Room air conditioners: Recommendations for policy design

May 2012

1. Summary

Split variable speed (inverter) air conditioners are today's best available technology (BAT). The most efficient models on the European market reach an Energy Efficiency Ratio (EER; cooling function) of 5.63 and a Coefficient of Performance (COP; heating function) of 5.68.

The stock of air conditioners installed in Europe is expected to grow from today's 40 million units to over 110 million units by 2020. Total annual electricity consumption by air conditioners in Europe is estimated at more than 40 TWh in 2010, two thirds are attributed to the heating function. By 2020 electricity consumption will increase to around 75 TWh annually without any measures (business as usual). The planned measures are expected to lead to savings of around 12 TWh annually – only 25% of the expected increase in electricity consumption. Only with strict minimum efficiency requirements guided by today's BAT the expected electricity consumption increase can be made up for. The BAT should be the guideline for strict future minimum efficiency requirements, announced in advance. An effective energy label supports the development of more efficient appliances towards the BAT. The future energy label should guide consumers to the most efficient models by distinguishing them from less efficient products and making visible the low relative efficiency of single ducts and double ducts. But first of all, measurement methods and efficiency indicators taking into account the efficiency gains of part load operation are needed: seasonal energy efficiency ratio (SEER, cooling) and seasonal coefficient of performance (SCOP, heating) do account for the high efficiency of variable speed air conditioners, unlike non-seasonal efficiency indicators. A test project by Topten implies that SEER and SCOP values will be considerably higher than current EER and COP values. This should be accounted for in the design of the energy labelling scale and future minimum efficiency requirements.

Box 1: Air conditioner types	
  Outdoor- and indoor unit  Mobile split	**Split air conditioners** consist of an indoor- and an outdoor unit, fixedly installed. The condenser including the compressor is located in the outdoor unit, not delivering any waste heat indoors. Several indoor units can be connected to one outdoor unit – resulting in a **multi-split** air conditioner. **Mobile split** air conditioners have a portable indoor unit containing the compressor, which leads to less efficiency. Air conditioners that are neither a double duct nor a single duct are called **room air-conditioners (RAC)** by the EC Working document.
	**Single ducts** consist of one single unit placed freely in the room. The air is expelled through a duct, which requires a window to be open. Warm air is drawn into the room, as the condenser is cooled with air taken from the room – the cooling effect is small and only local.
	**Double ducts** also consist of one single unit, but have separate ducts for air intake and exhaust. Either double ducts are moveable and placed next to a window, or the ducts are mounted into the wall.
	**Through-the-window air conditioners** (also: compact or through-the-wall AC) are widespread in the USA, but of no importance in Europe. They are too compact to be efficient and need an opening in the insulation.

Box 2: What is the difference between SEER and EER / SCOP and COP?

The current energy label for air conditioners refers to the **Energy Efficiency Ratio** (EER, cooling function) and **Coefficient Of Performance** (COP, heating function) to express the energy efficiency of air conditioners. These indicators are measured at full load operation and do not account for the efficiency gains by variable speed (inverter) drives' ability to work at part load.
Seasonal efficiency indicators (SEER for cooling, SCOP or Heating Seasonal Performance Factor (HSPF) for heating) do consider the different cooling or heating needs during the year and thus include part load operation of air conditioners. Many non-EU countries have been applying seasonal efficiency indicators, while the EU is about to introduce them now. Yet no measurement standard has been established for SEER and SCOP in Europe. Therefore **only non-seasonal efficiency values are known for EU air conditioners**, while global BAT values are indicated as SEER or SCOP. European variable speed air conditioners will reach higher efficiency values when measured on a seasonal basis than they reach now expressed as EER or COP. The result will depend on the defined cooling and heating season characteristics (temperatures and duration). A Topten measurement project has shown that the difference in the resulting efficiency indicators measured according the current European full load standard or the draft future part load standard can be vast – at least for efficient variable speed air conditioners (SEER was EER + 3.6, SCOP was COP + 0.6).

2. Best available and average Technology

2.1. Energy efficiency: split variable speed air conditioners are the BAT

The most energy efficient air conditioners on today's EU market are split air conditioners with a variable speed compressor and a permanent-magnet motor. Fixedly installed, split air conditioners generally reach much higher efficiency values than moveable (single duct, double duct or mobile split) products. Only split air conditioners have both condenser and compressor located outside, not delivering waste heat indoors. Furthermore moveables are too compact as to allow efficient heat transfer. Single ducts additionally require a window to be open through which the exhaust air is blown, which makes an effective cooling of a room impossible. The real cooling effect can be 40% lower than the indicated cooling capacity (Brunner et al. 2008).
The inverter 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

Many split models with variable speed drive have been on the market, soon the first variable speed double ducts are introduced on the market (WD cover note, April 2010).

For the heating mode, some products switch to (electrical) resistance heating, a highly inefficient way of heating. Potentially efficient are products with a reversible heat pump instead.
Furthermore, small capacity air conditioners are more efficient than high capacity models.
Energy efficiency of air conditioners has been indicated by the EER (Energy Efficiency Ratio) for the cooling mode, and, if present, in COP (Coefficient of Performance) for the heating mode. These indicators give the ratio of the total cooling or heating output and the energy consumption.
Inefficient products on the market have EER of around 2 and COP around 2.4. Resistance heating results in a COP of 1.

Table 1 gives an overview on BAT (Best available Technology) EER and COP values found on the EU market. Efficiency coefficients vary strongly between the different air conditioner types.

Air conditioner type	EER: BAT in EU	COP: BAT in EU
Split < 4kW, variable speed	6	6.13
Multi split, variable speed	5.09	5.06
Split > 4kW, variable speed	4.52	4.79
Mobile split	3.26	3.67
Double duct	3.22	
Single duct	3.06 / 3.59 (water evaporation)	

Tab. 1: EER (cooling) and COP (heating) of Best available Products on the European market (source: www.topten.eu, May 2012)

Efficiency indicators depend on measurement standard

Air conditioners on Asian markets reach higher efficiency levels than in Europe: the most efficient variable speed air conditioner in China in 2010 has an SEER (Seasonal Energy Efficiency Ratio) of 7.30. Japanese products also reach SEER levels of 7 or EER of 6.6 and COP values of 6.9 (Riviere et al., 2009).

A test project by Topten in 2011 however implied that the European efficiency indicators are mainly low because of the yet missing part load condition measurement and not because European ACs are less efficient than Asian models. Variable speed air conditioners reach higher efficiency values when measured at part load conditions. Furthermore, the calculation method of the seasonal efficiency indicator has an influence on the result.

The testing project by Topten showed that European air conditioners can be expected to reach as high SEER and SCOP values as Asian models do when the new European part load standard is applied. The real efficiency level of the European BAT models seems to be comparable with efficient Chinese air conditioners. The European measurement standard has recently been revised (EN 14511:2011) and amended with a part load measurement standard (EN 14825:2012).

2.2. Refrigerants: promising natural substances

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 (Riviere et al., 2009). 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 (Riviere et al., 2009). CO_2 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
CO_2	1

Tab. 2: GWPs of common refrigerants in air conditioners. R22 is being phased out.

3. Market situation in Europe

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 (Riviere et al., 2009, Fig. 1).

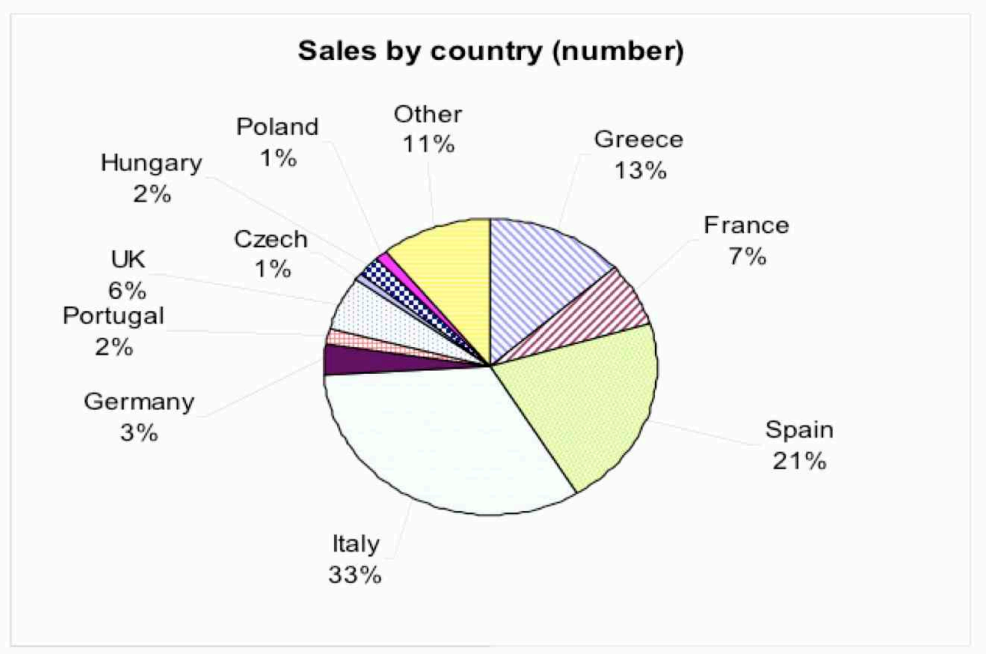


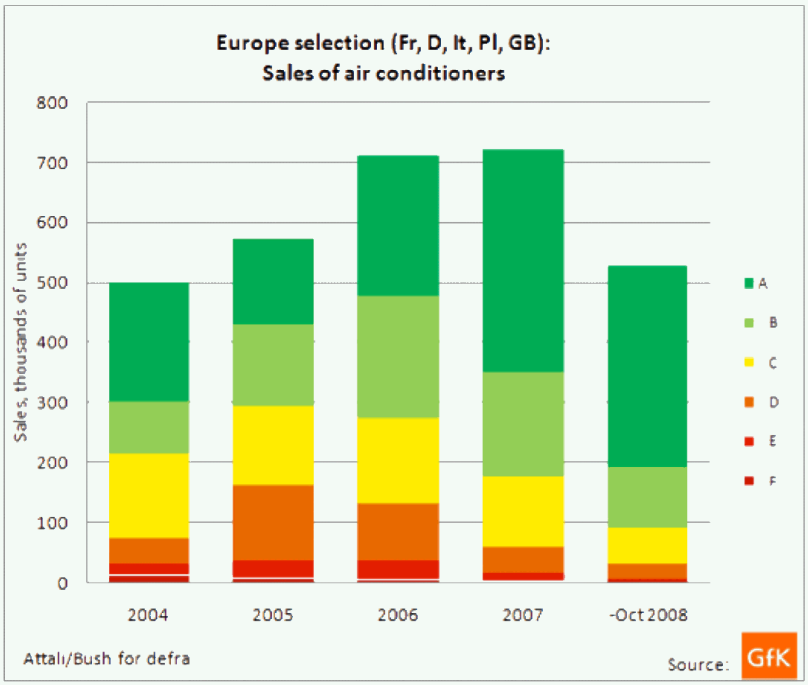
Fig. 1: Air conditioners sales shares (number of units) by country, EU-27. Source: Riviere et al., 2009.

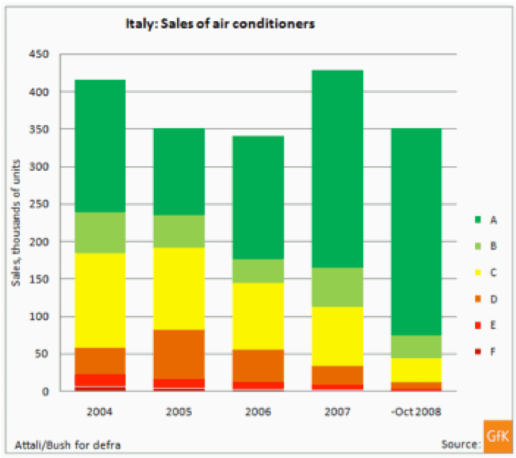
Reversible variable speed air conditioners are dominating the EU market

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 (Riviere et al., 2009).

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).





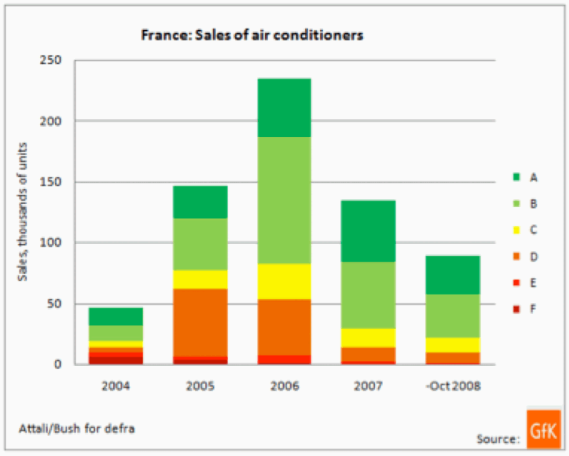


Fig. 2-4: Air conditioner sales in 5 EU-countries, Italy and France, 2004 – October 2008. Source: GfK/Attali/Bush for Defra, 2009.

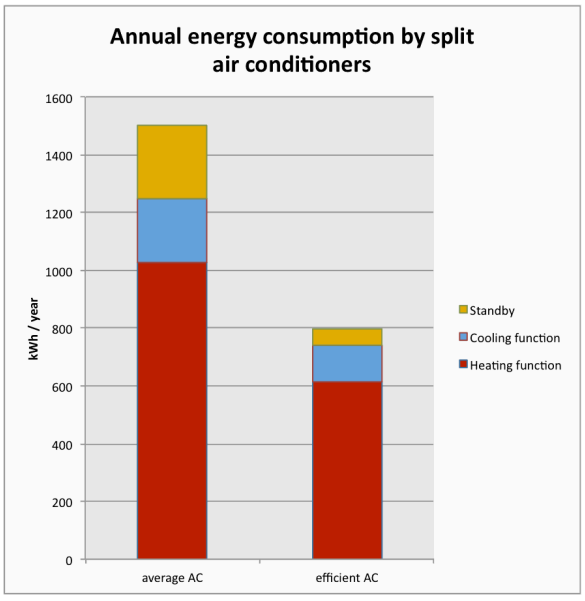
This market evolution seems to mainly have been triggered by the introduction of the energy label for air conditioners in 2002 (Bertoldi, Atanasiu, 2009). By now high efficiency split air conditioners have Energy Efficiency Ratio (EER) values of up to 5.6 - way beyond the class A threshold of 3.2. The introduction of the new energy label with classes of up to A+++ will start in 2012. From January 2013 the new label will be compulsory.

4. Energy consumption and saving potentials

Large differences in energy consumption between air conditioning types and models

Energy consumption during the use phase is dominating the overall environmental impact of air conditioners. 10-20% of the total greenhouse gas emissions are attributed to refrigerant leakage. In air conditioners featuring a heating mode, heating accounts for more than two thirds of the electrical consumption. The standby mode, including the crankcase heater, is usually responsible for around 10%, but especially crankcase heating without control can account for up to 25% of the total electricity consumption.

The total energy consumption depends mainly on the outdoor climate, building type and age, the capacity and the type of the appliance and can vary strongly.
An efficient split air conditioner with an EER of 5.63 and a COP of 5.68 consumes around 800 kWh per year[1]. According to Bertoldi, Atanasiu, 2009, the average EER of the air conditioner models sold in the EU-27 in 2008 was around 3.23, the average COP around 3.4. Such an average air conditioner consumes almost 90% more electricity than a BAT model – around 1500 kWh per year.
The most efficient moveable air conditioner is a single duct which supports its cooling effect with water evaporation. As long as the tank contains water this model reaches an EER of 3.59 (www.eurotopten.it). Purely air-cooled single ducts and double ducts don't reach higher efficiency values than 3.22, while most have EERs as low as 2.05. The real efficiency of single ducts and moveable double ducts is even lower than indicated, mainly because of the needed window opening. Inefficient single or double ducts consume around 400 kWh per year for local cooling only (Fig 5+6).



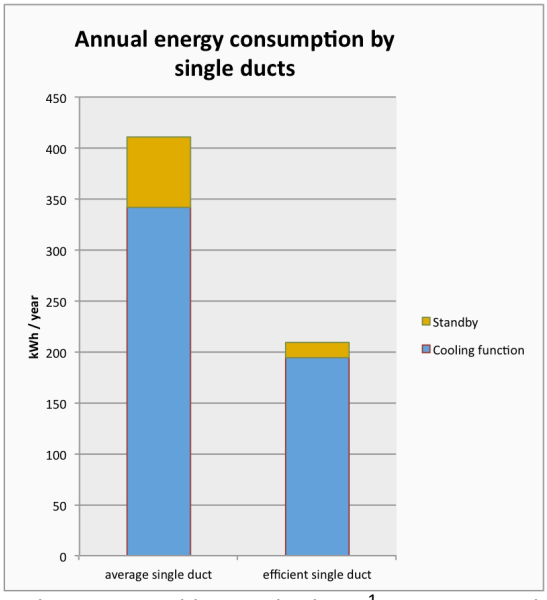


Fig. 5 + 6: Annual energy consumption by split air conditioners and by single ducts[1]. AC = reversible room air conditioner. Data source: topten.info, Bertoldi, Atanasiu 2009 and Riviere et al., 2009.

Increasing total consumption

Total annual electricity consumption by air conditioners in Europe is estimated at more than 40 TWh in 2010 (EC, 2009). Two thirds of the total consumption are attributed to the heating function (Riviere et al., 2009).
By 2020 electricity consumption will increase to around 75 TWh annually without any measures (business as usual) (EC, 2009), mainly due to higher market penetration (Riviere et al., 2009). The expected increase of 30 TWh annually corresponds to the production of almost five 750 MW-power plants.
The planned measures (minimum requirements and energy label) are expected to lead to savings of around 12 TWh annually by 2020 (EC, 2009) – only one third of the expected increase in electricity consumption.

[1] Assumed are 350 hours of operation in cooling , 1400 in heating mode, which is in line with the ecodesign working documents. Standby consumption includes thermostat off and crankcase heating. For average products standby consumption is assumed to account for 17%, for efficient products for 7% of the total consumption. All electricity consumption indications are for air conditioners with a cooling capacity of 2kW and a heating capacity of 2.5 kW.

BAT holds a high saving potential

The saving potential is higher than that: assuming that today's entire stock was replaced by BAT appliances would already lead to annual electricity savings of more than 12 TWh. The expected future stock of 110 million units in 2020 holds a saving potential of 31 TWh per year.

These calculations underestimate the real saving potential – because the effective efficiency of air conditioners with variable speed drive is higher than can be accounted for by the EER. The capability to save energy by running at partial load cannot be expressed with an EER – only with a Seasonal Energy Efficiency Ratio (SEER).

Still the calculations show that only with requiring today's BAT the expected electricity consumption increase of 30 TWh annually can be made up for.

5. Political instruments and initiatives

5.1. New measurement method: seasonal efficiency indicators

Until now, the electricity consumption of air conditioners was measured at full load operation, and the resulting efficiency indicator expressed as EER (cooling) or COP (heating function). Fix speed air conditioners reach a certain temperature by switching from full load operation to off, which is not efficient. Variable speed (also: inverter) air conditioners are more efficient than fix speed air conditioners, as they are able to work at part load and adapt their work load to the temperature change needed.

The old efficiency determination method however does not include part load operation. Consequently, the efficiency of variable speed air conditioners is not accounted for in the EER and COP values. Measurement methods and efficiency indicators taking into account part load operation are needed: seasonal energy efficiency ratio (SEER, cooling) and seasonal coefficient of performance (SCOP, heating) do consider varying cooling and heating needs during a year for a certain climate.

The need for seasonal efficiency indicators has been recognised by the ecodesign preparatory study (lot 10), and the current measurement standard EN14511 has been revised in 2011 and amended to include a method to measure and calculate seasonal performance indicators (EN 14825/2012). These seasonal performance indicators are the basis for the ecodesign requirements as well as for the revised energy label.

A testing project by Topten from 2011 implies that SEER values of variable speed air conditioners can be 3.6 points higher than the current EER values. For the heating function, the difference seems to be smaller (+0.6 for the tested model). Declarations according to the new measurement method will start to appear in the course of 2012, from 2013 all variable speed air conditioners will be rated according to their seasonal performance.

5.2. New energy label from 2013

The current (old) energy label for air conditioners was introduced in 2002, and it is accordingly outdated. It defines three different classification schemes: for split, compact (through-the-wall) air conditioners and for single – and double ducts (Tab. 3). Class A single- or double ducts (EER > 2.6) have the same energy efficiency ratio as a class D split appliance. At the same time, efficient split appliances reach much better values than the class A limit: the class A limit is at 3.2, while BAT split air conditioners reach EER values of 5.63! The current energy label allows no identification of the best appliances nor does it make visible the very low efficiency of single ducts and double ducts. Furthermore, the measurement tolerances of 15% are broader than the classes, which enabled 'creative' manufacturers to declare the efficiency of their products up to two classes above the real efficiency. The heating performance of air conditioners has not been displayed with the coloured arrows on the current energy label, only with a letter on the fiche indicating the efficiency class.

Current energy label

	Split and multi-split	Compact (through-the-wall)	Single- and double ducts
A	3.2 < EER	3.0 < EER	2.6 < EER
B	3.2 ≥ EER > 3.0	3.0 ≥ EER > 2.8	2.6 ≥ EER > 2.4
C	3.0 ≥ EER > 2.8	2.8 ≥ EER > 2.6	2.4 ≥ EER > 2.2
D	2.8 ≥ EER > 2.6	2.6 ≥ EER > 2.4	2.2 ≥ EER > 2.0
E	2.6 ≥ EER > 2.4	2.4 ≥ EER > 2.2	2.0 ≥ EER > 1.8
F	2.4 ≥ EER > 2.2	2.2 ≥ EER > 2.0	1.8 ≥ EER > 1.6
G	2.2 ≥ EER	2.0 ≥ EER	1.6 ≥ EER

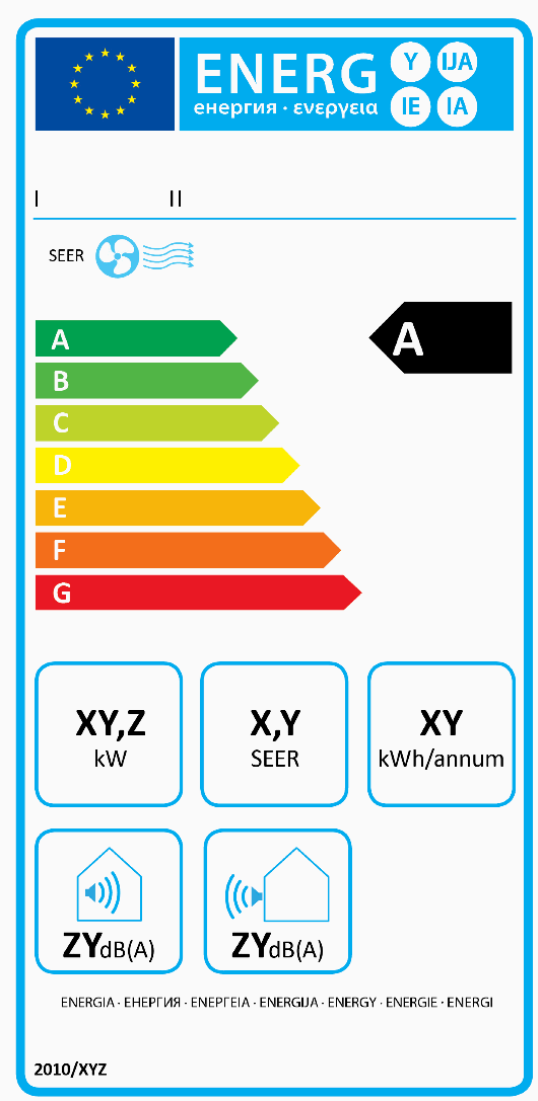
Tab. 3: current energy label classification (only cooling function efficiency (EER) is shown with arrows)

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

Tab. 4: classification scheme (incl. heating function) of the new energy label published in May 2011

In May 2011 the new energy labelling regulation has been published. 2012 will be the transition year, when the old label will still be present but first producers will start to label their products with the new label. From January 2013 the new label will be mandatory. The new label maintains three different labelling scales for double ducts, single ducts and all other air conditioners with a rated capacity of up to 12 kW (Tab. 4). Seasonal efficiency indicators are not applied for double ducts and single ducts, but effectively for split air conditioners only. The labelling scale results in a 10 class scheme ranging from A+++ to G. Appliances offering both cooling and heating function combine both scales on one label (Fig 7 + 8). The SEER of the heating function (only split air conditioners) is calculated depending on the climate zone, taking into account three different climate types. The proposed cooling efficiency scale for single and double ducts is identical, but the heating efficiency scale differs.



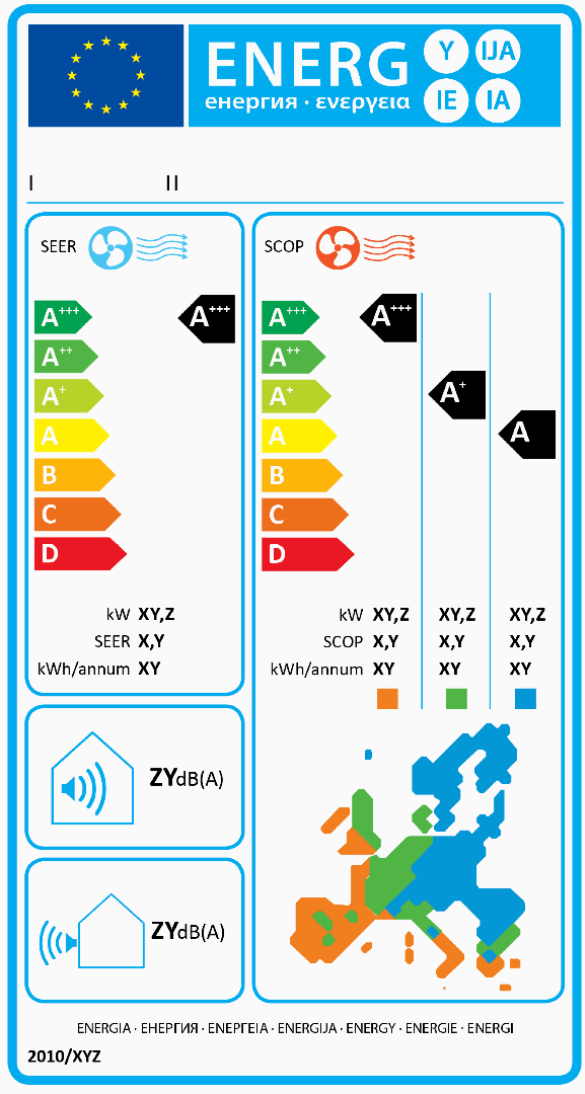


Fig. 7 + 8: Design of the new Energy label: for cooling only and for reversible appliances

5.3. Ecodesign regulation: gap to BAT

In March 2012 also the ecodesign regulation has been published in the Official Journal. Its requirements will apply from January 2013.

The draft regulation contains different minimum efficiency requirements for room air conditioners, single- and double-ducts, maximum power input for standby and off mode and maximum sound power levels. Appliances using refrigerants with a Global Warming Potential (GWP) below 150 receive a 10% reduction of the required efficiency levels. In tier 2 for large ACs (6-12kW) different, a bit less ambitious values are applied.

The minimum efficiency requirements for room air conditioners are based on a seasonal energy efficiency ratio, requirements for double ducts and single ducts are based on a non-seasonal (full load) energy efficiency ratio.

Ecodesign regulation: minimum efficiency requirements and BAT

MEPS	Room air conditioners SEER	SCOP	Double ducts EER	COP	Single ducts EER	COP
2013	3.6	3.4	2.4	2.36	2.4	1.8
2014	4.6	3.8	2.6	2.6	2.6	2.04
BAT EU 2012	EER: 6	COP: 6.13	EER: 3.22		EER: 3.59	
2011*	SEER: close to 9	SCOP: close to 6				

Tab. 5: Ecodesign requirements and BAT

* Results of a testing project by Topten in 2011 imply that variable speed air conditioner SEER values according to the new measurement standard will be more than 3.0 points higher than current EER and SCOP values 0.6 higher than COP values.

The introduction of a seasonal energy efficiency ratio for double ducts is foreseen for the next revision process (after 5 years), as accordingly the first models with variable speed drive are only about to enter the market.
Proposed standby and off mode requirements for single and double ducts are in line with the horizontal standby regulation 1275/2008, but are implemented some two years later. For single and double ducts the maximum power input values of 1W / 0.5W (Off mode and standby mode, tier 1/tier2) and 2W / 1W (Standby mode, with display) of the standby regulation are valid from 2013 and 2014 respectively. Standby and Off mode consumption by (split) room air conditioners is contained in the SEER calculation, no additional low power consumption requirements are proposed.

5.4. New energy label: A+++ classes already populated, no visualising of the low efficiency of single ducts and double ducts

The best split model on the EU market reaches an EER value of 5.63 and a COP of 5.68 – in terms of SEER and SCOP this model will reach higher values, as it operates with a variable speed drive. Based on the results of the Topten testing project (see chapter 5.1) this model can be expected to have a SEER of around 9 and a SCOP of around 6. Not only this BAT model, but also other air conditioning models below the BAT would end up in the A+++ classes for both cooling and heating function. All 6 models below 4kW on topten.eu can possibly reach class A+++ requirements when measured on a part load basis.
The cooling efficiency of proposed class A single and double ducts corresponds to the efficiency of class F room air conditioners. As for the heating function, class A single ducts have the efficiency of class C double ducts and of class E air conditioners. This efficiency scale system is rather confusing than helpful, and it does not make the low efficiency of double ducts and single ducts visible to consumers.
The minimum efficiency requirements from 2013 will ban split room air conditioners below cooling function class D (SEER) and heating function class A (SCOP). Classes G to E (cooling) or even G to B (heating) will be empty after 2013. The proposed tier 2 MEPS will lead to only class A and better (cooling) and the better half of class A and better (heating) to remain on the market after 2014. On the other hand the label classification lacks an incentive to develop more efficient air conditioners, as the top classes A+++ are already populated.

5.5. Policies from overseas: many EU models do not comply

In several countries seasonal efficiency indices have been introduced: more than 20 years ago in the USA, in Japan and Korea in 2004, and China runs two measurement methods in parallel; a SEER-based standard for variable speed- and a non-seasonal EER for fix-speed air conditioners.
Comparison of European EER and COP with Japanese legislation showed that 90% of the models sold in Europe in 2006 did not comply with Japanese legislation - despite the fact that many brands on the

Japanese and the EU markets are identical (Riviere et al., 2009)! Many models would neither have been allowed on the Australian, Chinese, South Korean, Taiwanese and US markets (Fig. 9 + 10).

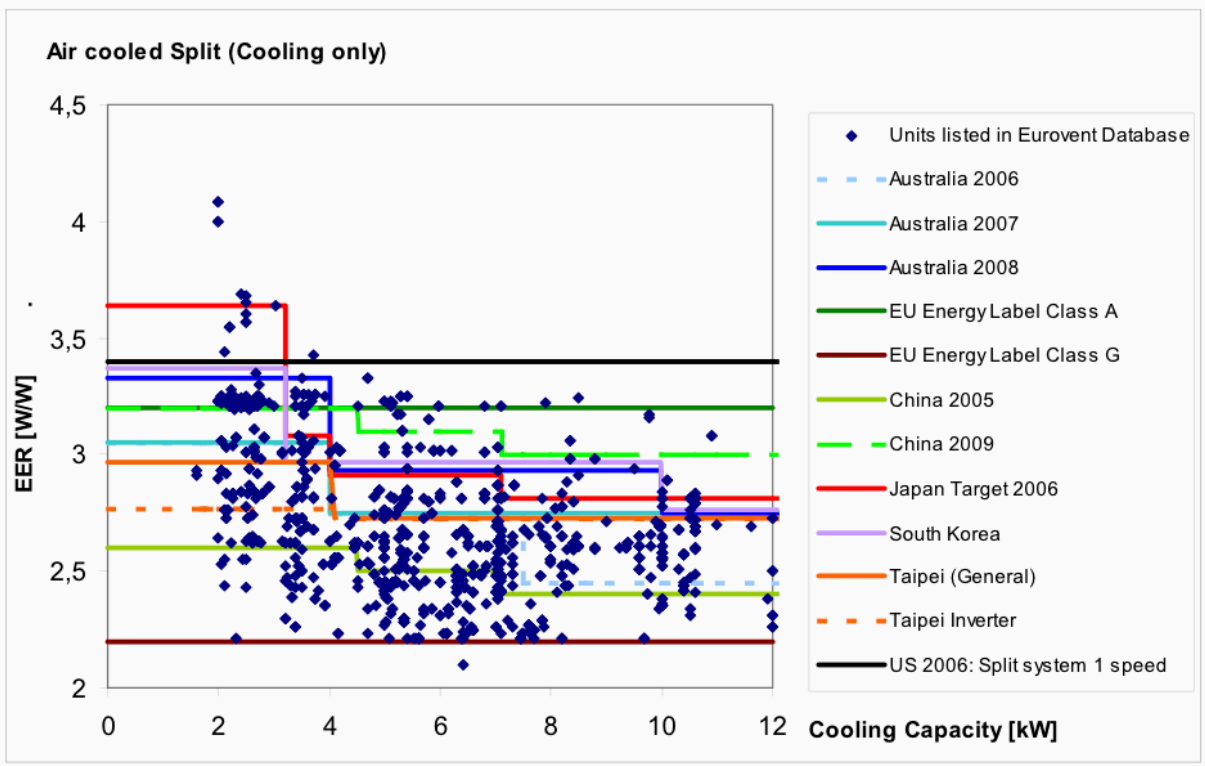


Fig. 9: Comparison of international MEPS with EER of European cooling only air conditioners (2006) (Source: Riviere et al., 2009)

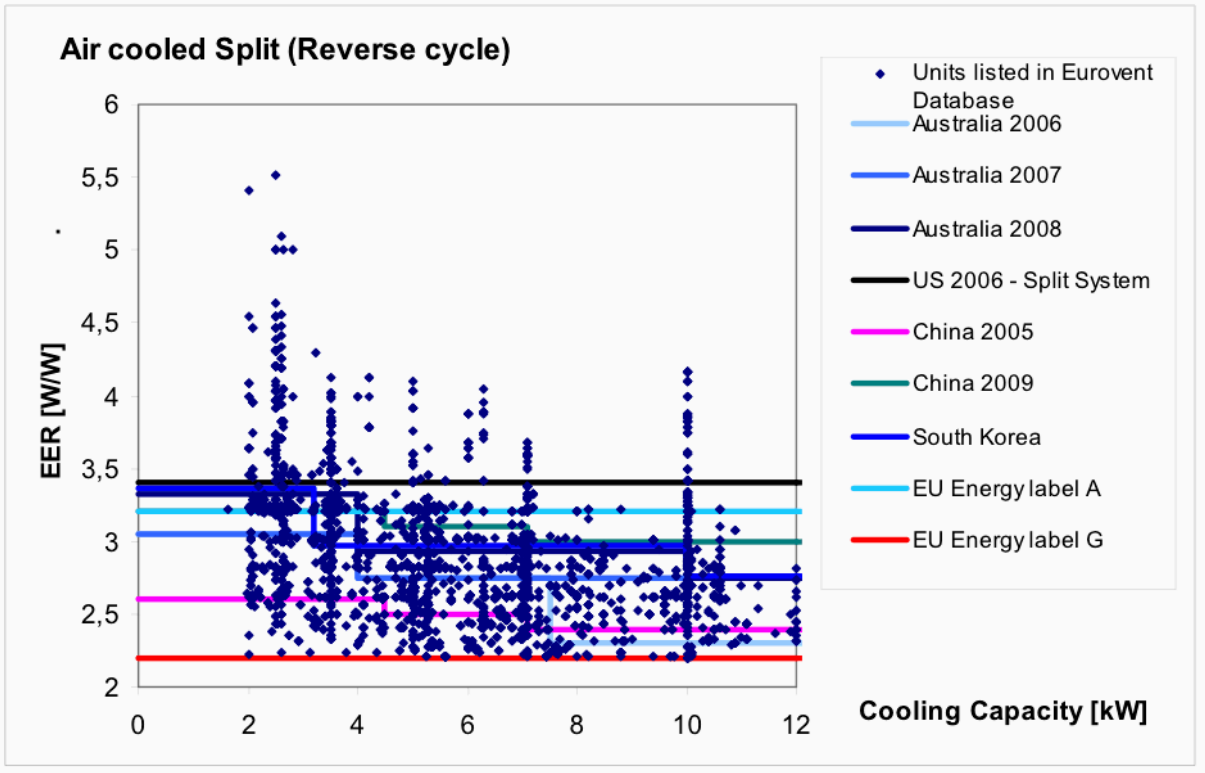


Fig. 10: Comparison of international MEPS with EER of European reversible air conditioners (2006) (Source: Riviere et al., 2009)

6. Recommendations regarding policy design

6.1. Scope and efficiency indicators of the energy label and ecodesign regulation: include large models, apply seasonal efficiency indicators also for double ducts

The scope of the present ecodesign and labelling regulation working documents is limited to air conditioning appliances with a rated capacity ≤ 12 kW. Larger air conditioners will be covered in lot 6 on tertiary air conditioners. This lot however has a long way to go before it results in any implementing measures and if the scope limit of the current regulation on is set at 12 kW it is easy to produce appliances with 13 kW, which then are out of the scope of the energy label and the ecodesign requirements. In order to avoid this, it is recommended to include air conditioners with input power of up to 17 kW into both the labelling and ecodesign regulation. As soon as stricter tertiary air conditioners implementing measures are adopted, these would replace the present legislation for large air conditioners.

Water-to-air appliances are exempt from both regulations. It has to be assured that this type is included in the future measures on tertiary air conditioners. It should be clarified that air-to-air, but evaporative water-cooled air conditioners are in the scope of the currently discussed regulations.

The implementation of seasonal efficiency indicators is key for effective measures. As the first double ducts with variable speed drive (inverters) are about to enter the market, there is no reason not to apply a seasonal efficiency indicator for double ducts (SEER and SCOP). Seasonal coefficients do account for the variable speed drive's ability to run at part load, which is neglected by non-seasonal EER and COP. The positive development towards more efficient double ducts with variable speed drive should not be hindered by renouncing on a method which accounts for their real efficiency. Measurement tolerances must be smaller than class width. The suggested 8% measurement tolerance for split ACs are reasonable and allow a credible efficiency class declaration. For single and double ducts the suggested tolerance is at 10%.

6.2. Energy label and ecodesign regulation: revision needed soon

As soon as the new energy label appears on the market in the course of 2012 it will become clearer how the European market is distributed. A systematic market monitoring programme would allow to draw the right conclusions for a label revision. It is expected that the top classes of the label are populated already at the introduction of the new energy label. In order to keep up an incentive for developing even more efficient products the top classes however should be empty. Therefore a near revision of the energy label should be planned – and more ambitious class limits be implemented. Furthermore the Energy label is most effective if it follows the initial A to G scale and if A stands for the best. A+ classes should therefore be reserved for future improvements. Only if the energy label covers all air conditioner types, consumers can see the low relative efficiency of double ducts and single ducts.

The ecodesign regulation will ban the least efficient air conditioners from the market. Table 5 however gives an idea that much more ambitious requirement could be possible. As soon as experiences with the new measurement standard have been made a revision of the ecodesign regulation should be envisaged.
Single ducts should not be granted extra-low requirements. They don't offer any additional value compared to double ducts, but they are less efficient than these. The required window or wall opening (and the waste heat which is delivered indoors) effectively leads to a cooling effect up to 40% below the declared capacity (Brunner et al. 2008) - single ducts in fact are less efficient than

declared. Consequently single ducts should be treated and measured the same way as double ducts and not be granted lower requirements.
Refrigerants with a GWP > 150 should be announced to be banned from 2016. In the case of cars, the use of such refrigerants is prohibited from 2011. The same has to be possible for air conditioners – with an early announcement.
As HFOs and propane are not less efficient than R410A, models using these as refrigerants don't need a reduction in efficiency requirement. The announced ban should be incentive enough to speed up the necessary construction adaptations. CO_2 however is indeed less efficient, but deserves to be promoted due to its very low GWP (GWP=1). Topten supports a reduction of efficiency requirements for models using CO_2 as refrigerant by 15%, as it was included in the draft Ecodesign regulation from April 2010.

7. References and Links

References

Michel, Bush, Nipkow, Brunner, 2011: Energy efficient room air conditioners – best available technology (BAT). EEDAL Conference 2011, Copenhagen.

Attali, Bush, Michel, 2009: Factors influencing the penetration of energy efficient electrical appliances into national markets in Europe. Report for Defra / the Market Transformation Programme by SoWATT and Bush Energie GmbH.

C.U. Brunner, U. Steinemann, J. Nipkow, 2008: Bauen, wenn das Klima wärmer wird. Faktor-Verlag, Zürich.

Electricity Consumption and Efficiency Trends in European Union – Status Report 2009. Paolo Bertoldi and Bogdan Atanasiu, 2009. JRC
http://re.jrc.ec.europa.eu/energyefficiency/pdf/EnEff_Report_2009.pdf

Riviere et al., 2008 / 2009: Preparatory study on the environmental performance of residential room conditioning appliances (airco and ventilation). Tasks 1-8.
http://www.ecoaircon.eu/

Air conditioner test by Topten (February 2011).

Commission Documents

COMMISSION DIRECTIVE 2002/31/EC of 22 March 2002 implementing Council Directive 92/75/EEC with regard to energy labelling of household air-conditioners
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0031:en:NOT

COMMISSION REGULATION No 1275/2008 of 17 December 2008 with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:339:0045:0052:en:PDF

COMMISSION DELEGATED REGULATION (EU) No 626/2011 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:2011:178:0001:0072:EN:PDF

COMMISSION REGULATION (EU) No 206/2012 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

Note on changes between the attached draft proposal and the Working Document presented to the Consultation Forum on 22 June 2009 on air-conditioning appliances, April 2010

European Commission, 2011: Impact assessment report on air conditioners. Not yet published.

Links

Topten.info, best products in Europe: www.topten.eu

Topten China: http://www.top10china.cn/english.html

Eurovent certification, database of conformity tested air conditioners:
http://www.eurovent-certification.com

Chigo, brand of one of the most efficient air conditioners (SEER = 7.30):
http://www.chigogroup.com/en/default.aspx

Coolproducts for a cool planet, information on the ecodesign process: http://www.coolproducts.eu/

Position of the Environmental NGOs on the draft ecodesign and labelling measures for domestic air conditioners (17. June 2009):
http://env-ngo.eup-network.de/fileadmin/user_upload/ENGOs_Intern/Position_Papers/Air-co_EuP_Environmental_NGOs-June09.pdf

SELINA, Standby and Off-Mode Energy Losses In New Appliances Measured in Shops:
http://www.selina-project.eu/