

# Product Criteria Paper

## Room Air Conditioners

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Coordinated by



## **The Project in brief**

Topten is part of the international Euro-Topten Plus 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](http://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 20 project partners are:

<b>Project Partner</b>	<b>Country</b>
Agence de l'Environnement et de la Maitrise de l'Energie (ADEME)	FR
Energy Research and Modernising Institute - ICEMENERG	RO
Ecological Center Luxembourg (Oeko-Zenter)	LU
Norwegian Society for the Conservation of Nature / friends of earth Norway	NO
Österreichische Energieagentur – Austrian Energy Agency (A.E.A.)	AT
WWF European Policy Programme AISBL (WWF EPO)	BE
ICLEI European Secretariat GmbH (ICLEI)	DE
WWF France	FR
WWF Belgium	BE
WWF Italy	IT
Quercus – National Association for Nature Conservation (Quercus)	PT
Wuppertal Institute for Climate, Environment and Energy (WIKUE)	DE
World wide fund for nature – WWF GR	GR
Polish Foundation for Energy Efficiency (FEWE)	PL
WWF Spain	ES
ESCAN, S.A.	ES
SEVEn, The Energy Efficiency Center (SEVEn)	CZ
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# Criteria Paper for Room Air Conditioners

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## 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 publicised. 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](http://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 thermodynamics devices where a gas or liquid refrigerant fluid circulate 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 the labelling Directive 2002/31/EC and the Directive on Energy Performance of Buildings 2002/91/EC. 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 between 4 and 12 kW.

## 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
- **Single ducts units:** a condenser intake air is introduced from the space containing the unit and discharged outside this space
- **Double ducts 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
- **(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".

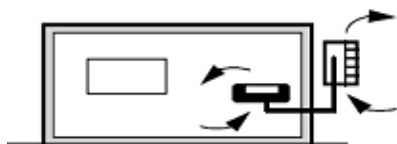
### Split-packaged units

This type of appliance comprises two packages: one indoor and one outdoor unit connected only by the pipe that transfers the refrigerant.

Indoor unit(s) can be ducted or non-ducted. In that 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:



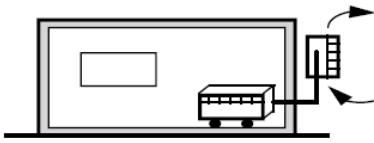
#### Outdoor unit:



#### Mobile split:

The outdoor unit containing the condenser, while the indoor unit has the compressor. The two units are connected by a pipe containing the refrigerant.

Indoor and outdoor mobile split:

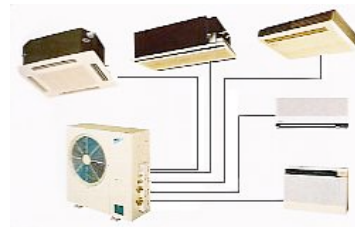
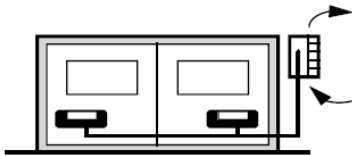


## Multi-Split-packaged units

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.

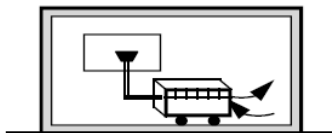


## Single-packaged units

### Single-duct units

#### Compact system

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

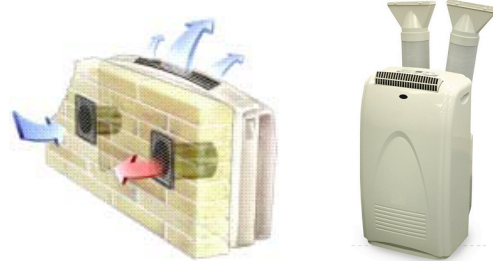
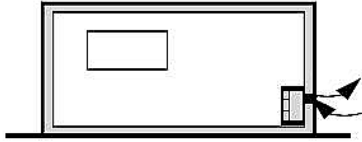


This type of equipment are noisy and generally used with an open windows to evacuate hot air, so performances are debatable and it is difficult to properly measure the thermal effect.

## 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.

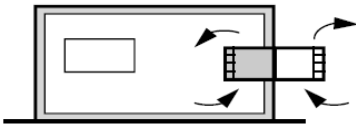


By blowing the air outside through its duct, a single duct actually creates a low pressure in the room, and – usually warm – air from other rooms or outside flows into the room. Double ducts do not have this problem and the airflow into the room is better controlled thanks to their intake hose. They 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.

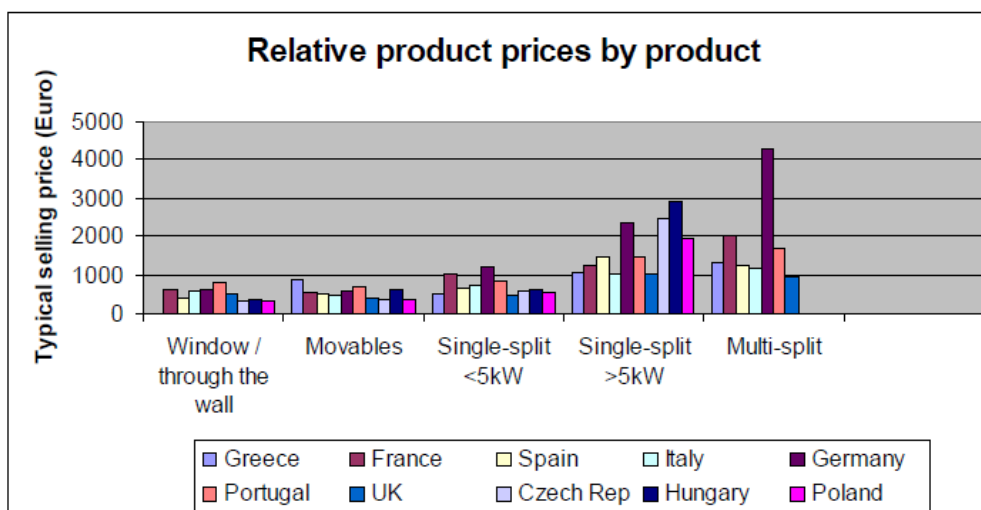


This type of equipment comprises a single package, one side of which is in contact with the outside air heat release outside, while the other side provides direct cooling to the air inside.

The two sides of the appliance are separated by a dividing wall, which is insulated to reduce heat transfer between the two sides.

## Prices Information

1.



2. 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)
<b>Reversible split air conditioners</b>					
3,5 kW	12 years	683	67	1 000	1 489
7,1 kW	12 years	1 385	95	1 000	3 150
<b>Cooling only split air conditioners</b>					
3,5 kW	12 years	683	67	1 000	445
7,1 kW	12 years	1 385	95	1 000	969
<b>Single duct air conditioners</b>					
	12 years	389,4	15,6	0	394

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

### 2.3. Best Available Technology

#### Variable frequency drive and permanent magnet motor

The 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. 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.

An other 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 CO<sub>2</sub> 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).

$EER = \text{cooling capacity (W)} / \text{power input (W)}$ .

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) + 7°C.

$COP = \text{heating capacity (W)} / \text{power input (W)}$ .

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.

Many countries have been applying seasonal efficiency indicators while the EU is about to introduce them through its new measurement standard (expected in March 2012)

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

Current and future MEPS requirements are set out in AS/NZS 3823.2-2005.

In addition:

- At least one unit has to be tested (or simulated) and results supplied with the application
- Physical tests in a calorimeter or using the enthalpy method are acceptable
- Simulation to AS/NZS 3823.3 is an acceptable alternative to physical tests
- Cooling capacity and energy consumption is determined to condition T1
- Heating capacity and energy consumption is determined to condition H1 (ISO condition "high")
- For each unit tested, the measured capacity shall be > 0.95 of the rated value
- For each unit tested, the measured energy consumption shall be < 1.05 of the rated value.
- Tolerance of 10 % is allowed on the EER.

		Cooling only – Minimum EER				Reverse cycle – Minimum EER			
Windows/Wall	Rated cooling capacity (kW)	< 7,5	7,5 to < 10	10 to 18,9		< 7,5	7,5 to < 11	11 to 18,9	
		2,84	2,84	2,75		2,84	2,84	2,75	
Non duct split	Rated cooling capacity (kW)	< 4	4 to < 7,5	7,5 to < 10	10 to 18,9	< 4	4 to < 7,5	7,5 to < 10	10 to 18,9
		3,33	2,93	2,93	2,75	3,33	2,93	2,93	2,75

4. Australia - Minimum EER for non-duct splits and non-duct units – Oct. 2008

➤ China

1) China's new standard for 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.

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.

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

5. 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

6. China Room Air Conditioner Energy Efficiency Criteria

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

2) **Topten China** proposes a different breakdown: To be selected in the Topten product list, the energy efficiency ratio (EER) of the air conditioner should not be lower than the following values

Total Cooling Capacity (CC, W)	EER (W/W)
CC ≤ 2800W	≥ 3.70
2800W < CC ≤ 4500W	≥ 3.65

For the free-standing air conditioner

Total Cooling Capacity (CC, W)	EER (W/W)
4500W ≤ CC ≤ 6000W	≥ 3.49
6000W < CC ≤ 7500W	≥ 3.40

➤ **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 is currently developing 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](http://www1.eere.energy.gov/buildings/appliance_standards/residential/room_ac.html)

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	Cooling power (kW)	Minimum EER ratio (W/W)
		Cooling only		
Windows/wall air conditioners	With louvered sides		less than 1,76	2,84
			1,76 to 2,34	2,84
			2,34 to 4,10	2,87
			4,10 to 5,86	2,84
			5,86 and over	2,49
	Without louvered sides		less than 1,77	2,64
			1,76 to 2,35	2,64
			2,34 to 4,11	2,49
			4,10 to 5,87	2,49
			5,86 and over	2,49
	Heating and cooling			
	With louvered sides		less than 5,86	2,64
			5,86 and more	2,49
	Without louvered sides		less than 4,10	2,49
			4,10 and more	2,34
	Casement only		-	2,55
	Casement sliders		-	2,78

7. USA - Requirements for residential room air conditioners – window/wall single package air conditioners - and central air conditioners

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](http://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	Subcategory	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 high velocity, air cooled	<65 000 Btu/h (19kW)	all	Split system	10,0 SEER (2,93)	
Air conditioners, water end evaporatively cooled	<65 000 Btu/h (19kW)	all	Split system and single package	12,1 EER (3,5)	

Source: ASHRAE 90.1-2007

**3) The Consortium for Energy Efficiency (CEE)** is a non-profit public benefits corporation whose aim is to promote manufacture and purchase of energy efficient unitary equipment and services. Its members include utilities, state-wide and regional market transformation administrators, environmental groups, research organisations and State energy offices throughout the US and Canada. Contributing members also include the USDOE and the USEPA.

CEE has established peak efficiency tiers for packaged (unitary) air conditioners and heat pumps. ( <http://www.cee1.org> )

Equipment type	Size category	Sub-category	CEE Tier 1 Btu/h (w/w)	CEE Tier 2 Btu/h (w/w)
Air cooled air conditioners	<65000 Btu/h (19kW)	Split system	14.0 SEER (4.10) 12.0 EER (3.51)	15.0 SEER (4.39) 12.5 EER (3.66)
		Single packaged	14.0 SEER (4.10) 11.6 EER (3.40)	15.0 SEER (4.39) 12.0 EER (3.51)
Water cooled air conditioners	<65000 Btu/h (19kW)	Split system	14.0 SEER (4.10)	No specification
		Single packaged	14.0 SEER (4.10)	No specification

8. CEE commercial unitary AC and HP specification. Unitary air conditioning specification  
Effective January 16, 2009 (<http://www.cee1.org/com/hecac/hecac-tiers.pdf>)

**4) 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)	Federal Standard EER, with louvered sides		ENERGY STAR EER, with louvered sides		Federal Standard EER, without louvered sides		ENERGY STAR EER, without louvered sides	
	Btu/hr/W	W/W	Btu/hr/W	W/W	Btu/hr/W	W/W	Btu/hr/W	W/W
< 6,000 (1,76kW)	≥ 9.7	≥ 2,84	≥ 10.7	≥ 3,13	≥ 9.0	≥ 2,63	≥ 9.9	≥ 2.9

<b>6,000 to 7,999</b> (1,76kW to 2,343kW)								
<b>8,000 to 13,999</b> (2,344kW to 4,101kW)	≥ 9.8	≥ 2,87	≥ 10.8	≥ 3,16	≥ 8.5    ≥ 2,49		≥ 9.4	≥ 2,75
<b>14,000 to 19,999</b> (4,102kW to 5,859kW)	≥ 9.7	≥ 2,84	≥ 10.7	≥ 3,13				
<b>≥ 20,000</b> (5,860kW)	≥ 8.5	≥ 2,49	≥ 9.4	≥ 2,75				
<b>Casement</b>	<b>Federal Standard EER</b>				<b>ENERGY STAR EER</b>			
Casement-only	≥ 8.7 (2.55)				≥ 9.6 (2.81)			
Casement-slider	≥ 9.5 (2.78)				≥ 10.5 (3.07)			
<b>REVERSE CYCLE</b>								
<b>Capacity (Btu/Hr)</b>	<b>Federal Standard EER, with louvered sides</b>		<b>ENERGY STAR EER, with louvered sides</b>		<b>Federal Standard EER, without louvered sides</b>		<b>ENERGY STAR EER, without louvered sides</b>	
	<b>Btu/hr/W</b>	<b>W/W</b>	<b>Btu/hr/W</b>	<b>W/W</b>	<b>Btu/hr/W</b>	<b>W/W</b>	<b>Btu/hr/W</b>	<b>W/W</b>
<b>&lt; 14,000</b> (4,102kW)	n/a	n/a	n/a	n/a	≥ 8.5	≥ 2,49	≥ 9.4	≥ 2,75
<b>≥ 14,000</b> (4,102kW)					≥ 8.0	≥ 3,15	≥ 8.8	≥ 2,57
<b>&lt; 20,000</b> (5,860kW)	≥ 9.0	≥ 2,63	≥ 9.9	≥ 2.9	n/a    n/a		n/a	n/a
<b>≥ 20,000</b> (5,860kW)	≥ 8.5	≥ 2,49	≥ 9.4	≥ 2,75				

#### 9. Energy Star air room conditioners eligibility

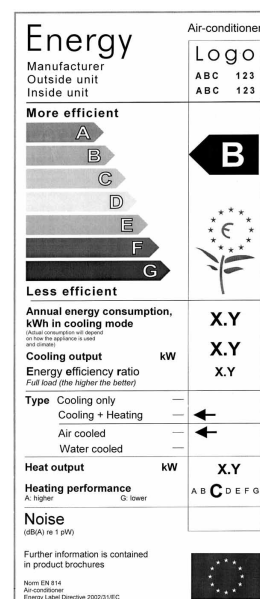
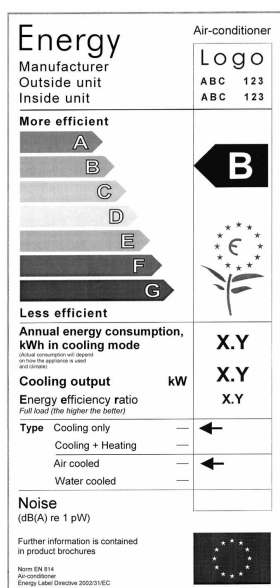
### 2.4.3. Europe

The current regulation is framed by Directive 2002/31/EC of March 2002 on energy labelling of household air-conditioners. However, two major regulations were recently developed: an Eco-design regulation (with no number yet since expected to be published in 2012, which sets minimum energy performance standards) and a new labelling regulation n°626/2011.

We present below the two regulations.

#### 2.4.3.1. Current European regulation (valid until December 2012)

Directive 2002/31/EC only stipulates the existence of a mandatory information label which looks like this.



#### 10. Label for cooling only appliances

#### Label for cooling/heating appliances

Under this label, air conditioners are classified in energy classes according to the following elements:

Energy efficiency class	Air-cooled air conditioners			Water-cooled air conditioners	
	Split and multi split appliances	Packaged (*)	Single duct	Split and multi split appliances	Packaged (*)
<b>A</b>	$3,20 < \text{EER}$	$3,00 < \text{EER}$	$2,60 < \text{EER}$	$3,60 < \text{EER}$	$4,40 < \text{EER}$
<b>B</b>	$3,20 \geq \text{EER} > 3,00$	$3,00 \geq \text{EER} > 2,80$	$2,60 \geq \text{EER} > 2,40$	$3,60 \geq \text{EER} > 3,30$	$4,40 \geq \text{EER} > 4,10$
<b>C</b>	$3,00 \geq \text{EER} > 2,80$	$2,80 \geq \text{EER} > 2,60$	$2,40 \geq \text{EER} > 2,20$	$3,30 \geq \text{EER} > 3,10$	$4,10 \geq \text{EER} > 3,80$
<b>D</b>	$2,80 \geq \text{EER} > 2,60$	$2,60 \geq \text{EER} > 2,40$	$2,20 \geq \text{EER} > 2,00$	$3,10 \geq \text{EER} > 2,80$	$3,80 \geq \text{EER} > 3,50$
<b>E</b>	$2,60 \geq \text{EER} > 2,40$	$2,40 \geq \text{EER} > 2,20$	$2,00 \geq \text{EER} > 1,80$	$2,80 \geq \text{EER} > 2,50$	$3,50 \geq \text{EER} > 3,20$
<b>F</b>	$2,40 \geq \text{EER} > 2,20$	$2,20 \geq \text{EER} > 2,00$	$1,80 \geq \text{EER} > 1,60$	$2,50 \geq \text{EER} > 2,20$	$3,20 \geq \text{EER} > 2,90$
<b>G</b>	$2,20 \geq \text{EER}$	$2,00 \geq \text{EER}$	$1,60 \geq \text{EER}$	$2,20 \geq \text{EER}$	$2,90 \geq \text{EER}$

- Packaged 'double ducts' units (known commercially as 'double ducts') defined as 'Air conditioner completely positioned inside the conditioned space, with the condenser air intake and air discharge connected to the outside by means of two ducts', will be classified according to Table 1.2 with a correction factor of - 0,4.

#### 11. Europe, current Directive until December 2012, cooling mode

Energy efficiency class	Air-cooled air conditioners			Water-cooled air conditioners	
	Split and multi split appliances	Packaged (*)	Single duct	Split and multi split appliances	Packaged (*)
A	$3,60 < \text{COP}$	$3,40 < \text{COP}$	$3,00 < \text{COP}$	$4,00 < \text{COP}$	$4,70 < \text{COP}$
B	$3,60 \geq \text{COP} > 3,40$	$3,40 \geq \text{COP} > 3,20$	$3,00 \geq \text{COP} > 2,80$	$4,00 \geq \text{COP} > 3,70$	$4,70 \geq \text{COP} > 4,40$
C	$3,40 \geq \text{COP} > 3,20$	$3,20 \geq \text{COP} > 3,00$	$2,80 \geq \text{COP} > 2,60$	$3,70 \geq \text{COP} > 3,40$	$4,40 \geq \text{COP} > 4,10$
D	$3,20 \geq \text{COP} > 2,80$	$3,00 \geq \text{COP} > 2,60$	$2,60 \geq \text{COP} > 2,40$	$3,40 \geq \text{COP} > 3,10$	$4,10 \geq \text{COP} > 3,80$
E	$2,80 \geq \text{COP} > 2,60$	$2,60 \geq \text{COP} > 2,40$	$2,40 \geq \text{COP} > 2,10$	$3,10 \geq \text{COP} > 2,80$	$3,80 \geq \text{COP} > 3,50$
F	$2,60 \geq \text{COP} > 2,40$	$2,40 \geq \text{COP} > 2,20$	$2,10 \geq \text{COP} > 1,80$	$2,80 \geq \text{COP} > 2,50$	$3,50 \geq \text{COP} > 3,20$
G	$2,40 \geq \text{COP}$	$2,20 \geq \text{COP}$	$1,80 \geq \text{COP}$	$2,50 \geq \text{COP}$	$3,20 \geq \text{COP}$

\* Packaged 'double ducts' units (known commercially as 'double ducts') defined as 'Air conditioner completely positioned inside the conditioned space, with the condenser air intake and air discharge connected to the outside by means of two ducts', will be classified according to Table 3.2 with a correction factor of – 0,4.

## 12. Europe, current Directive until December 2012, heating mode

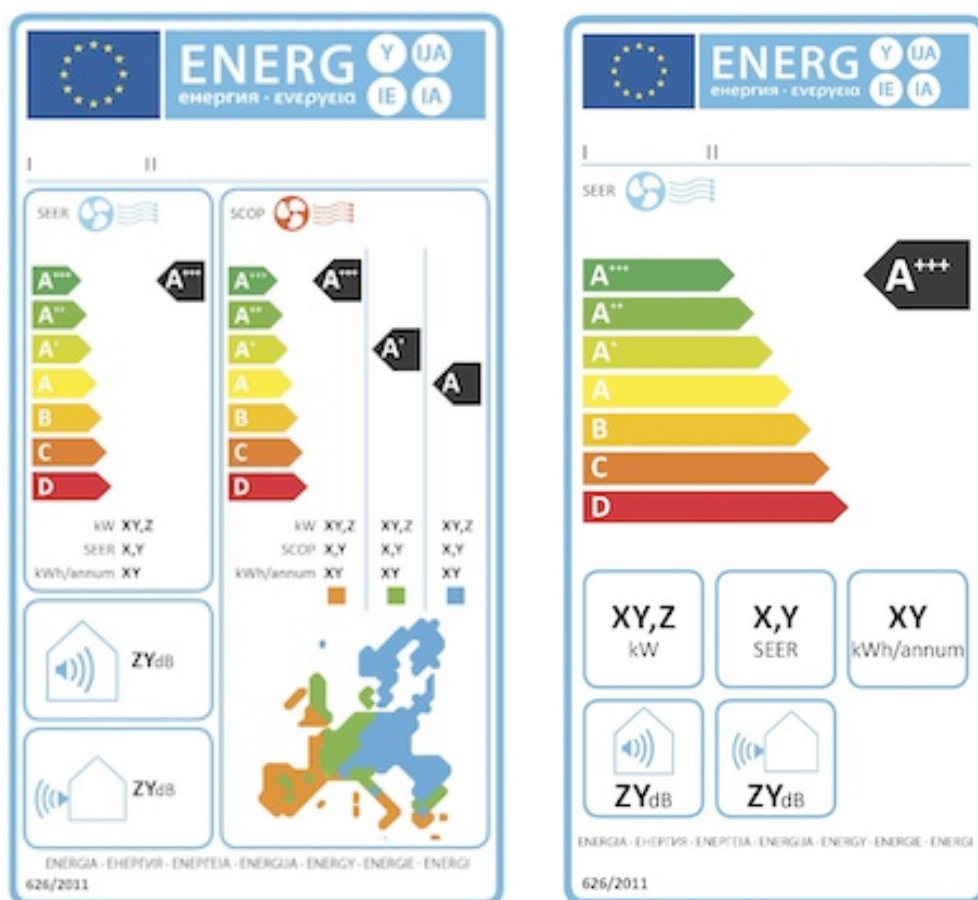
### 2.4.3.2. Future European regulations

#### New energy label

The new energy labelling regulation has been adopted and published in the Official Journal of the European Union. From 1. January 2013 the new energy label will apply, 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+++	$\geq 8,5$	$\geq 5,1$	$\geq 4,1$	$\geq 4,6$	$\geq 4,1$	$\geq 3,6$
A++	$\geq 6,1$	$\geq 4,6$	$\geq 3,6$	$\geq 4,1$	$\geq 3,6$	$\geq 3,1$
A+	$\geq 5,6$	$\geq 4,0$	$\geq 3,1$	$\geq 3,6$	$\geq 3,1$	$\geq 2,6$
A	$\geq 5,1$	$\geq 3,4$	$\geq 2,6$	$\geq 3,1$	$\geq 2,6$	$\geq 2,3$
B	$\geq 4,6$	$\geq 3,1$	$\geq 2,4$	$\geq 2,6$	$\geq 2,4$	$\geq 2,0$
C	$\geq 4,1$	$\geq 2,8$	$\geq 2,1$	$\geq 2,4$	$\geq 2,1$	$\geq 1,8$
D	$\geq 3,6$	$\geq 2,5$	$\geq 1,8$	$\geq 2,0$	$\geq 1,8$	$\geq 1,6$
E	$\geq 3,1$	$\geq 2,2$	$\geq 1,6$	$\geq 1,8$	$\geq 1,6$	$\geq 1,4$
F	$\geq 2,6$	$\geq 1,9$	$\geq 1,4$	$\geq 1,6$	$\geq 1,4$	$\geq 1,2$
G	$< 2,6$	$< 1,9$	$< 1,4$	$< 1,6$	$< 1,4$	$< 1,2$



### 13. Energy label layouts for reversible and for cooling only air conditioners

#### **Future Eco-design requirement**

The proposed Eco-design requirements are expected to be published in the Official Journal soon.

According to the latest documents, these requirements – which are the core of the regulation – concern:

1) Minimum energy performance levels in order to be allowed on the European market, planned to enter into force in 2013 and 2014. The proposed requirements are shown in the table below:

#### **Proposed minimum efficiency requirements and BAT**

<b>MEPS</b>	Room air conditioners		Double ducts		Single ducts	
	SEER	SCOP	EER	COP	EER	COP
2013	3.6	3.2	2.4	2.36	2.4	1.8
2014	4.3	3.5	2.6	2.6	2.6	2.04
<b>BAT EU 2010</b>	EER: 5.63 COP: 5.68		EER: 3.22		EER: 3.59	
<b>2011*</b>	SEER: close to 9 SCOP: close to 6					

2) The Global Warming Potential (GWP) of refrigerants. A difference is made between:

- Refrigerants with GWP > 150
- Refrigerants with GWP < 150

Air conditioners using refrigerants with GWP < 150 get a 10% reduction of the required energy efficiency level.

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. CO<sub>2</sub> is a promising future refrigerant candidate, but compressor adaptations are needed as it requires a higher pressure.

<i>Refrigerant</i>	<i>GWP</i>
<i>R22 (HCFC)</i>	<i>1700</i>
<i>R407C (HFC)</i>	<i>1653</i>
<i>R410A (HFC)</i>	<i>1725</i>
<i>HFOs</i>	<i>around 4</i>
<i>R290 (Propane)</i>	<i>3</i>
<i>CO<sub>2</sub></i>	<i>1</i>

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

3) Noise emission: a maximum sound power level will be introduced (details will be provided when the final regulation is published).

#### 2.4.3.3. 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 Conditioners  up to 12 kW12 to 45 kW45 to 100 kW	AC1 AC2 AC3	Air cooled	A	Split	S	Cooling only	C	High wall	W
								Floor mounted	L
								Cassette	C
								Ceiling suspended	S
		Water cooled	W	Multisplit	M	Reverse cycle	R	Built-in-horizontal	B
								Built-in-vertical	V
								Roof top	R
								Window	Wi
				Packaged	P				

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**

Part 3 of EN 14511, “air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for heating and cooling”, specifies the test methods for the rating and performance of air and water-cooled air conditioners, liquid chilling packages, air-to-air, water-to-air, air-to-water and water-to-water heat pumps with electrically driven compressors when used for space heating and cooling. It also specifies the method of testing and reporting for heat recovery capacities, system reduced capacities and the capacity of individual indoor units of multisplit systems, where applicable.

Packaged units, single split and multisplit systems, as well as single duct and double duct units are covered by this standard.

In the case of units consisting of several parts, the standard applies only to those designed and supplied as a complete package, except for liquid chilling packages with remote condenser.

The units having their condenser cooled by air and by the evaporation of external additional water are not covered by this standard.

This standard does not apply to units using transcritical cycles, e.g. with CO<sub>2</sub> as refrigerant.

Installations used for heating and/or cooling of industrial processes are not within the scope of this standard.

A new measurement standard which also includes part load conditions (important to rate variable speed air conditioners) is being finalised in 2011. CEN expects its publication by march 2012.

##### **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](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

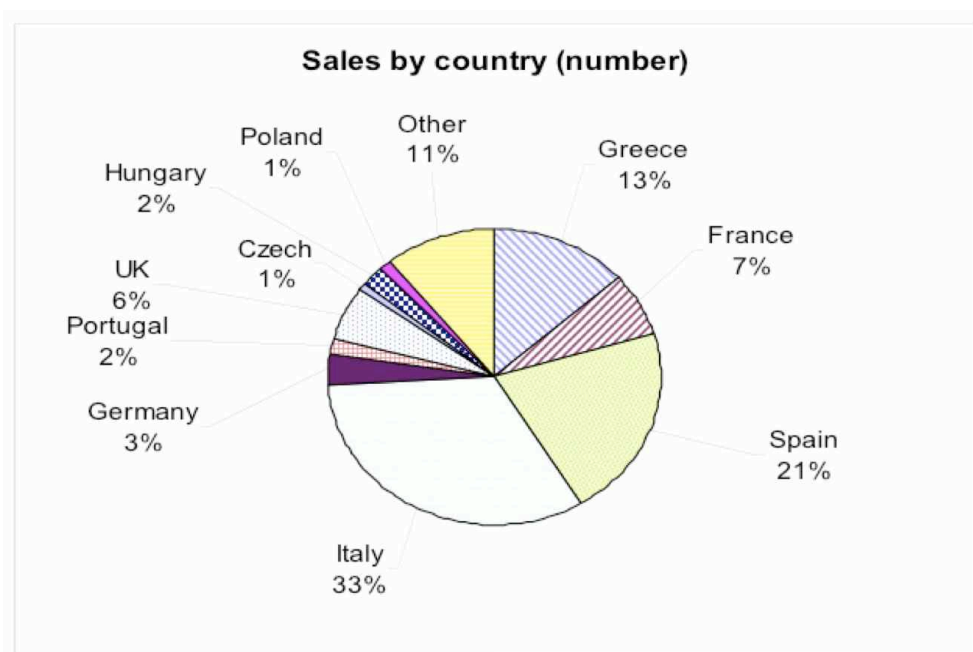
Source : Ecodesign – Lot10 – Task2 (Economic and market Analysis) – 2008, Room air conditioners: Recommendations for policy design, Topten.eu, May 2011.

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 growing. 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.

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.



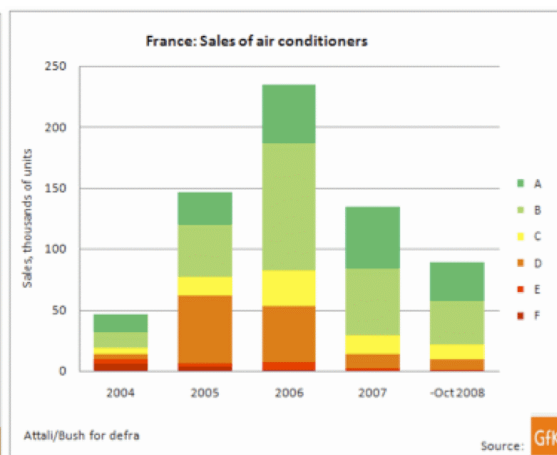
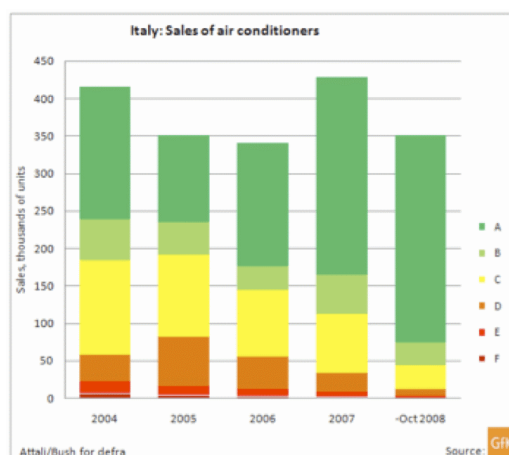
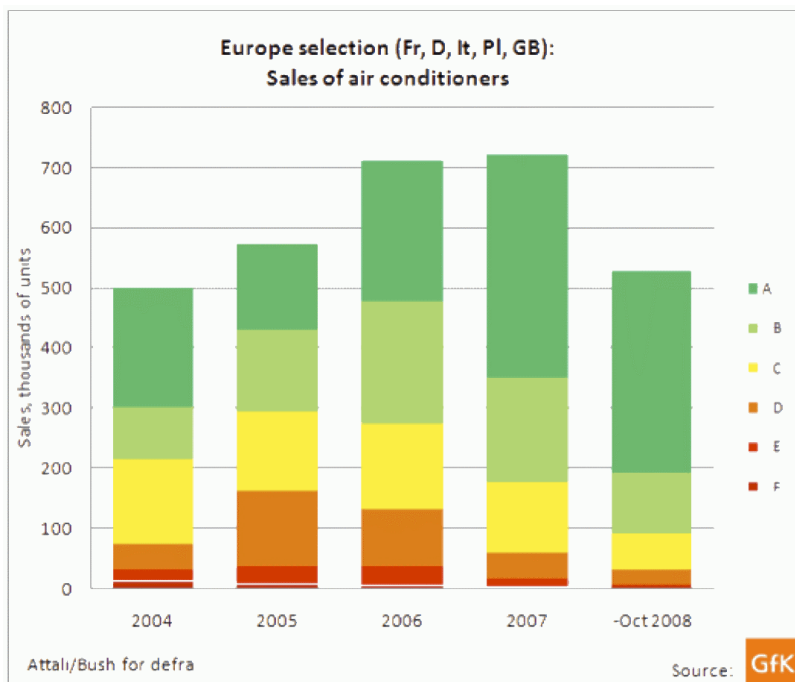
#### Reversible variable speed air conditioners are dominating the EU market

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).

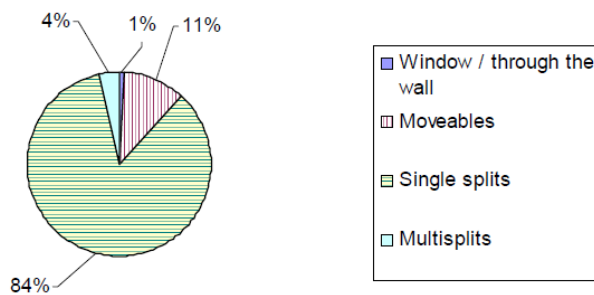


Air conditioner sales in 5 EU-countries, Italy and France, 2004 – October 2008.  
Source: GfK/Attali/Bush for Defra, 2009.

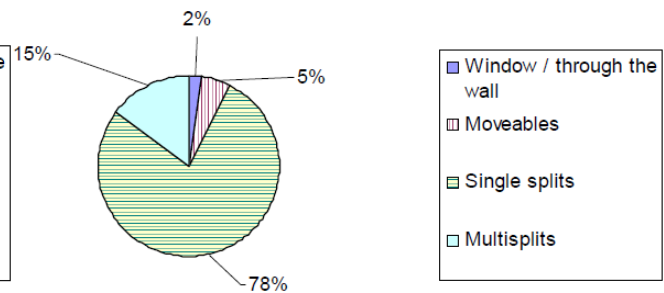


This market evolution seems to mainly have been triggered by the introduction of the energy label for air conditioners in 2002. By now high efficiency split air conditioners have Energy Efficiency Ratio (EER) values of up to 5.6 - way beyond the class A threshold of 3.2.

**Residential by Type (kW)**



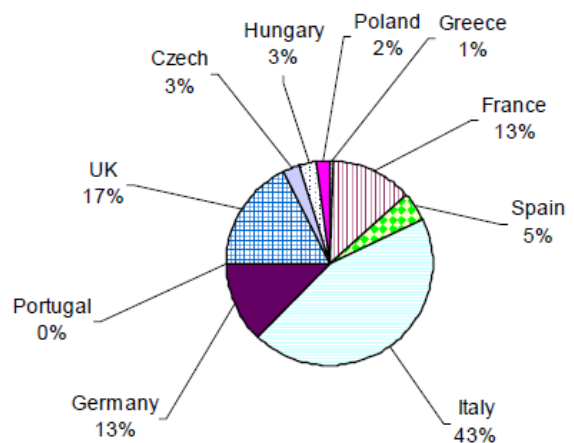
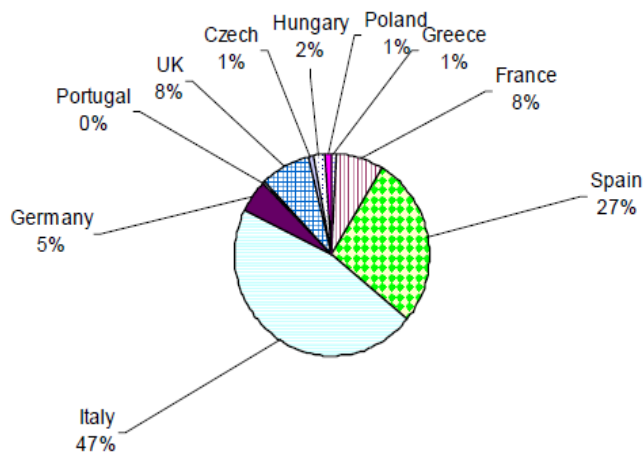
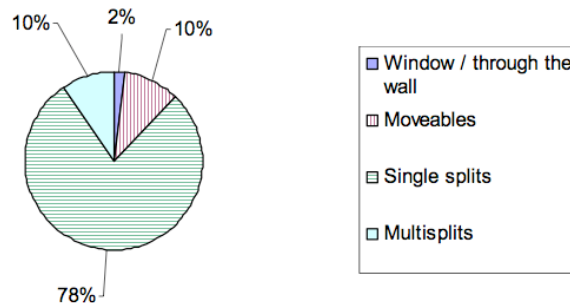
**Non-residential by type (kW)**



#### 14. Repartition by type in residential or non residential

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

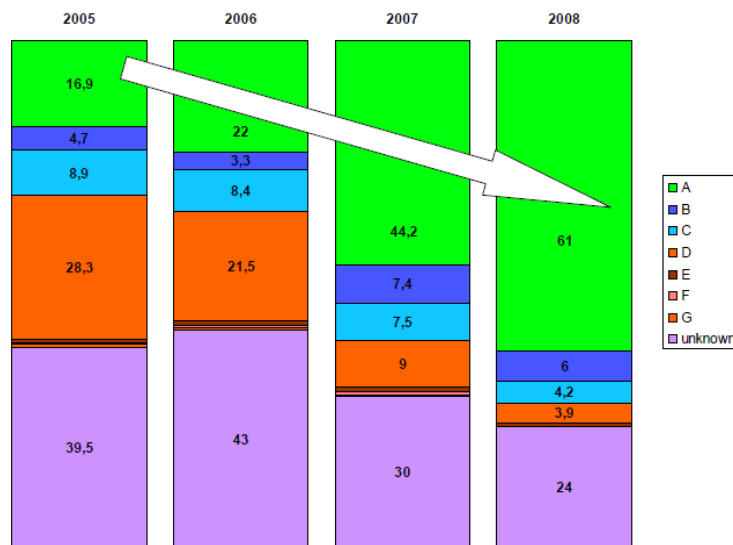
**Sales by Type (number)**



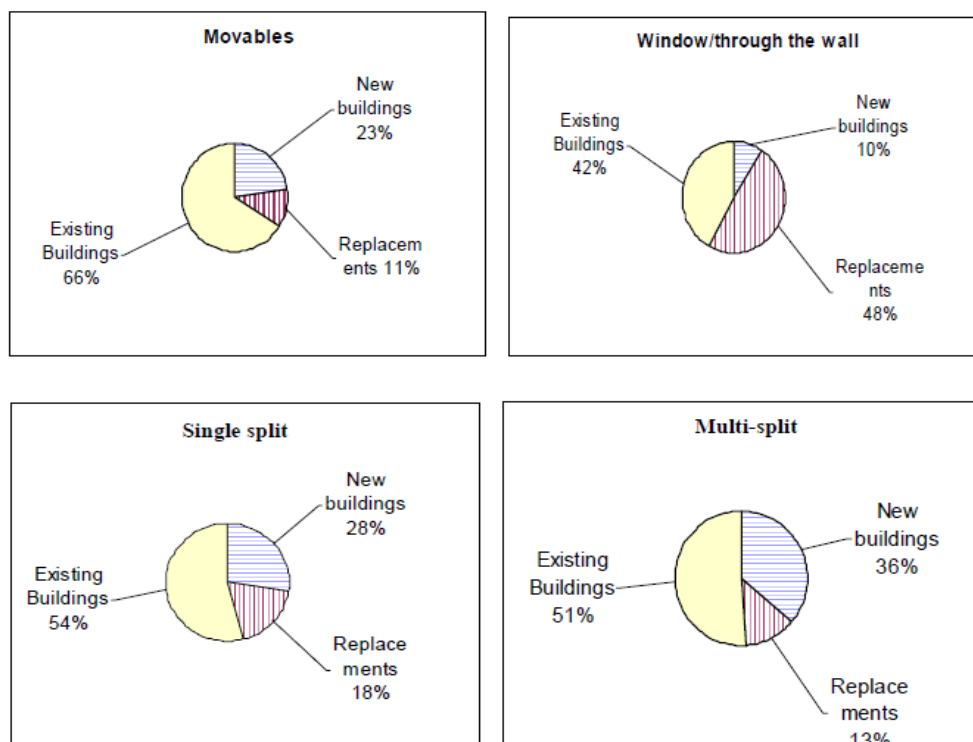
15. Cooling only split and multi split by country (kW) Moveable units by country (kW)

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.



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





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

18. List of producers/manufacturers

## 5. Topten Selection Criteria

### 5.1. Euro-Topten selection criteria

Partners of the Euro-Topten Plus 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](http://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](http://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).

In the future, and to be in-line with the coming labelling Directive and Eco-Design requirement, Topten.eu will

- set a seasonal requirement (as a selection criteria)
- ask manufacturers about the type of refrigerants (as an information to feature in the Topten Table), and possibly exclude some of them.

### 5.2. National Topten selection criteria

At the national level, Topten selection criteria 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).

#### ➤ Topten Switzerland selection criteria

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



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

➤ **Topten Spain selection criteria**

Spain separates split and multisplit in two capacity (<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 are given in the Topten tables (i.e. there is no threshold but these are information of interest for consumers)

- Brand
- Model
- Type of air conditioner
- Cooling capacity (W)
- Heating capacity (W)
- Power input cooling
- EER (cooling) – which will be replaced by SEER as soon as the products will be declared accordingly
- COP (heating) - which will be replaced by SCOP as soon as the products will be declared accordingly
- Energy class (heating/cooling)
- Electricity consumption (heating / cooling, in kWh/year)

- Electricity costs (heating / cooling, in Euros for 10 years). The hypotheses for calculating these costs are the same as those used for the values declared on the label. They are based on a cooling season of 350 hours and a heating season of 1 400 hours – except in cold areas, where the heating season is 2 100 hours.
- Size indoor unit
- Size outdoor unit
- Noise emission (according to by Directive 86/594/EEC) (however, noise is part of the requirements so this issue should be looked at when the regulation is published).



## 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](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](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](http://www1.eere.energy.gov/buildings/appliance_standards/residential/room_ac.html)

### ➤ Directives, labels, publications...

**Directive 2002/31/EC** of March 2002, on energy labelling of household air-conditioners.

**Electricity consumption and efficiency trends in European Union** - Status report 2009

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

**Commission Working Document on possible Eco-design Requirements for air-conditioning appliances and comfort fans**

**Commission Working Document on possible energy labelling requirements on air-conditioning appliances**