacity of 65 kW that fall within the scope of AS/NZS 3823.1.1, AS/NZS 3823.1.2, AS/NZS 3823.1.3 or AS/NZS 3823.1.4.

A draft revised Version is elaborated and expected to become effective in 2013:

DR 2013 AS/NZS 3823.2 CP
Performance of electrical appliances - Air conditioners and heat pumps - Part 3: Energy labelling and minimum energy performance standards (MEPS) requirements.

In addition:

- **China**

1) China's standard for fixed-speed air conditioners is GB 12021.3-2010. It sets minimum energy efficiency values and values for the different grades on the energy label for room air conditioners. In 2008 with GB 21455 MEPS were introduced[1] also for variable speed air conditioners. The testing standard for variable speed air conditioners is.GB/T 7725-2004. The two standards contain different SEER calculation methods. For the Energy Label GB 21455 is relevant, but manufacturers also declare the SEER according to GB/T 7725, which renders higher (better) results because the number of cooling hours is higher.
The requirements apply to air-cooling condensers, completely closed type electric motor-compressor with a cooling capacity below 14kW under climate type T1. It does not apply to portable, variable speed or multi-connected types of ACs. In China only the cooling function is rated.

Type	Rated Cooling Cooling Capacity (CC) W	EER W / W	
		Cooling Only	Heat Pump
Single-Package	CC ≤ 4500	2.20	2.15
	CC > 4500	-	-
Split	CC ≤ 2500	2.50	2.40
	2500 < CC ≤ 4500	2.45	2.35
	4500 < CC ≤ 7100	2.40	2.30
	CC > 7100	2.30	2.25

China Room Air Conditioner Minimum Standards, June 2010

Type	Rated Cooling Cooling Capacity (CC) W	EER W / W	
		Cooling Only	Heat Pump
Single-Package	CC ≤ 4500	2.35	2.30
	CC > 4500	-	-
Split	CC ≤ 2500	2.85	2.75
	2500 < CC ≤ 4500	2.70	2.60
	CC > 4500	2.55	2.45

China Room Air Conditioner Energy Efficiency Criteria

Source CLASP: http://www.clasponline.org/clasp.online.worldwide.php?programinfo=165

[1] Source: www.topten.eu/uploads/File/023_Anette_Michel_final_paper_S.pdf

2) Topten China proposes a different breakdown**:** To select Fix Speed Air Conditioners for the Topten product list, the energy efficiency ratio (EER) of the air conditioner[2] should not be lower than the following values

Total Cooling Capacity (CC, W)	EER (W/W)
CC ≤ 2800W	**≥ 3.40**
2800W < CC ≤ 4500W	**≥ 3.40**

For the free-standing air conditioner

Total Cooling Capacity (CC, W)	EER (W/W)
4500W ≤ CC ≤ 6000W	**≥ 3.30**
6000W < CC ≤ 7500W	**≥ 3.20**

For Inverter Air Conditioners Topten China sets criteria in terms of seasonal energy efficiency ratio (SEER). The SEER value should not be lower than the following values:

Total Cooling Capacity (CC, W)	SEER (W x h / W x h)
CC ≤ 2800W	**≥ 4.77**
2800W < CC ≤ 4500W	**≥ 4.62**

For the free-standing air conditioners

Total Cooling Capacity (CC, W)	SEER (W x h / W x h)
4500W ≤ CC ≤ 6000W	**≥ 4.06**
6000W < CC ≤ 7500W	**≥ 3.76**

- **USA**

1) The **Energy Policy and Conservation Act (EPCA)** established the Energy Conservation Program for Consumer Products Other than Automobiles, covering major household appliances including room air conditioners. The National Appliance Energy Conservation Act of 1987 subsequently amended EPCA by establishing energy conservation standards for room air conditioners. The U.S. Department of Energy developed the second rulemaking to review and amend energy conservation standards pursuant to 42 U.S.C. 6295(c)(2).
http://www1.eere.energy.gov/buildings/appliance_standards/residential/room_ac.html

[2] Source: TopTen.cn

The USA have an extensive MEPS programme for air conditioners and heat pumps, which includes the following product types:

- Residential room air conditioners (Window/wall)
- Package terminal air conditioners (wall units with an air change function included)
- Central air conditioners and heat pumps
- Small commercial package air-conditioners and heat pumps
- Large commercial package air-conditioners and heat pumps

Products with and without louvered sides are defined as distinct categories. The product is required to be tested in accordance with Federal test procedures to meet mandatory efficiency standards.

Product class	Energy efficiency ratio, effective from Oct. 1, 2000 to May 31, 2014	Combined energy efficiency ratio, effective as of June 1, 2014
1. Without reverse cycle, with louvered sides, and less than 6,000 Btu/h	9.7	11.0
2. Without reverse cycle, with louvered sides, and 6,000 to 7,999 Btu/h	9.7	11.0
3. Without reverse cycle, with louvered sides, and 8,000 to 13,999 Btu/h	9.8	10.9
4. Without reverse cycle, with louvered sides, and 14,000 to 19,999 Btu/h	9.7	10.7
5a. Without reverse cycle, with louvered sides, and 20,000 to 24,999 Btu/h	8.5	9.4
5b. Without reverse cycle, with louvered sides, and 25,000 Btu/h or more		9.0
6. Without reverse cycle, without louvered sides, and less than 6,000 Btu/h	9.0	10.0
7. Without reverse cycle, without louvered sides, and 6,000 to 7,999 Btu/h	9.0	10.0
8a. Without reverse cycle, without louvered sides, and 8,000 to 10,999 Btu/h	8.5	9.6
8b. Without reverse cycle, without louvered sides, and 11,000 to 13,999 Btu/h		9.5
9. Without reverse cycle, without louvered sides, and 14,000 to 19,999 Btu/h	8.5	9.3
10. Without reverse cycle, without louvered sides, and 20,000 Btu/h or more	8.5	9.4
11. With reverse cycle, with louvered sides, and less than 20,000 Btu/h	9.0	9.8
12. With reverse cycle, without louvered sides, and less than 14,000 Btu/h	8.5	9.3
13. With reverse cycle, with louvered sides, and 20,000 Btu/h or more	8.5	9.3
14. With reverse cycle, without louvered sides, and 14,000 Btu/h or more	8.0	8.7
15. Casement-Only	8.7	9.5
16. Casement-Slider	9.5	10.4

USA - Requirements for residential room air conditioners , current and future standard (Source: DoE 2013[3])

[3] U.S. Department of Energy, Building Technologies Office, Standards & Test Procedures, Residential Room Air Conditioners, http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/41#recentupdates

2) ASHRAE (The American Society of Heating, Refrigerating and Air-Conditioning Engineers), founded in 1894, is an international organisation of 51 000 persons. ASHRAE fulfils its mission of advancing heating, ventilation, air conditioning and refrigeration to serve humanity and promote a sustainable world through research, standards writing, publishing and continuing education.
ASHRAE develops standards for its members and other professional organisations dealing with refrigeration processes and indoor air quality standards.

Every three years, ASHRAE publishes the **Energy Standard for Buildings except Low-Rise Residential Buildings** (see www.ashrae.org for the latest version).
In this energy standard, ASHRAE defined minimum efficiency requirements for electrically operated Air Conditioners and condensing units.

Requirements values for air conditioners are summarised in the next table.
EER, SEER and IPLV have units of BTU per Wh (BTU/h = 0.293 W).
IPLV is a weighted average of efficiency measurements at various part-load conditions.

Equipment type	Size category	Heating Section type	Subgategory	Minimum efficiency	test procedure
Air conditioner, air cooled	<65 000 Btu/h *(19kW)*	all	Split system	13,0 SEER *(3,8)*	ARI 210/240
			Single package	13,0 SEER *(3,8)*	
Small duct hight velocity, air cooled	<65 000 Btu/h *(19kW)*	all	Split system	10,0 SEER *(2,93)*	
Air conditioners, water end evapora-tively cooled	<65 000 Btu/h *(19kW)*	all	Split system and single package	12,1 EER *(3,5)*	

Source: ASHRAE 90.1-2007

3) Energy Star is a joint programme of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping save money and protect the environment through energy efficient products and practices. It is a voluntary labelling schemes distinguishing very efficient appliances.

Capacity (Btu/Hr)	**ENERGY STAR EER, with louvered sides**		**ENERGY STAR EER, without louvered sides**	
	Btu/hr/W	***W/W***	**Btu/hr/W**	***W/W***
< 6,000 (1,76kW)	**≥ 11.2**	*≥ 3,28*	**≥ 10.4**	*≥ 3.05*
6,000 to 7,999 (1,76kW to 2,343kW)				
8,000 to 13,999 (2,344kW to 4,101kW)	**≥ 11.3**	*≥ 3,31*	**≥ 9.8**	*≥ 2,87*
14,000 to 19,999 (4,102kW to 5,859kW)	**≥ 11.2**	*≥ 3,28*		
≥ 20,000 (5,860kW)	**≥ 9.8**	*≥ 2,87*		
Casement	**ENERGY STAR EER**			
Casement-only	**≥ 10.0** *(2.93)*			
Casement-slider	**≥ 10.9** *(3.19)*			
REVERSE CYCLE				
Capacity (Btu/Hr)	**ENERGY STAR EER, with louvered sides**		**ENERGY STAR EER, without louvered sides**	
	Btu/hr/W	***W/W***	**Btu/hr/W**	***W/W***
< 14,000 (4,102kW)	**n/a**	*n/a*	**≥ 9.8**	*≥ 2,87*
≥ 14,000 (4,102kW)			**≥ 9.2**	*≥ 2,69*
< 20,000 (5,860kW)	**≥ 10.4**	*≥ 3.05*	**n/a**	*n/a*
≥ 20,000 (5,860kW)	**≥ 9.8**	*≥ 2,87*		

Source_ Energy Star air room conditioners eligibility, Version 3.0, effective from October 1, 2013,
http://www.energystar.gov/index.cfm?fuseaction=products_for_partners.showRoomAC.

2.4.3. Europe

The current regulations are framed by Directives n° 2010/30/EU on energy labelling of energy-related products (ErP) and 2009/125/EC for the setting of Ecodesign requirements for ErPs. The two regulations relevant for air conditioners are:

- Regulation No 206/2012 on Ecodesign requirements for air conditioners and comfort fans. It applies since January 2013.

  www.topten.eu/uploads/File/Aircon%20Ecodesign%20regu%20March%202012.pdf

- Regulation No 626/2011 on the energy labelling of air conditioners, also applying since January 2013.

  http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:178:0001:0072:EN:PDF

The European Commission expects these measures to lead to savings of 11 TWh by 2020, compared to the situation without measures.

In the following, both regulations are presented.

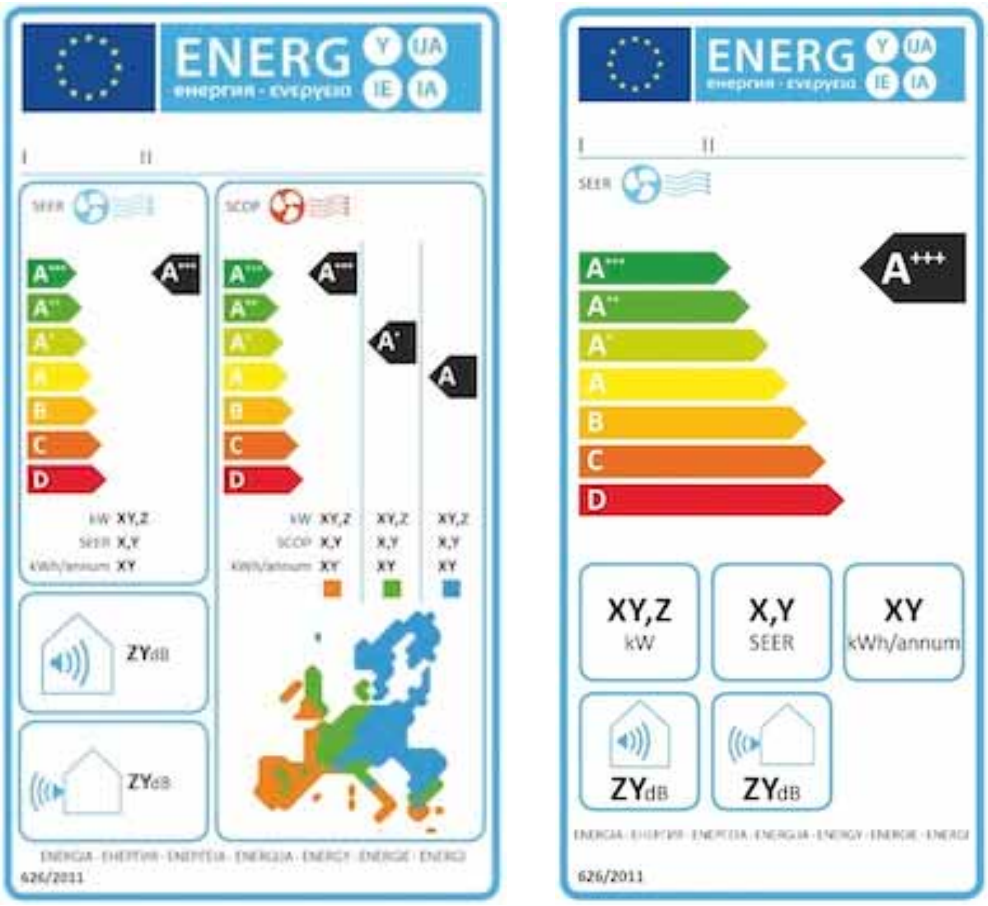
2.4.3.1. Current European regulation

New EU-energy label
Under the new labelling directive (2010/31/EU) a recast energy labelling regulation for room air conditioners (626/2011/EU) has been adopted and published in the Official Journal of the European Union.

Since 1st January 2013 the new energy label has been applying, with the following classification scheme and layout (below):

New energy label regulation

	Room air conditioners		Double ducts		Single ducts	
	SEER	SCOP	EER	COP	EER	COP
A+++	≥ 8.5	≥ 5.1	≥ 4.1	≥ 4.6	≥ 4.1	≥ 3.6
A++	≥ 6.1	≥ 4.6	≥ 3.6	≥ 4.1	≥ 3.6	≥ 3.1
A+	≥ 5.6	≥ 4.0	≥ 3.1	≥ 3.6	≥ 3.1	≥ 2.6
A	≥ 5.1	≥ 3.4	≥ 2.6	≥ 3.1	≥ 2.6	≥ 2.3
B	≥ 4.6	≥ 3.1	≥ 2.4	≥ 2.6	≥ 2.4	≥ 2.0
C	≥ 4.1	≥ 2.8	≥ 2.1	≥ 2.4	≥ 2.1	≥ 1.8
D	≥ 3.6	≥ 2.5	≥ 1.8	≥ 2.0	≥ 1.8	≥ 1.6
E	≥ 3.1	≥ 2.2	≥ 1.6	≥ 1.8	≥ 1.6	≥ 1.4
F	≥ 2.6	≥ 1.9	≥ 1.4	≥ 1.6	≥ 1.4	≥ 1.2
G	< 2.6	< 1.9	< 1.4	< 1.6	< 1.4	< 1.2



Energy label layouts for reversible and for cooling only air conditioners

New Eco-design requirements

The new Eco-design requirements are covered by regulation n° 206/2012/EU, which was published in 2012.

This document concerns:

1) **Minimum energy performance levels** allowed on the European market, entering into force in 2013 and 2014. A difference is made between refrigerants with GWP > 150 and Refrigerants with GWP < 150.
The requirements are shown in the tables below:

Since January 2013, the following requirements for **single duct and double duct air conditioners** have to be met:

	Double duct air conditioners		**Single ducts air conditioners**	
	EERrated	**COPrated**	**EERrated**	**COPrated**
GWP > 150	2,40	3,36	2,40	1,80
GWP ≤ 150	2,16	2,12	2,16	1,62

For air conditioners, except single duct and double duct air conditioners the following requirements came into force in January 2013:

	SEER	**SCOP**
GWP > 150	3,60	3,40
GWP ≤ 150	3,24	3,06

From January 2014 on, the requirements will be as described in the following tables.

a. For air conditioners, except single duct and double duct air conditioners

	SEER	**SCOP**
GWP > 150 for < 6 kW	4,60	3,80
GWP ≤ 150 for < 6 kW	4,14	3,42
GWP > 150 for 6-12 kW	4,30	3,80
GWP ≤ 150 for 6-12 kW	3,87	3,42

b. For double duct air conditioners

	EER rated	**COP rated**
GWP > 150 for < 6 kW	2,60	2,60
GWP ≤ 150 for < 6 kW	2,34	2,34
GWP > 150 for 6-12 kW	2,60	2,60
GWP ≤ 150 for 6-12 kW	2,34	2,34

c. For single duct air conditioners

	EER rated	**COP rated**
GWP > 150 for < 6 kW	2,60	2,04
GWP ≤ 150 for < 6 kW	2,34	1,84
GWP > 150 for 6-12 kW	2,60	2,04
GWP ≤ 150 for 6-12 kW	2,34	1,84

Background on refrigerants

The refrigerant has an effect on an air conditioner's efficiency. However, also the Global Warming Potential (GWP) has to be taken into account, as refrigerant losses account for 10-20% of the total greenhouse gas emissions. R22 is being phased out because of its Ozone Depletion Potential (ODP). R410A has become the most common refrigerant in Europe.

Today HFOs (Hydrofluoro-Olefines) and natural refrigerants with much lower GWPs than R410A or R407C start to be used. HFOs have GWPs around 4-6, propane has a GWP of 3. HFOs are as efficient as R410A or R407C, propane is even 7% more

efficient. Yet propane however can only be used in small capacity single duct appliances due to safety restrictions in the EU. CO2 is a promising future refrigerant candidate, but compressor adaptations are needed as it requires a higher pressure.

Refrigerant	*GWP*
~~R22 (HCFC)~~	*1700*
R407C (HFC)	*1653*
R410A (HFC)	*1725*
HFOs	*around 4*
R290 (Propane)	*3*
CO2	*1*

GWPs of common refrigerants in air conditioners. R22 is being phased out.

2) **Noise emission**

Regulation 206/2012/EC also introduced a maximum sound power level, whereas

a. Since January 2013 the maximum **indoor** sound power level in dB(A) is 65
b. From January 2014 the maximum sound power level is as described in the following table:

Rated capacity ≤ 6 kW		**6 < Rated capacity ≤12 kW**	
Indoor sound power level in dB(A)	Outdoor sound power level in dB(A)	Indoor sound power level in dB(A)	Outdoor sound power level in dB(A)
60	65	65	70

3) From January 2014, single duct and double duct air conditioners (and comfort fans) also have to meet requirements on maximum power consumption in off-mode and standby mode. The requirements are described in the table below:

Off mode	Power consumption of equipment in any off-mode condition shall not exceed 0,5 W.
Standby mode	Power consumption in any condition providing a reactivation function and/or indication of a reactivation function shall not exceed 0,5 W.
	Power consumption in any condition providing only information or status display (or in combination with the reactivation function): 1 W.
Availability of standby and/or off mode	Equipment shall provide off mode and/or standby mode (except where this is in appropriate for the intended use) or another condition which does not exceed the power consumption of the latter modes
Power management	Automatically controlled power management function switching to standby mode, off mode or similar power saving modes.

4) **Product Information Requirements**

Additionally, a bundle of product information has to be provided either in the technical documentation of the product or on a free access website of the manufacturer. The respective detailed requirements can be taken from Regulation 206/2012/EC, page 17.

2.4.3.2. Eurovent

Eurovent is the **European Association of Air Handling and Refrigerating Equipment Manufacturers.**

By participating in the Eurovent-Certification scheme and allowing their products to be independently tested, manufacturers have the right to include their products in the annual Eurovent-Certification product directory, which is circulated among consultants and installers. They are also allowed to use the Eurovent-Certification endorsement label.

The Eurovent certification does not cover single and double ducts, nor mobile splits.

The models in the Eurovent-Certification directory (Eurovent-Certification, 2006) are sorted by categories similar to those in EN 14511, but present additional information. Each model is classified according to 5 parameters:

- The cooling capacity (AC1: <12 kW; AC2: 12-45 kW; AC3: 45-100 kW).
- The heat rejection way: air-cooled or water-cooled.
- The type of system: Split, MultiSplit and Packaged.
- The type of operation: reversible or cooling only.
- The mounting on the wall.

Programme	Code	Heat rejection	Code	System	Code	Operation	Code	Mounting*	Code
Comfort Air Conditoners	AC1 AC2 AC3	Air cooled	A	Split	S	Cooling only	C	High wall	W
								Floor mounted	L
								Cassette	C
				Multisplit	M			Ceiling suspended	S
up to 12 kW12 to 45 kW45 to 100 kW		Water cooled	W			Reverse cycle	R	Built-in-horizontal	B
								Built-in-vertical	V
				Packaged	P			Roof top	R
								Window	Wi

The Topten European segmentation and selection criteria are presented in section 5.

3. Test Standards

3.1. Tests standards in Europe

The European energy label and the Eurovent certification are based on the following measurement standards:

Performances:

EN 14511:2011

This is the 'old' measurement standard for air conditioners, liquid chilling packages and heat pumps using either air, water or brine as heat transfer media, with electrically driven compressors when used for space heating and/or cooling. Today it is relevant for the performance assessment for the energy label for single ducts and double ducts. Part load testing (of variable speed air conditioners) is dealt with in the new measurement standard EN 14825.

EN 14825:2012
This is the new measurement standard, based on which the performance asessment for the energy label of air conditioners (except single ducts) is conducted. It defines the testing at part load conditions and the calculation of seasonal efficiency indictors: SEER (cooling) and SCOP (heating).
In the standard description it says:
This European Standard gives the calculation methods for the determination of reference seasonal energy efficiency SEER and SEERon and reference seasonal coefficient of performance SCOP, SCOPon and SCOPnet. Such calculation methods may be based on calculated or measured values. In case of measured values, this European Standard covers the test methods for determination of capacities, EER and COP values during active mode at part load conditions. It also covers test methods for electric power consumption during thermostat off mode, standby mode and crankcase heater mode.

Acoustic :
- EN ISO 3741 "determination of sound power levels of noise sources using pressure. Precision methods considering the frequency range of interest between 100Hz and 10kHz"
- Eurovent 6/C/006-97

3.2. Test standards in other countries

Many countries have developed testing standards for rating cooling capacity and energy efficiency of air conditioners. According to specific legislative habits, standards may include not only temperatures and other test characteristics definitions but also capacity ranges, tolerances on testing results, labelling schemes or MEPS requirements as well as noise testing or even refrigerant legislation.

Most countries use the ISO 5151 and 13253 standards to compare the energy efficiency of air conditioners, with sometimes minor modifications. The complete list of these countries is available on the APEC-ESIS website:
http://www.apec-esis.org/list_reference.php .

The most used standards are the following:

ISO 5151: Non ducted air conditioners and heat pumps – testing and rating performances (RAC's Split)

It specifies the standard conditions under which the ratings of single-package and split-system non-ducted air conditioners employing air and water-cooled condensers and heat pumps employing air-cooled condensers are based, and the test methods to be applied for determination of the various ratings. This international Standard is limited to systems utilizing a simple refrigeration circuit and having one evaporator and one condenser. It also specifies the test conditions and the corresponding test procedures for determining various performance characteristics of these non-ducted air conditioners and heat pumps. It does not apply to the testing and rating for water-source heat pumps, multiple split-system air conditioners and heat pumps, units designed for use with additional ducting, or mobile (windowless) units having a condenser exhaust duct.

The following tests are executed:

- Cooling capacity rating test, maximum cooling test, minimum cooling test
- Heating capacity rating test, maximum heating test, minimum heating test
- Enclosure sweat and condensate disposal test
- Freeze-up test

ISO 13253: Ducted air-conditioners and air-to-air heat pumps - Testing and rating for performance

It establishes performance testing and rating criteria for ducted air-conditioners using air- and water-cooled condensers and ducted air-to-air heat pumps. It is limited to systems which use a single refrigeration circuit and have one evaporator and one condenser.

USA: ARI 210/240 – 2006, Central air conditioners and heat pumps - Performance rating of unitary air-conditioning and air-source heat pump equipment

A central air conditioner or heat pump is defined as a "product other than a packaged terminal air conditioner, which is powered by single phase electrical current, air cooled, rated below 65 000 Btu/h (19,05 kW), not contained within the same cabinet as a furnace, the rated capacity of which is above 225 000 Btu/hr and is a heat pump or cooling only unit".
This definition includes split packaged (single and multi split) room air conditioners, cooling only and reversible.
The official US test procedure is contained in DOE regulations Code of Federal Regulations 430 Appendix M.

The cooling and heating capacities, power input and energy efficiency ratio(s) are measured according to the method in ASHRAE-37-1988 *Methods of testing for rating unitary air conditioning and heat pump equipment*. (replaced by ASHRAE 37-2009)

ASHRAE Standard 37-2009 -- Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment (ANSI Approved)
The purpose of this standard is to provide test methods for determining the cooling capacity of unitary air-conditioning equipment and the cooling or heating capacities, or both, of unitary heat pump equipment. These test methods do not specify methods of establishing ratings that involve factors such as manufacturing tolerances and quality control procedures.

ASHRAE Standard 16-1983 (R2009) -- Method of Testing for Rating Room Air Conditioners and Packaged Terminal Air Conditioners (ANSI Approved)
This standard prescribes a method of testing for obtaining cooling capacity and airflow quantity for rating room air conditioners and packaged terminal air conditioners. The purpose of this standard is to establish a uniform method of testing for obtaining rating data, specify types of test equipment for performing such tests, and specify data required and calculations to be used, and list and define the terms used in testing.

Standard JRA: 4046 (JRA, 2004) - "Calculating method of annual power consumption for room air conditioners"
The JRA standard "Calculating method of annual power consumption for room air conditioners" (JRA, 2004) specifies room air conditioners to be sold in the Japanese market, which are classified as single-package type or split-system type with a rated cooling capacity not exceeding 10 kW and rated electric power consumption not exceeding 3 kW.
Moreover only air conditioners with single speed compressor or variable speed compressor are in the scope of this standard. Units with double speed compressors or two capacity stages are not sold on the Japanese market.

Standards JRA: 4048 (JRA, 2006) - "Annual Performance Factor of Package Air Conditioners"
The standards covers package air conditioners (cooling capacity < 28 kW), for air conditioners primarily intended for commercial use.

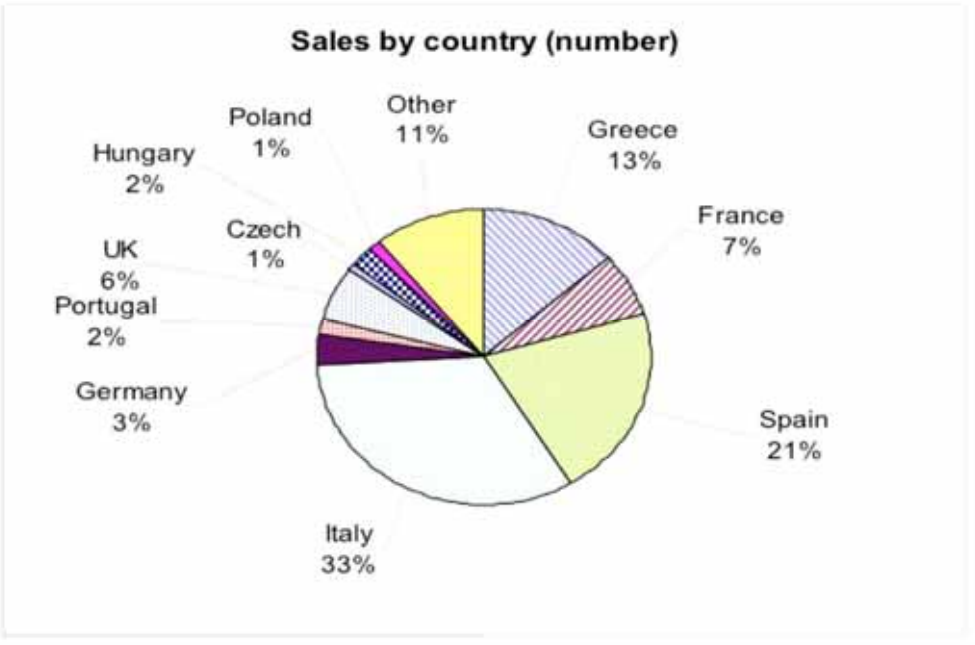
4. Economic and Market Analysis

4.1. Market and Stock data

Source: Ecodesign – Lot10 – Task2 (Economic and market Analysis) – 2008, Room air conditioners: Recommendations for policy design, Topten.eu, May 2011.
All data comes from BSRIA market data 2002 and 2005, presented in the preparatory studies for Ecodesign requirements of air conditioners.

Growing sales and stock

The air conditioners market in the EU is far from being saturated. In 2005, 4.9 million units were sold across the EU-27. By 2020, sales are expected to double to close to 10 million units. The stock is estimated to grow from over 40 million units today to 110 million units by 2020. Annually an additional cooling capacity of around 12.6 GW is installed in EU houses. Annual sales are depending on the weather conditions. The annual electricity consumption by the European AC stock in 2007 was around 17 TWh. Because of low sales in 2008 and 2009 the stock is thought to have remained almost constant until 2009. (JRC, 2012). Sales recovered in 2010.
Most air conditioners are sold in Italy, Spain and Greece. Sales of Italy and Spain together account for more than 50% of the entire EU market.



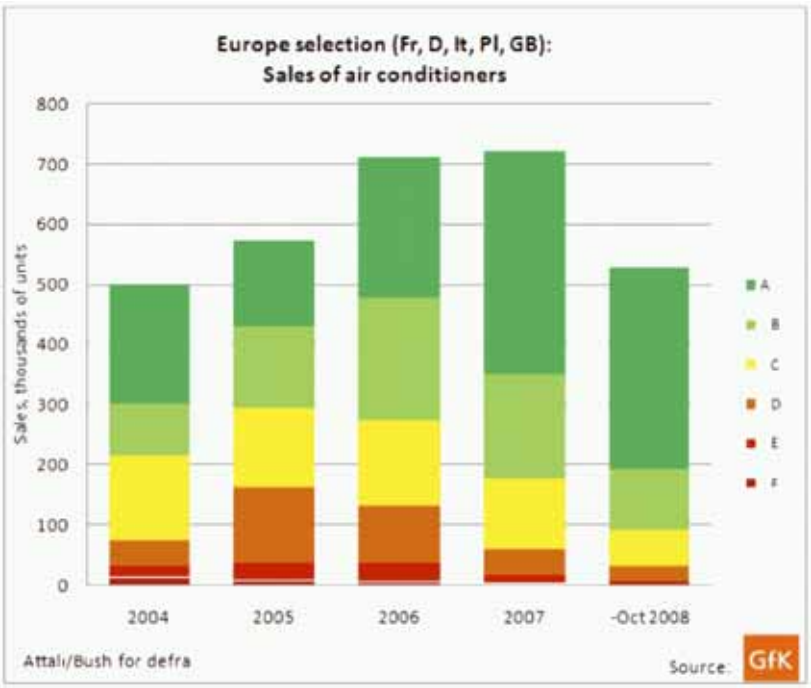
Reversible variable speed air conditioners are dominating the EU market

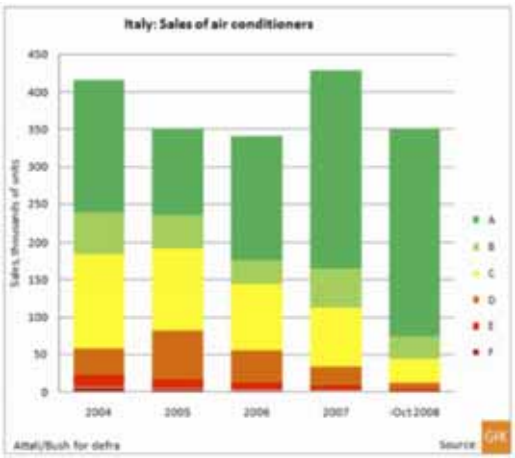
Products on the market across the EU are similar, but national markets differ strongly due to different climate, building design, legislation and income. The heating function of air conditioners for instance is important in Southern countries, while houses in Northern countries usually have central heating installed. Across Europe, about 75% of the sales are air conditioners including a heating function with a reversible heat pump.

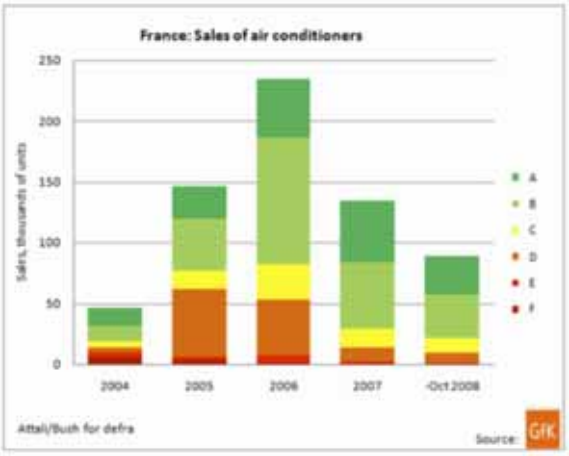
In 2007 55-75% were variable speed (inverter) air conditioners. Sales shares of both reversible heat pumps and variable speed air conditioners are expected to grow further. Split cooling only appliances (without heating function) are expected to disappear from the market. Single ducts and double ducts, today accounting for about 15% of the sales, are expected to become more popular. The most important refrigerant in the EU is R410A: it is used in 60% of the air conditioners.

Class A has become standard

According to sales data from 5 European countries from 2005- 2008 (till October) class A air conditioners by now account for the majority of the sales (GfK/Attali/Bush for Defra, 2009). In 2010, 56% of the fixed AC sales were class A in the EU (77% in Western Europe) (JRC, 2012)

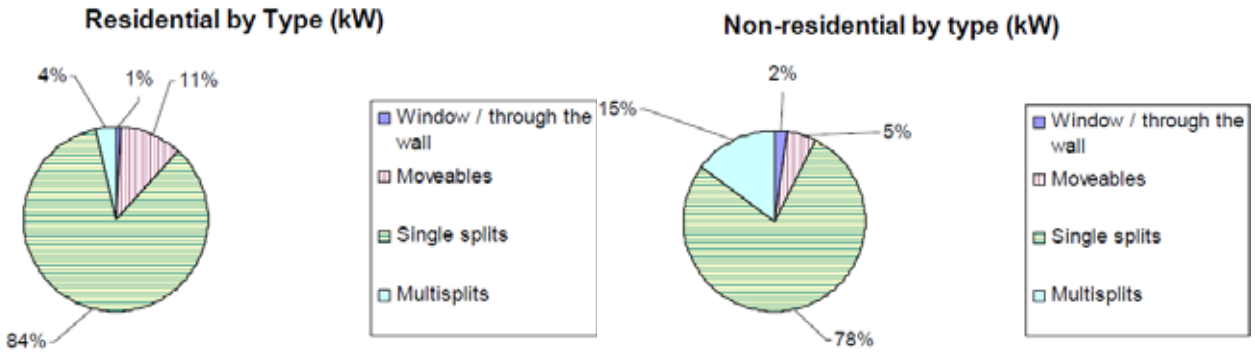






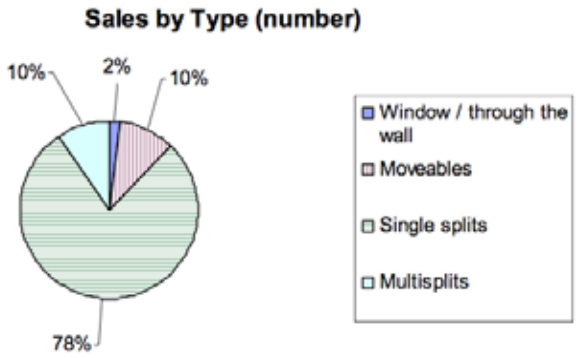
Air conditioner sales in 5 EU-countries, Italy and France, 2004 – October 2008.
Source: GfK/Attali/Bush for Defra, 2009.

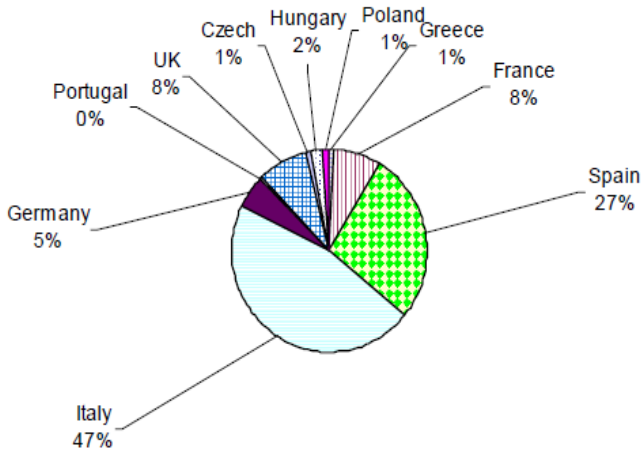
This market evolution seems to mainly have been triggered by the introduction of the energy label for air conditioners in 2002. By now high efficiency split air conditioners have Energy Efficiency Ratio (EER) values of up to 5.6 - way beyond the class A threshold of 3.2.

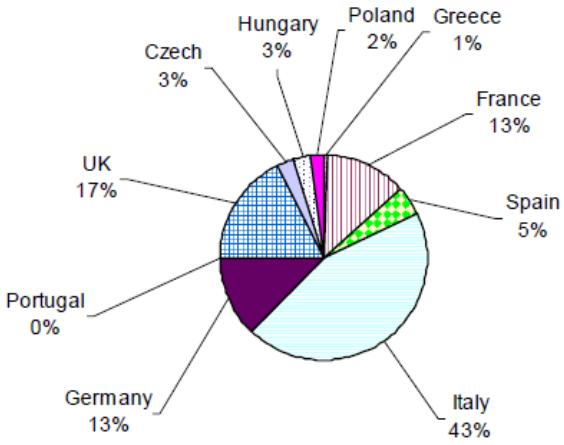


Repartition by type in residential or non residential

Split AC are the most used appliances in Europe, whether in residential or non residential sectors.



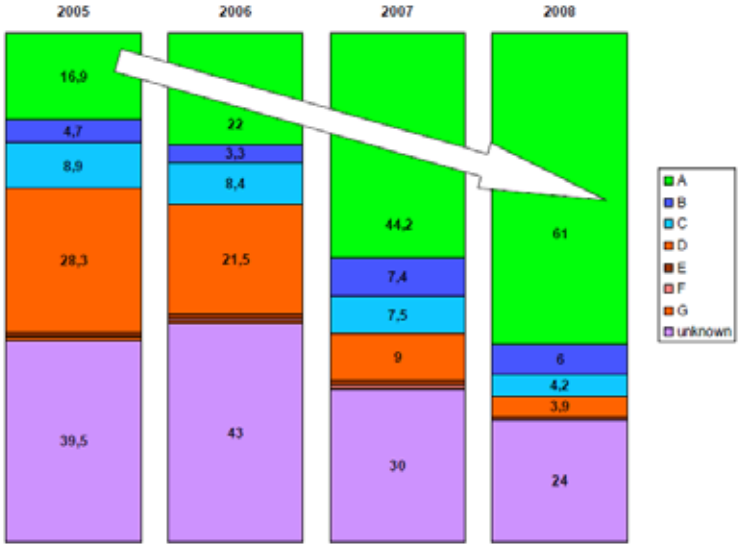




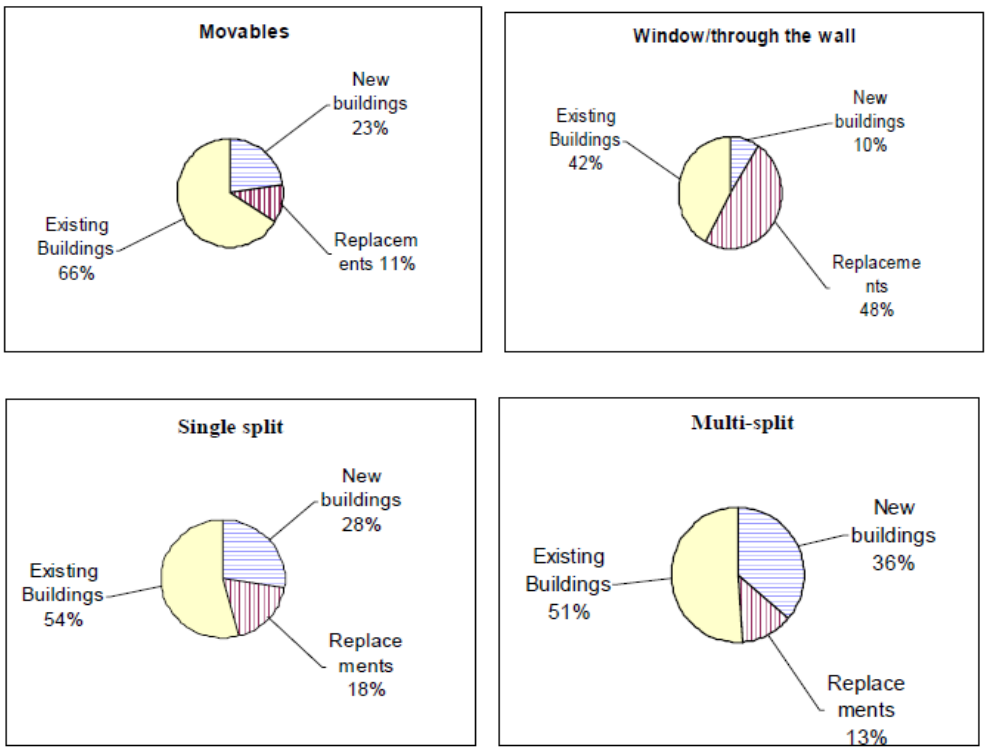
Cooling only split and multi split by country (kW) *Moveable units by country (kW)*

Split and multi split are the most used in Italy, Spain and Greece. Moveable units are the most used in Italy, UK, France and Germany.

The biggest EU markets are Italy, Greece, Spain and France. The introduction of the European Energy label allowed to transform the market and direct it towards class A models, which sales have grown by 361% from 2005 to 2008. We can see the example of sales distributions by energy classes in Spain and Italy.



Evolution of the air conditioning sales in Italy and Spain by energy classes [STO2009]



Air conditioners (<12kW) sales destination by type: New building, existing buyiding, replacement

As we can see, devices have different applications, especially about 50% of the window/through the wall air conditioners are for replacement purposes (but they have a very small market share), whereas only 10% go to new buildings.

Across Europe, about 75% of the sales are air conditioners including a heating function with a reversible heat pump. In 2007 55-75% were variable speed (inverter) air conditioners. Sales shares of both reversible heat pumps and variable speed air conditioners are expected to grow further. Split cooling only appliances (without heating function) are expected to disappear from the market.

4.2. Manufacturers and Distributors

We can list the following main distributors / manufacturers:

Distributors	Links
AEG	http://www.aeg.com/node369.asp?categoryid=1
Airwell	http://www.airwell.com/
Daikin	http://www.daikin.com/
DeLonghi	http://www.delonghi.com/
Fujitsu	http://www.fujitsu.com/global/
Hitachi	http://www.hitachi.com/
Klimavent	http://www.klimavent.ch/klimavent/default.asp
LG	http://www.lg.com/global/index.jsp
Mitsubishi	http://global.mitsubishielectric.com/products/airconditioning/index.html
Olimpia splendid	http://www.olimpiasplendid.com/index.php
Sanyo	http://sanyo.com/
Stiebel Eltron	http://www.stiebel-eltron.de/en/privatkunden/
Subag tech AG	http://www.subag-tech.ch/
Technibel	http://www.technibel.com/lang_uk/home.html
Toshiba	http://www.toshibaclim.com/

List of producers/manufacturers

5. Topten Selection Criteria

5.1. Euro-Topten selection criteria

Partners of the Euro-Topten Max project interested in selecting room air conditioners may have their own selection criteria, since they should be adapted to their market. At the European level, on www.topten.eu, the current requirements to selected BAT and best models are the following:

Air conditioner type	Cooling mode		Heating mode
	EER Topten	EER class A	COP Topten / class A
Compact - through-the-wall	> 3.0	> 3.0	> 3.4
Compact - single- and double-duct	> 3.0	> 2.6	> 3.0
Mobile split	> 3.2	> 3.2	> 3.6
Split < 4kW	> 5.0	> 3.2	> 3.6
Split > 4kW	> 4.1	> 3.2	> 3.6
Multi-split	> 3.5	> 3.2	> 3.6

Topten recognize six categories of air conditioners below 12 kW, and does not mix split and multi-split. Today, no through the wall model is able to comply with the Topten criteria and on line on www.topten.eu, single- and double-ducts and mobile split are grouped together on one list (therefore there are less product tables on line than the 6 categories – but the various criteria above apply anyway).

5.1.1. Input for possible revision of criteria

To be in-line with the labelling Directive and Eco-Design requirement, Topten.eu will soon:

- Define selection criteria based on the seasonal performance for air conditioners, regarding the cooling and the heating functions (except single ducts and, if no variable speed double ducts are on the market, double ducts).
- Define stricter non-seasonal efficiency selection criteria for single ducts (and double ducts, if no variable speed double ducts enter the market)
- Ask manufacturers about the type of refrigerants (as an information to feature in the Topten Table), and possibly exclude some of them.

As stated above, the European Commission has adopted Seasonal Energy Efficiency Indicators (SEER for cooling and SCOP for heating) within the latest regulations:

Minimum SEER and SCOP levels according to the Ecodesign regulaiton are depending on

- type of device
- Global Warming Potential (GWP) of refrigerant
- Capacity of device (in kW)

Based on more elaborate market research these values should be adapted (hence: strengthened) to guarantee that only the most energy efficient devices are selected.

5.2. National Topten selection criteria

At the national level, Topten selection criteira can be driven by the market (e.g. absence of the most efficient models spotted at EU level), or by specific policies (e.g. a rebate programme). As soon as new models are on the market with declaration based on the Labelling regulation, national selection criteria should be adapted to seasonal performance indicators and to reflect the market development.

- **Topten Switzerland selection criteria**

Switzerland separates split and multi-split in two capacity (<4kW, >4kW), and presents five categories of air conditioners.

Device	EER
Monoblocs compact	**≥ 3.0**
Mobile Split	**≥ 3.2**
Fixed Split/ capacity cooling < 4kW	**≥ 4.0**
Fixed Split/t capacity cooling > 4kW	**≥ 3.5**
Multisplit for some rooms	**≥ 3.3**

- **Topten Spain selection criteria**

Spain separates split and multisplit in two capacities (<4kW, >4kW), and has four categories of air conditioners.

Device	EER
Fixed Split/multisplit capacity cooling < 4kW	**> 4.3**
Fixed Split/multisplit capacity cooling > 4kW	**> 4.0**
Moveable Split	**> 3.2**
Compact	**> 3.0**

5.3. Topten product features

Once the selection criteria are set, we recommend that the following information is given in the Topten tables (i.e. there is no threshold but these are information of interest for consumers). 'Air conditioners' means air conditioners except single ducts and double ducts.

- Brand
- Model
- Type of air conditioner (Split / Multi-split / Double duct / Single ducts AND reversible / heating only / cooling only)
- Cooling capacity (W) (called 'design load' for air conditioners)
- Heating capacity (W) (called 'design load' for air conditioners, 3 values for 3 climate zones)
- Power input cooling
- For single and double ducts: EER (cooling) – For air conditioners: SEER
- For single and double ducts with heating function: COP (heating) – for air conditioners with heating function: SCOP (3 values for 3 climate zones)
- Energy class (heating/cooling if both functions are present). Air conditioners, heating function energy class (based on SCOP): 3 classes for 3 climate zones
- Electricity consumption (heating / cooling, in kWh/year for air conditioners with 3 values for the consumption by the heating function for 3 climate zones). For single and double ducts the energy consumption is indicated in kWh/h on the label.
- Electricity costs (heating / cooling, in Euros for 10 years). For air conditioners it is based on the kWh/year on the label for the relevant climate zone in countries (on topten.eu we may go for the middle value or that of Southern countries, because the Label assumes that in Northern countries more heating is done than in Southern countries. However, we think it is more Southern countries using ACs for heating..)
- Size indoor unit
- Size outdoor unit
- Noise emission: sound power level (dK(A)) of indoor and outdoor unit
- Name and Global Warming Potential (GWP) of the refrigerant

6. Additional Considerations

EN 378: 2008 "Refrigerating systems and heat pumps — Safety and environmental requirements"

European Standard for the design and construction of refrigeration systems.
It is published in four parts:
Part 1: Basic requirements, definitions, classification and selection criteria
Part 2: Design, construction, testing, marking and documentation
Part 3: Installation site and personal protection
Part 4: Operation, maintenance, repair and recovery

Part 4 gives some criteria on the recovery of refrigerants fluids. They have to respect some requirements regarding transport, recycling, use and stock.

EN 13313 Refrigerating systems and heat pumps. Competence of personnel
This European Standard establishes procedures for achieving and assessing the competence of persons who design, construct, install, inspect, test and commission, maintain, repair, decommission and dispose of refrigerating systems and heat pumps with respect to health, safety, environmental protection and energy conservation requirements.

IEC EN 60335-2-104 Household and similar electrical appliances - Safety - Part 2-104: Particular requirements for appliances to recover and/or recycle refrigerant from air conditioning and refrigeration equipment
Deals with the safety of electrical appliances to recover and/or recycle refrigerant from air conditioning and refrigeration equipment incorporating open drive or motor-compressors. The maximum rated voltage being not more than 250V for single phase appliances and 600V for all other appliances.

ISO 817: 2005 Refrigerants - Designation system
ISO 817:2005 provides an unambiguous system for numbering and assigning composition-designating prefixes to refrigerants. Tables listing the refrigerant designations are included. It is intended to be used with other relevant safety standards such as ISO 5149, IEC 603352-24 and IEC 60335-2-40.

ISO 11650 Performance of refrigerant recovery and/or recycling equipment
This International Standard specifies the test apparatus, test gas mixtures, sampling procedures and analytical techniques used to determine the performance of refrigerant recovery and/or recycling equipment.

This International Standard also specifies the refrigerants to be used for the evaluation of equipment, i.e. halogenated hydrocarbon refrigerants and blends containing halogenated hydrocarbons.

7. Bibliography

- **Links**

ASHRAE (The American Society of Heating, Refrigerating and Air-Conditioning Engineers), http://www.ashrae.org/

APEC-ESIS database (Asia Pacific Economic Cooperation – Energy Standard Information System)
http://www.apec-esis.org/list_reference.php

CEE (The Consortium for Energy)
http://www.cee1.org/

CLASP (Collaborating Labelling and Appliances Standards Program)
http://www.clasponline.org/index.php

ENERGY STAR
http://www.energystar.gov/

EU Energy Labelling
http://ec.europa.eu/energy/efficiency/labelling/energy_labelling_en.htm

European Network
http://www.eup-network.de/

Eurovent certification
http://www.eurovent-certification.com/index.php.en

Topten info
http://www.topten.info/

US department of energy
http://www1.eere.energy.gov/buildings/appliance_standards/residential/room_ac.html

- **Directives, labels, publications…**

Directive 2010/30/EU of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010L0030:en:NOT

Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings (recast), http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

Regulation No 206/2012/EU of 6 March 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for air conditioners and comfort fans, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:072:0007:0027:EN:PDF

Regulation No 626/2011/EU of 4 May 2011 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of air conditioners, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:178:0001:01:EN:HTML

JRC: Energy Efficiency Status Report 2012: Electricity consumption and efficiency trend in the EU-27. P. Bertoldi, B. Hirl, N. Labanca.

Preparatory study on environmental performances of residential room conditioning appliances – Draft of task 1 to 8 – March 2008