

## Room air conditioners: Recommendations for policy design

October 2014

### Summary

Since January 2013 the new Energy Label for air conditioners applies. It no longer discourages efficient part load function of room air conditioners and has led to huge efficiency improvements. The top classes A+++/A+++ (cooling/ heating) are already exceeded by around 20%.

Single and double ducts (Local Air Coolers, LACs) are much less efficient. However, the Energy Label does not allow comparing the low efficiency of LACs with room air conditioners due to separate test methods and Labelling scales.

The Ecodesign requirements ban inefficient air conditioners from the market since 2013 (tier 1) and 2014 (tier 2). Despite these measures, the electricity consumption by air conditioners in Europe is expected to grow by more than 50% from 2005 to 2020 – due to increasing sales. Future policy measures are indispensable to limit the growth in energy consumption.

Key policy recommendations:

**1. Update the Energy Label to keep it effective:**

The Energy Label should be updated soon to retrieve the original A-G scheme and to keep posing an incentive for further efficiency developments.

**2. No protection of inefficient technologies:**

The same Labelling scheme, test method and Ecodesign requirements should apply to single- and double-ducts as for other air conditioners.

**3. Phase out high-GWP refrigerants:**

The Label should bear an icon showing if a model contains a low-GWP or a high-GWP-refrigerant. Future Ecodesign requirements should aim at phasing out high-GWP refrigerants in air conditioners – faster and more completely than the revised F-gas regulation.

**4. Systematic Market Monitoring:**

The air conditioner market should be monitored annually based on sound sales data. Such a market monitoring would allow evaluating the impacts of policy measures, planning revisions on time, deciding on new Label and Ecodesign requirement thresholds, and basing stock and consumption models upon.

### Best available technology

#### Huge efficiency improvements thanks to new Energy Label

The new Energy Label for Air conditioners with classes up to A+++ applies since January 2013 (regulation No 626/2011). Topten lists the most energy efficient air conditioners. The new lists show that the efficiency of room air conditioners has made huge progress since the introduction of the new Energy Label:

- Eleven models already reach the top class A+++ / A+++ (cooling / heating).
- The new models are very efficient: benchmark values are SEER = 10.1, SCOP = 5.9.
- Climate-friendly refrigerants start entering the market: three new models use R-32 instead of R-410A, with a Global Warming Potential (GWP) of 550 instead of 1975.

The new Energy Label and the Ecodesign requirements for room air conditioners are based on the Seasonal Energy Efficiency indicators SEER (cooling) and SCOP (heating function), which also considers the efficiency of part load function. The new efficiency calculation no longer discourages

part load efficiency and brings a big improvement. For single and double ducts however, the efficiency index (EER / COP) is still based on a full load measurement.

### **Top classes already exceeded**

Because the measurement standard for part load testing was developed at the same time as the Energy Label, it was difficult to know what values would be reached according to the new test standard. Obviously the energy Label could have been designed more ambitiously. Many models already reach the top classes, and the thresholds for A+++ / A+++ (8.5 / 5.1) are exceeded by nearly 20% (cooling) and 16% (heating) - after the new Label has been in place for one year.

### **Superiority of split air conditioners over local air coolers not visible**

Split variable speed (inverter) air conditioners are today's best available technology (BAT). These products are much more efficient than single and double ducts (also: Local Air Coolers LACs). However, the Energy Label and the Ecodesign requirements for Single- and Double-ducts are based on a separate measurement and Labelling scale. The Energy Label does not allow comparing the efficiency of LACS to room air conditioners. The Energy Label protects these generally very inefficient products instead of making their low performance visible to consumers. Class A for Single / Double-ducts corresponds to class F of (split) room air conditioners – 50% less efficient. In reality the so-called Local Air Coolers (LACs) are even less efficient: most of these products are not able to run at part load, the waste heat is delivered into the room, and many require a window or wall opening through which warm air is sucked into the room.

## **Background**

### **Market is expected to double, energy consumption to increase**

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 (Riviere et al., 2009).

Total annual electricity consumption by air conditioners in Europe was estimated at around 30 TWh in 2005. By 2020 electricity consumption was expected to increase to around 73 TWh annually without any measures (business as usual) (EC, 2012). The Ecodesign regulation and the new Energy Label are expected to lead to savings of around 16 TWh annually by 2020 (EC, 2012) – less than 50% of the expected increase in electricity consumption.

### **Energy Label: different schemes for different technologies**

The first air conditioner Energy Label was in place from 2003 until 2012 (Directive 2002/31/EC). By 2008, most of the sold models were in class A (GfK/Attali/Bush for Defra, 2009). The new Energy Label has classes up to A+++ and is compulsory since January 2013.

For reversible air conditioners the new Energy Label rates both the efficiency of the cooling and of the heating function. The efficiency and energy consumption of the heating function can be declared for three different climate zones. The assumed cooling and heating hours per year and the part load ratios depend on the climate zone.

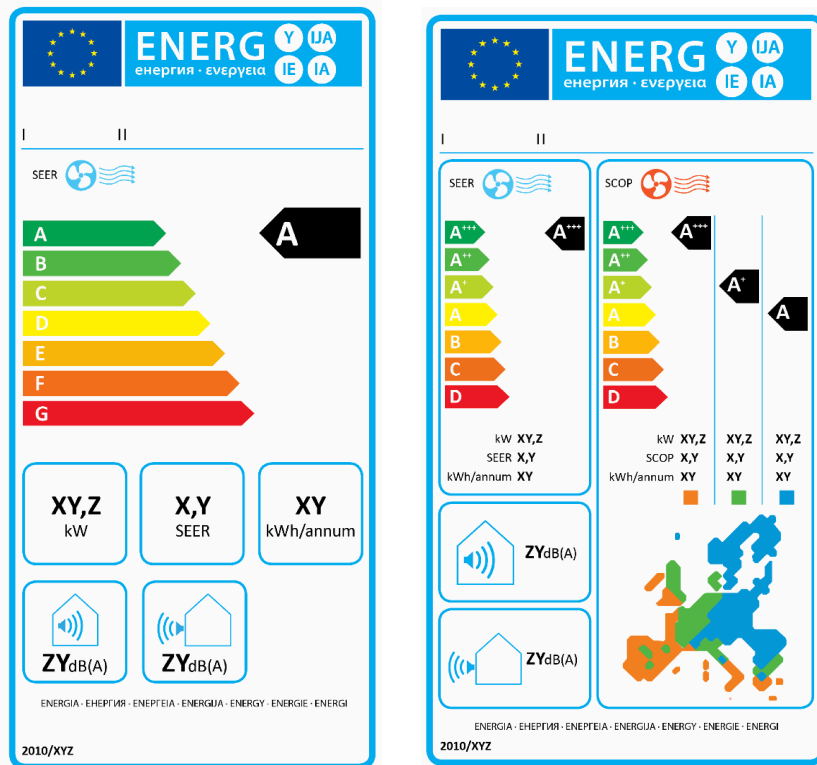


Fig. 1 + 2: Design of the new Energy label: for cooling only and for reversible appliances

The new Energy Label’s classification scheme distinguishes between room air conditioners, single and double ducts. Class A for single and double ducts (EER = 2.6) corresponds to class F for room air conditioners (SEER = 2.6), which has been banned from the market in 2013.

Table 1: Classification scheme of the Energy Label

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

**Ecodesign regulation: tier 2 requirements in force**

Tier 1 of the Ecodesign regulation No 206/2012 banned air conditioners less efficient than class D/A (cooling / heating) and single and double ducts less efficient than class B/C from the market from January 2013.

Since January 2014 tier 2 of the Ecodesign regulation No 206/2012 applies. For the heating efficiency the minimum energy performance standards (MEPS) are not in line with the Label class thresholds:

Table 2: tier 2 Ecodesign requirements, applying since January 2014

	cooling		heating	
	SEER	class	SCOP	class
Room air conditioners	4.6	B	3.8	A / A+
	EER	class	EER	class
Double ducts	2.6	A	2.6	B
Single ducts	2.6	A	2.04	B / A

**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 EU Energy Label. Split variable speed (inverter) air conditioners are today's best available technology (BAT).



**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 new Energy Label and Ecodesign requirements for room air conditioners are based on **Seasonal** efficiency indicators (**Seasonal Energy Efficiency Ratio (SEER)** for cooling, **Seasonal Coefficient of Performance (SCOP)** or Heating Seasonal Performance Factor (HSPF) for heating). These indicators do consider the different cooling or heating needs during the year and thus include part load operation of air conditioners. The efficiency is measured at four different outdoor temperatures and the respective loads. The measured efficiency is then interpolated to a wide range of outdoor temperature values, and the SEER / SCOP calculation formula defines the number of hours for each temperature across the year and integrates the respective efficiency values. Seasonal efficiency indicators do account for the efficiency gains by variable speed (inverter) drives' ability to work at part load. In Europe the SEER and SCOP are applied for room air conditioners since the introduction of the new Energy Label in 2013. The European measurement standard has been revised (EN 14511:2011) and amended with a part load measurement standard (EN 14825:2012) at the same time when the new Label was designed. It was not known what values would be reached according to the new test standard – a difficult precondition for designing an Energy Label with appropriate classes. A test of an efficient Chinese air conditioner by Topten in 2011 implied that the top class of the new Label would already be met (Michel, 2011).

The old energy label for air conditioners referred to the **Energy Efficiency Ratio** (EER, cooling function) and **Coefficient Of Performance** (COP, heating function) to express the energy efficiency of all air conditioners. These indicators are measured at full load operation only. For single and double ducts, still EER and COP is applied.

### Key policy recommendations:

#### 5. Update the Energy Label to keep it effective:

The Energy Label should be updated soon to retrieve the original A-G scheme and to keep posing an incentive for further efficiency developments. The top classes A+++/A+++ are already reached by several products and the threshold is exceeded by around 20%. The fast development shows that further efficiency improvements are possible, but if there is no possibility to communicate these the development will slow down.

#### 6. No protection of inefficient technologies:

The same Labelling scheme, test method and Ecodesign requirements should apply to Single- and Double-Ducts as for other air conditioners. The Energy Label should bring transparency and allow consumers to compare the efficiency of single and double ducts to room air conditioners. The current Label with a separate classification scheme protects these inefficient products instead of making their low efficiency visible.

#### 7. Phase out high-GWP refrigerants:

The Label should bear an icon showing if a model contains a low-GWP or a high-GWP-refrigerant. Future Ecodesign requirements should aim at phasing out high-GWP refrigerants in air conditioners – faster and more completely than the revised F-gas regulation.

#### 8. Systematic Market Monitoring:

The air conditioner market should be monitored annually based on sound sales data. Such a market monitoring would allow evaluating the impacts of policy measures, planning revisions on time, deciding on new Label and Ecodesign requirement thresholds, and basing stock and consumption models upon.

## References

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.

<http://www.topten.eu/uploads/File/Factors%20influencing%20the%20penetration%20of%20energy%20efficient%20electrical%20appliances%20into%20national%20markets%20in%20Europe-1.pdf>

Commission Directive 2002/31/EC with regard to energy labelling of household air-conditioners

Commission Regulation No 626/2011 on the energy labelling of air conditioners

Commission Regulation No 206/2012 on ecodesign requirements for air conditioners and comfort fans

Coolproducts informs about the Ecodesign policy process in Europe:

<http://www.coolproducts.eu/product/air-conditioners>

European Commission: Full Impact assessment accompanying the Proposal for Ecodesign requirements for air conditioners and comfort fans. Brussels, 6.3.2012.

Michel Anette, Bush Eric, Nipkow Jürg, Brunner Conrad, Hu Bo: Energy efficient room air conditioners – best available technology (BAT). Presented at EEDAL 2011, Copenhagen.

[http://www.topten.eu/uploads/File/023\\_Anette\\_Michel\\_final\\_paper\\_S.pdf](http://www.topten.eu/uploads/File/023_Anette_Michel_final_paper_S.pdf)

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

Topten: Best Products of Europe. [www.topten.eu](http://www.topten.eu)