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COMMISSION STAFF WORKING DOCUMENT

Full Impact Assessment

Accompanying the document

Proposal for a Commission Regulation

implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for air conditioners and comfort fans

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Lead DG: ENER

Associated DG: ENTR

Other involved services: SG, ENV, CLIMA, COMP, ECFIN, INFSO, MARKT, SANCO, TRADE, RTD, JRC.

1. PROCEDURAL ISSUES AND CONSULTATION

1.1 Organisation and timing

The implementing measure for air conditioning appliances and comfort fans is one of the priorities of the Action Plan on Energy Efficiency[1], and is part of the 2008 Catalogue of actions[2] adopted by the Commission for the year 2008. A preparatory study was conducted on 2006-2009, the impact assessment, including two Consultation Forum meetings on 2009-2010 with the objective of adopting ecodesign and energy labelling measures on the second half of 2010 in compliance with the above mentioned Directives.

The Implementing measures are based on the Directives 2009/126/EC[3] setting ecodesign requirements for energy-using products and 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other recourses by energy-related products.

The Commission carried out a preparatory study on room air conditioning appliances and comfort fans[4] in preparation of the implementing measures.

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1 COM(2006)545 final.

2 COM(2008)11 final.

3 OJ L 285, 31.10.2009, p10.

4 Service Contract to DG TREN Preparatory study on the environmental performance of residential room conditioning appliances (airco and ventilation). Contract TREN/D1/40-2005/LOT10/S07.56606. Final Report, March 2009. Co-ordinator: Philippe Riviere, Armines, France. Jérôme Adnot, Laurent Grignon-Masse, Sébastien Legendre, Dominique Marchio, Guillaume Nermond, Sri Rahim, ARMINES, France. Philippe Andre, Laurie Detroux, Jean Lebrun, Julien L'Hoest, Vladut Teodorose, Université de Liège (ULg), Belgium. José Luis Alexandre, Emanuel Sa Idmec, University of Porto, Faculty of Eng., Portugal. Georg Benke, Thomas Bogner, Austrian Energy Angency, Austria. Amanda Conroy, Roger Hitchin, Christine Pout, Wendy Thorpe, BRE, UK. Stavroula Karatasou, IASA, Greece.

On 22 June 2009 and 23 April 2010 meetings of the Ecodesign Consultation Forum established under Article 18 of the Ecodesign Directive were held (details are provided below).

The impact assessment was launched in May 2009 and supported by an Interservice Steering Group including SG, ENV, CLIMA, COMP, ECFIN, INFSO, MARKT, SANCO, TRADE, RTD, JRC. The deadline for the ISG consultation from 8 June 2010 to 17 June 2010 was extended to 24 June 2010 due to the reception of a number of absence messages. Apart from the cooperation taking place between the Commission services through the Consultation Forum meetings and the ISG a number of bilateral contacts between officials in various key services took place during the preparatory study and the impact assessment phase.

1.2 Impact Assessment Board

This impact assessment has been scrutinised by the Commission's Impact Assessment Board (IAB). In its opinion, the IAB concluded that "the report should provide greater clarity on both the methodology and the proposed requirements in order to make clear the case for EU intervention on air conditioners. It should address a number of issues. First, the report needs to clarify to what extent the principle of least life cycle costs for the consumers is respected in the proposed measure. Secondly, it should clarify how the proposed requirements and timing of their introduction relates to those applied in other major economies. Thirdly, the report should explain more clearly the incentive ('bonus') system for placing on the market appliances which contain refrigerants with low global warming potential. Finally, the social impacts - affordability of the appliances for low income households and the effects on employment in the EU -need to be discussed in more depth." The IAB also provided a list of more technical comments separate to the final IAB opinion.

The report was completed with back-ground information on the methodology and the proposed requirements and explanation on the relation between the least life cycle costs for the consumers and the requirements was added. A chapter on international comparison was added and the incentive ('bonus') for appliances using low-GWP refrigerants was explained more thoroughly, partly in bringing relevant information from the Annexes to the body text. The chapter on social impacts was further broadened and the more technical IAB comments were integrated into relevant chapters.

1.3 Transparency of the consultation process

Expertise was gathered in particular through a study providing a technical, environmental and economic analysis of these appliances (from here on referred to as "preparatory study"), carried out by external consultants on behalf of the Commission's Directorate General for Energy and Transport (DG TREN). The preparatory study took into account input from all relevant stakeholders including manufacturers and their associations, environmental NGOs, consumer organizations, and EU Member State experts. Information on the preparatory study was made publicly available through a dedicated website[5] where interim results and further relevant materials were published regularly for timely stakeholder consultation and input. The study website was promoted on the ecodesign-specific websites of DG TREN and DG ENTR. Open consultation meetings for directly affected stakeholders were organised on 13.2.2007,

[5] Available on http://www.ecoaircon.eu/

21.5.2007, 23.10.2007 and 7.4.2008 for discussing and validating the preliminary results of the study.

On 22 June 2009 the Meeting of the Ecodesign Consultation Forum took place where Commission Service's proposals were presented building on the results of the preparatory study. Documents were made available in time and sent to the members of the Consultation Forum, and to the secretariats of the ENVI (Environment, Public Health and Food Safety) and ITRE (Industry, Research and Energy) Committees of the European Parliament for information. The working document was published on DG TREN's ecodesign website, and it was included in the Commission's CIRCA system alongside the stakeholder comments received in writing before and after the meetings. Minutes of the Meeting of the Ecodesign Consultation Forum are annexed (Annex 1).

On a parallel track Technical Committee 113 of the CEN Working Group 7 is drawing closer to finalising the European standard (prEN 14825:2009) which deals with seasonal performance of air conditioners in the European climate. The envisaged measures would take the results of this work into account.

During the impact assessment period, two main issues (regarding introduction of measures to reduce direct GHG emissions and proposal for energy labelling scales) were identified on which further advice was sought from stakeholders. For these purposes, Commission Working Documents were sent to stakeholders on 12.04.2010 and a discussion was held in a second meeting of the Consultation Forum on 23 April 2010. Comments were gathered until 31 May 2010 for the needs of the impact assessment.

1.4 Preliminary results of stakeholder consultation

Stakeholder consultations were made on the basis of the results from the preparatory study and the Commission Staff Working Document, presented at the first meeting of the Consultation Forum on 22.6.2009. A second meeting on a few specific issues was organised on 23.04.2010.

In the first Consultation Forum, stakeholders largely welcomed the proposed approach. The meeting agreed that energy in use, noise and the impacts of refrigerants are key environmental parameters to be considered. The main discussion focused on what level of requirements should be applied to the various types and capacities of air conditioners including the impact of energy labelling on these appliances.

Member States largely agree with the suggested levels and the staged implementation of requirements. The importance of the difference between cooling need and the capacity of the appliance was raised. It is important to indicate both the size and capacity of the appliance but some Member States did not find it useful to indicate the capacity for cooling a given space in square meters, as the quality and nature of these square meters is not known[6]. It was considered that direct GHG emissions could be addressed as well but a solution should be found as to how to take these leakages into account given that although leakages are

[6] Many manufacturers brochures do give an indication of the floorspace (or cubic volume) that can be cooled, combined with the remark that actual performance depends on room characteristics and climate. Many manufacturers also indicate capacity in BTU (British thermal units), a unit most consumers are even less familiar with than kW.

unintentional, they are also unavoidable, and can only be minimised by considering the type of appliances and the way it is installed, serviced and discarded.

Requests were made that all air conditioners be put in one labelling scale, as otherwise consumers would be guided to buy the cheapest (less efficient) product. It was suggested that a specific pictogram could indicate the existence of low GWP refrigerants in the label. A request was made that the minimum requirements correspond with the lower levels of the labelling classes.

Industry associations largely supported the Commission proposal. The industry thinks that a large share of current models would be banned, but this would have to be confirmed by measurements in laboratories due to novelty of the new efficiency calculation method. Although the industry considered noise as being self-regulated by the market (consumers requiring low-noise appliances), noise was considered important for consumers and information requirements on noise for the indoor and outdoor units were supported but minimum requirements refused. Industry wanted to leave the regulation of refrigerants for the F-gas Regulation to avoid overlapping legislation.

Industry objected to the space heating profiles as proposed in the Working Document; it would not be understood by consumers or installers and appliances falling in between categories would not show optimal efficiency although in real life they could be efficient.

Environmental NGOs and **consumer's associations** were generally in support of the measure but considered that the proposed minimum energy efficiency requirements are too low and proposed to go immediately to LLCC (least life cycle cost) level and to set minimum requirements at benchmark level in five years from now, including the modification of the labelling scheme accordingly. Also, more stringent requirements on single ducts were requested due to their inherently lower efficiency and effects on performance caused by intrusion of warm air when compared with other air conditioners.

The space heating profiles were rejected as they would not be understood by consumers but it was also stated that the indication of the output power of the appliance (*kW*) is often not understood by consumers, in particular as room sizes vary strongly from site to site.

Environmental NGOs agreed that an important part of appliances current on the market would be banned but noted that the European air-conditioning sales are composed of very low efficiency appliances when compared to other countries. As manufacturers are operating in a global market, there should be no significant cost for the industry to deliver more efficient appliances also to the European market.

An opinion was raised emphasising that more ambitious noise requirements are necessary corresponding to 55 dB(A) for the indoor unit.

The F-gas Regulation was seen as focusing essentially on avoiding leakages but not directly promoting alternative refrigerants. It was considered that Ecodesign could promote alternative refrigerants. An overall GHG emission figure would not serve the purpose, as it is based on the average European energy mix. However, a specific pictogram could indicate the existence of low GWP refrigerants in appliances.

A second Working document building on the earlier stakeholder comments and on selected issues raised during the impact assessment was discussed in the Consultation Forum on 23

April 2010. The discussion focused on options for labelling (main issue: unified label or multiple labels) and options for promoting the use of low-GWP appliances (less stringent ecodesign requirements and/or higher labelling classification).

The second Consultation Forum approved the approach to set minimum energy efficiency requirements, requested sound power level requirements and approved the proposed bonus for appliances using a refrigerant with low-GWP. However, generally the Forum preferred to have only one bonus level instead of two for different GWP-levels of refrigerants. While some stakeholders still preferred one single label others refused it requesting the application of the Energy Labelling Framework Directive (adding pluses for appliances for which A-level appliances are not cut of from the market by the ecodesign requirements) and requested that appliances for which no changes in efficiency calculation method took place should not be downgraded. Stakeholders also requested the indication of annual energy consumption on the energy label and choose not to set minimum energy performance requirements on comfort fans due to insufficient information on efficiency and fan markets in Europe. The proposal to set information requirements on comfort fans was supported.

On comfort fans, the preparatory study showed that the energy efficiency data, mainly due to false declarations, was not reliable enough to set ecodesign or energy labelling requirements on these appliances. As a solution, minimum energy efficiency requirements were proposed on the basis of the requirements set in China and Taiwan. However, towards the end of the impact assessment process, it was found that the required efficiency levels are unattainable when measured on the basis of the IEC60879 efficiency measurement standard; the proposed levels of the requirements would risk leading to a complete ban of most of these appliances in the European market. While not being able to identify the least life cycle cost level in line with the Ecodesign Framework Directive, it will be possible to set information requirements for the indication of the measured efficiency of the appliances and the measurement standard used. This information will help national authorities in market surveillance and will ensure that possible future ecodesign and/or energy labelling requirements can be based on reliable data.

2. PROBLEM DEFINITION

The current stock of air conditioners is responsible for a significant part of the total energy consumed annually by households and small commercial establishments. The previous years have shown a considerable sales increase of especially air conditioners and the sales are expected to continue rising due to (a.o.) hotter summers, higher demand in personal cooling comfort, increase in average purchasing power and decrease in average purchase price, even when the recent economic downturn (2008-2010 est.) is taken into account.

Most appliances sold today are low-efficient appliances although high-efficient appliances exist on the market. Consequently, the life-cycle cost of air conditioners is relatively high and is associated with negative impacts on the environment.

Furthermore, the preparatory study showed that the average energy efficiency of split package units sold in other major air-conditioning markets are clearly above that of 'splits' sold in the EU and ample room for cost-effective improvement exists, despite the existing EU energy labelling scheme. It is thought that since most other economies with major air conditioner markets (Japan, USA, Australia, South-Korea and China) have established minimum energy efficiency requirements, manufacturers based in these countries can not anymore place low-efficient appliances on these markets, but can still place these on the EU market.

As requested by Article 15 of the Ecodesign Directive, the preparatory study identified the relevant environmental aspects of air conditioners. The analysis shows that most of the environmental impacts (and life cycle costs) are attributable to the use-phase. While indirect green house emissions from energy use represent some 80-85% of the total green house gas emissions in the use phase, emissions from possible leakages of refrigerants amount to some 15-20%.The lifecycle cost (LCC) analysis shows significant reduction potential of the LCC for high-efficient appliances.

2.1 Baseline scenario

The preparatory study for air conditioners provided a technical, environmental and economic analysis. The study provided, amongst others, the following key elements:

– Description of the scope of the study. This impact assessment describes the scope of air conditioners in detail by adding further types and functionalities (see Annex 2);

– The annual sales plus sales expectations up to 2030, the typical product life, and the installed base ("stock") and definition of typical or average products (referred to as base cases);

– Typical heating and cooling demand up to year 2030 (based on usage patterns for three end-use applications (residential, small office, small retail), building characteristics, climates and appliance saturation levels per year and per member state);

– The typical seasonal energy efficiency in multiple climate zones and annual electricity consumption including low-power modes;

– An environmental analysis of the basecase appliances, identifying the main environmental parameters over the product life and including the relationship between environmental parameters like annual electricity consumption, emissions from refrigerant leakage and noise;

– Description of technologies yielding reduced electricity consumption and the additional costs for applying them compared to the current "market average" (basecase).

The baseline has been adjusted for the economic crisis (see Annex 3). The downturn is based on PRIMES projections which essentially describe a dip in economic activity in the year 2008-20010 and an increasing economic activity from 2010 onwards.

The following sections describe in more detail the inputs used to define the baseline scenario for calculating future economical and environmental impacts.

2.1.1. Scope of appliances covered

The scope was decided on the basis of the Ecodesign Directive Articles 15 and 16[7]. The scope and product categorising were refined during the preparatory study together with stakeholders

[7] In particular Point 2 of Article 16.

in search for a functional approach[8]. However, the particular service of double ducts[9] and the different function of single ducts[10] had to be accommodated in order to avoid the complete deletion of these appliances (services/functions) from the market (see also Annex 2). As the Commission Energy Labelling Directive 2002/31/EC is based on groups of appliances per technology, the change in approach leads to both technical and business related impacts. Simultaneously, no perfect market data on appliances is available and a new efficiency calculation and measurement method is introduced that has not yet been used in real life. Thus, the efficiency levels for the appliance groups in scope were based on the least-life cycle cost within the limits set by the quality of the market and efficiency data, including the consideration of appliances with specific services/functions (single and double ducts);

The definitions used follow the definitions used during the preparatory study and the impact assessment phase as follows:

- ‘Air conditioner’ is a device capable of cooling and/or heating indoor air using a vapour compression cycle driven by an electric compressor;
- ‘Split package’ means an 'air conditioner' in which the components of the refrigeration cycle are split into one or more mountings, one (usually containing the compressor) is installed outside and the others are ;
- 'Window / through-the-wall unit' means an 'air conditioner' in which the components of the refrigeration cycle are a factory assembly on a common mounting to form a discrete unit and which is placed on a window sill or in an aptly shaped hole through a wall;
- ‘Double duct’ means an 'air conditioner' in which during cooling (heating) the condensor (evaporator) intake air is introduced from the outdoor environment to the unit by a duct and rejected to the outdoor environment by a second duct and which is placed wholly inside the space to be conditioned, near a wall;
- ‘Single duct’ means an 'air conditioner' in which during cooling (heating) the condenser (evaporator) intake air is introduced from the space containing the unit and discharged outside this space;
- ‘Design load’ means the declared peak cooling or heating power demand, or both, in W that the ‘air-conditioning appliance’ can meet at the applicable extreme outdoor temperatures;
- ‘Comfort fan’ means an appliance designed for creating air movement around (part of) a human body for personal cooling comfort. This definition includes comfort fans that can perform additional functionalities such as lighting;
- ‘Electric fan power input’ means the electric input power in W of a ‘comfort fan’ measured at the declared maximum flow rate.

A more detailed description of the scope is provided in Annex 2

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8 Ecodesign Directive Article 15, Point 2(ii).

9 Double ducts is the only type of air conditioners that can be used e.g. in many historic buildings.

10 Single ducts do not cool a room but only part of a room.

2.1.2. Measurement and calculation method

A new efficiency calculation and measurement method has been developed in parallel with the preparatory study by the industry manufacturing air conditioners, thorough the European standardisation organisations CEN and CENELEC (prEN14825). The European Commission has issued a mandate for a harmonised measurement method for the air conditioners in scope. The harmonised standard will be available in 2011. Meanwhile, a transitory method will be used for which a methodology, in compliance with the prEN14825, has been developed in collaboration with stakeholders. The main aspect of the seasonal method is that it allows taking into account the impact of the climate on the efficiency of the appliance.

The move towards seasonal energy efficiency is global due to the widespread use of inverter technology in split appliances. The measurement method has not yet deployed in the market so effects are based on calculations. For this, a prudent approach is required when setting efficiency or noise or any other requirements (as there is often a link between e.g. efficiency and noise, efficiency vs. the type and quantity of refrigerants used etc. that thus far is not yet know in detail). The move towards the use of the seasonal measurement method is assumed to happen without difficulties, if sufficient time is granted for the industry. The move towards the use of the new method is supported by the fact that the industry has developed the method in parallel with the preparatory study, supported by the experiences in the US in the use of such a method.

2.1.3. Relevance of product group for eco-design implementing measures

As requested by Article 15 of the Ecodesign Directive, the preparatory study identified that air conditioners fulfil the criteria for setting ecodesign requirements because they:

(1) have a significant economical and environmental impact within the Community;

(2) present significant potential for improvement without entailing excessive costs;

(3) are not addressed properly by market forces;

(4) are not sufficiently addressed by other relevant Community legislation.

The sector is economically significant. The unit sales of air conditioners in the EU27 amount to approximately 4.7 million units, resulting in a combined turnover of the air-conditioning industry (manufacturers, wholesale and retail) of 6.3 billion Euro in 2005. Industry turnover is thought to be some 1.4 billion Euro, of which only 7% can be attributed to EU manufacturers, the rest is associated with mainly Japanese, Korean and USA brands. The largest share of total turnover stems from retail activities and installation/maintenance activities.

The environmental impacts are significant. The impact assessment calculated a total electricity consumption of the stock of air conditioners of 30 TWh/a in 2005. This corresponds to a total of around 14 Mton CO2 eq. emissions (0.3% of the total CO2 emissions in the EU27[11]). This includes indirect CO2 emissions from energy use and direct emissions from refrigerant leakage.

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[11] According the 2010 Statistical Pocketbook "EU Energy & Transport" the EU-27 emissions in 2005 are 4521 Mton CO2. 14 Mton are 0.3% of that.

The current market trends are expected to lead to a continued increase in sales, energy consumption and environmental impact. The existing EU Energy Label is not able to reduce the detrimental effects of rising sales of low-efficient appliances.

The preparatory study concluded that energy saving can be economical for air conditioners. For this purpose the study proposed minimum energy efficiency requirements, information requirements and an updated energy label.

Based on the information provided by the preparatory studies and this impact assessment it has been concluded that air conditioners comply with the criteria listed in Art. 15 and therefore are subject for ecodesign and energy labelling measures.

Measures described in this impact assessment estimate savings of approximately 11 TWh from air conditioners in 2020 and approximately 15 TWh/a in 2030[12].

2.1.4. Refrigerants

As stated above, the preparatory study estimated that in 2005 some 14% of the total CO2 emissions are due to refrigerant leakages in form of direct emissions (see Annex 4). The F-Gas regulatory framework (Regulation 842/2006) would provide a legal basis for the banning of harmful refrigerants, as is the case e.g. with the ban of HFC-134a used in air conditioning systems in vehicles (Directive 2006/40/EC) or the complete ban of HCFCs by 2014. However, as more than 99% of the air conditioners in scope use R410A and R407C (GWP ranging between 2088 and 1774) it is unlikely that appliances (and/or production lines) could be converted to use e.g. low-GWP HFC's (HFO's) or natural refrigerants (hydrocarbons or CO2) with GWP's ranging between 150 and 0 in the given timeframe due to commercial, safety and technological issues at stake.

The direct CO2 emissions from estimated leakages being a significant environmental impact and the total ban of the most environmental-damaging refrigerants being not feasible on the basis of the current knowledge and market situation, the Ecodesign Directive can provide a framework for the promotion of the use of the most environmental-friendly refrigerants. This is important also in the global context knowing that no third market succeeds showing a better situation; the global (air-to-air air) conditioner market closely resembles the situation in the EU market in terms of the types of refrigerants used. Any succssfull EU attempt in promoting the use of more benign refrigerants could serve as an example for other markets, with corresponding environmental impacts.

2.1.5. Sales and stock

Sales of air conditioners are expected to grow from 4.7 million units in 2005 to some 9 million units in 2020 and to 10.3 million units in 2030. This assessment is based on expectations for main market drivers such as increased household income (stimulates affordability), increased demand for personal thermal comfort and lower purchase prices (stimulates purchase decisions, also in non-residential sectors) and hotter climates (stimulates demand) and includes a correction for reduced sales in the period 2008-2010 (effects of economic crisis).

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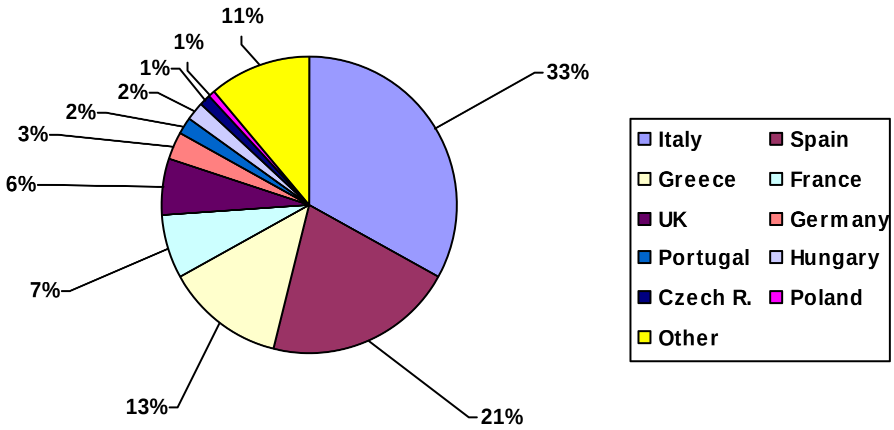
12 These values relate to minimum efficiency requirements introduced in 2012-2014.

By far the largest market of air conditioners in the EU is Italy with 33% of EU sales, followed by Spain (21%) and Greece (13%). These three countries combined form two-thirds of the EU market for AC appliances. Since Greece is close to its expected maximum saturation the main growth for the coming years will come from large markets such as Italy and Spain, unsaturated markets like France and UK, and the northern European countries for appliances with heating function. For further details, see Annex 7.

Figure on share in total air conditioners sales by country (2005)



The preparatory study identified an average product life of air conditioners of around 12 years. Combined with historical sales date and the expected market growth the installed base is estimated to be 31 million units in 2005, growing to over 82 million units in 2020 and almost 117 million units in 2030.

The split-up of the market according to category of air conditioners is as follows:

Share of AC categories in sales	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Split packages avg. 3.5 kW (incl. cooling-only)	86%	84%	83%	83%	83%	83%
Split packages avg. 7.1 kW (reversible)	5%	7%	9%	9%	9%	9%
Window/wall	2%	2%	2%	1%	1%	1%
Double ducts	1%	1%	1%	1%	1%	1%
Single ducts	6%	6%	6%	6%	6%	6%

2.1.6. *Market structure*

The air conditioner market is global. The EU market represents approximately 7% of the total world market, the largest markets being the USA and Japan[13].

Virtually all production and R&D of air conditioners is located outside the EU and is dominated by large multinational companies, since a large production base is vital to keep costs down allowing investment in R&D. Of brand names, some 7% can be traced back to EU based manufacturers, but even then the actual production of the units may have taken place outside the EU.

In general, manufacturers have difficulties in foreseeing changes in demand in markets in which they operate (e.g. due to changes in legislation in a given country). When new stricter minimum requirements restrict the sales of appliances from existing production lines (for which the return to the investment has not yet fully taken place), manufacturers shift their sales to other markets where no such requirements yet restrict the sales of these appliances. This can happen with lower sales prices until there is no more return to the investment. The European air conditioner market has experienced this phenomenon; when minimum efficiency requirements have stopped low-efficient air conditioner sales in one country (e.g. in the US or Japan), manufacturers continue and/or reinforce sales and marketing of low-efficient appliances in countries outside these countries, such as in Europe.

Figure on the origin of brand names of air conditioners in the EU market

Japan	S-Korea	USA	EU	Israel	China
60%	13%	10%	7%	6%	5%

As regards single duct appliances, until 2003 most of the market was serviced by Italian companies but after the heat wave of 2003 a large number of direct import channels from Asia were opened. Stakeholders believe that, at the moment, the country of origin of most single ducts is outside the EU, mostly China, even though the brand it carries is based in the EU. A few companies in the EU have focused on niche products like the double duct unit. These 'specialised' manufacturers can be SME-sized (less than 500 employees).

Most SME-sized companies in the air conditioner sector are found in the installer/retail sector. These companies that sell, install, maintain and remove air conditioners (often small retailers/installers of 1-20 employees) are responsible for most of the total turnover of the sector and some 35.000 to 40.000 thousand jobs. The persons handling the refrigerants must be qualified according the requirements of F-Gas Regulation 842/2006.

It is estimated that the EU-based air conditioner manufacturing industry employs 2000 to 2500 workers at various levels, mainly in the production of split air conditioners, but also including single and double duct production. Production facilities are known to exist in Belgium and Czech Republic (Daikin Europe) and Italy (DeLonghi, Olimpia Splendid, Fimer). Due to the fact that the EU-facilities include product development (R/D will increase,

13 The total market of small air conditioners (room air conditioners, portables, but also including small packaged air conditioners popular in the USA) is estimated by experts to be close to 71 million units globally. The EU sales of 4.7 million are only 7% of that total.

not decrease), Daikin is a world-leader in product efficiency and the EU-industry is leading in single and double duct efficiency, it is assumed that no negative employment effects are to be experienced at national or regional levels.

2.1.7. Electricity consumption in 2005 and 2020

The preparatory study comes to the conclusion that the large penetration rate of air conditioners leads to significant electricity consumption.

For the year 2005, an annual electricity consumption of 30 TWh/a was calculated, corresponding to electricity costs of 6 billion Euro[14] (with total expenditure costs some 14 billion euro) and 14 Mt of CO_2 emissions[15].

It is estimated that through awareness campaigns and the continuation of the current energy label for air conditioners the average energy efficiency of air conditioners would continue rising slightly until by 2030 all current split package appliances will be present in (current) class A, with an average EER of around 3.5. The share of inverter appliances (capable of running variable speeds) is expected to be some 90%.

For the year 2020, assuming no change in policy measures, the electricity consumption is assumed to 73 TWh/a, corresponding to electricity costs of 45 billion Euro and 37 Mt of CO_2 emissions.

It is therefore concluded that, without taking additional specific action on air conditioners, the market transformation towards more efficient appliances will take place only very slowly and the negative impact on the environment will continue to rise.

2.2 Improvement potential and costs

The preparatory study identified the main environmental impacts of air conditioners over their life cycles. The corresponding environmental parameters of air conditioners are:

a) electricity consumption during use;

b) leakage of refrigerants with high GWP over the product life;

c) sound power (noise) during use.

An effective ecodesign option of reducing electricity consumption is the use of inverter driven appliances able to adjust the performance of the appliance depending on (changing) operating conditions (outdoor and indoor air temperature). This will improve the so called 'seasonal efficiency' significantly. A second ecodesign option is the reduction of energy consumption of auxiliary functions like, standby, off-mode, reactivation function etc. These elements are taken into account in the new Seasonal Energy Efficiency Calculation method (SEER for cooling, SCOP for heating). More details on the calculation method is given in Annexes 3 and 6.

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14 Average electricity price in the EU 2005: 0.136 €/kWh.

15 The IA assumes 458 g/kWh electric. This is slightly above average specific EU emissions in 2003 for EU-25 of 400g CO2 per kWh (EURELECTRIC, Environmental Statistics of the European Electricity Industry, Trends in Environmental Performance 2003-2004). The IA figure is higher because e.g. mining related effects are taken into account (MEEuP: plus 10%).

The seasonal efficiency of the basecase split unit (the most commonly sold appliance today in Europe) as defined in the preparatory study can be doubled against lower life cycle costs. This translates into a reduction of annual electricity consumption of 46%, which compensates the increase in purchase price of 50% and leads to 17% lower total life cycle cost.

The Table below gives the outcome of the preparatory study as regards the calculation of efficiency (EER and SEER) for the basecase (2005 unit), LLCC and BAT. Values for double ducts (not given in the preparatory study but developed with experts and stakeholders during the impact assessment), the market average of 2010 and the benchmark for 2010 (the benchmark differs from BAT since BAT is the outcome of a theoretical exercise of what the maximum efficiency can be, the benchmark is closer to what is best of currently available).

Table on cooling efficiencies[16]

	Split_rev 3.5 kW		**Split_rev 7.1 kW**		**Split_cooling only**		**Single duct**	**Double duct**
	EER	**SEER**	**EER**	**SEER**	**EER**	**SEER**	**EER**	**EER**
Basecase (no inverters)	3.1	(2.8)	2.9	(2.70	2.9	(2.5)	2.3	(category not assessed separately in prep.study)
LLCC	4.3	(5.4)	3.9	(5.3)	3.2	(4.0)	2.8	
BAT	5.8	(6.50	5.8	(6.5)	5.8	(6.1)	4.4	
2010 market average	3.3	*(4.1)*	3.03	*(3.8)*	2.94	*(3.6)*	2.3	2.15
EU benchmark		*(5.1)*					3.15 (evap. cooling)	2.64 (dry air), 3.15 (evap. cooling)
World benchmark (appliances available in third markets)		7.1						

The table gives efficiency values for cooling performance only. Heating performance usually follows the same trend line as cooling performance and leads to COP/SCOP values as stated in Table below.

Table on heating efficiencies[17]

	Split_rev 3.5 kW		**Split_rev 7.1 kW**		**Single duct**	**Double duct**
	COP	SCOP	COP	SCOP	COP	COP
Basecase (no inverters)	3.40	2.60	3.20	2.50	(heating/category not assessed in prep.study)	
LLCC	4.50	4.00	4.30	4.00		
BAT	5.70	4.80	5.70	4.90		

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16 EER values are measured values. SEER values for basecase, LLCC and BAT are calculated indicative values (not measured) based on the approach used in the preparatory study. SEER values for 2010 market average and EU benchmark are based on simplified calculations made during the impact assessment and based on the approach of the preparatory study. SEER values for world benchmark are declared values by manufacturers on the basis of third country efficiency measures (different temperature settings and without noise requirements). Double duct market average and (dry heat exchanger) benchmark as presented by industry, evaporative cooling benchmark (3.15) based on analogy with single duct.

17 COP value for single duct 2010 market average assumed in the IA to be comparable to the 1 tier ecodesign requirements. EU benchmark level indicated as presented by industry. COP value for double duct 2010 market average and EU benchmark as presented by industry.

2010 market average	3.54	(2.80)	(included in splits 3.5 kW)		1.80	2.40
EU benchmark		4.00		3.40	2.60	3.10
World benchmark (appliances available in third markets)		4.60		4.00		

Cut-off percentages

At the LLCC value of SEER 5.4 (for split reversible) the corresponding EER is close to 4.3[18]. In the Eurovent database 2010 an EER of more than 4.3 corresponds to 2.4% of the population, meaning that 97.6% will be phased out[19].

A SEER value of 3.6 would represent a cut-off of 75%. Note that these cut-off percentages are based on a dataset and are not sales weighted. It could be that the real market average is more efficient than calculated on the basis of the Eurovent dataset, thereby reducing the cut-off percentages. However, as the average energy efficiency of appliances in the EU market is not as high as in other countries, minimum efficiency requirements on appliances in the EU market should be set with caution. A second reason is that making a unit more efficient can increase the noise level, which could set a constraint to the setting of minimum energy efficiency requirements. However, this relationship is not undisputedly observed from data on available models. In the past, manufacturers have found ways to simultaneously reduce noise and increase efficiency until the efficiency levels come very close to what is technologically possible. Annex 4 gives more information on the specificities of the relation between sound power level and efficiency.

For single duct and double ducts, requirement levels specific to these appliances have been identified with experts and stakeholders; the requirement levels applied on splits would ban all of these appliances from the market.

2.3 Energy labelling

The air conditioner industry has some experience in voluntary agreements (Eurovent Certification in 2004) but does not endorse this option anymore due to its failure to deliver the expected results. The main reason is a concern for "free-riders" (which in the globalised market of air conditioners appears as a justified concern: only 7% of sales can be attributed to EU-based companies). There are also brands that may "exist" for only one year. The importers of these short-lived brands place low–cost low-efficient products into the EU market at the start of the cooling season and return the next year under a different brand name and agency. Such free-rider behaviour is difficult to control and imposes economic damages to other participants in a voluntary agreement.

18 For indicative purposes, the impact assessment is using a relationship between EER and SEER values as calculated in the preparatory study (for the average EU climate). Although the relationship depends on the specific technical design option applied and the category of appliance, conversion factors were identified for indicative purposes (for splits with inverter SEER = 1.25*EER, for splits without inverter SEER = 0.9*EER).

19 The average of the EER of 1643 reversible split package units in the 2010 Eurovent database is 3.25. The standard deviation is 0.529. The population is fairly close to a normal distribution, therefore the cut-off percentages can be calculated using the normal distribution function.

The continuation of the present labelling scale has following deficiencies:

1. The current scaling is not effective in identifying the state-of-the-art appliances. In the group of split package appliances, the current class A is already achieved by over 50% of models in 2005, and expected to increase to over 60% in 2010[20]. However, this efficiency level is still low in comparison with the existing potential. The current scheme does not allow consumers to identify differences in energy efficiency within this class A-group. Still, split appliances with much higher efficiencies than the current A-threshold efficiency level (A-class is EER=3.20 vs. the highest EER in the database = 5.7) could be purchased in this group with lower life cycle cost for the consumer. The same trend applies to other appliances such as single duct appliances. For the niche product double duct appliances (less than 1% in sales) this trend can not be observed[21].

2. The current energy label is based on steady-state efficiency (EER/COP) failing to address savings that can be achieved by good part load efficiency of air conditioners (many air conditioners operate in part load most of the time);

3. The current energy label scheme does not take into account the low power modes like standby, crankcase heating, etc. which would lead to unaddressed savings potential.

The Energy Labelling Framework Directive adds a complication that has to be accommodated, without negative impact on the clarity of the label for the consumer or on the industry. The ecodesign requirements setting the framework for energy labelling, the efficiency classes[22] for split appliances can be defined to ensure continuous improvement in efficiency of best split appliances, with the impact of downgrading close to all currently labelled split appliances under Directive 2002/31/EC. Double ducts and single ducts[23] do not reach the high efficiency levels of split appliances due to the inherently lower efficiency and different service/function provided by these appliances. As the Energy Labelling Framework Directive does not foresee the downgrading of the existing appliances[24], additional classes must be added on top of the existing label. However, in order not to send wrong signals to the consumer[25] the highest reachable energy efficiency class for single and double ducts could be identified as A+ (while the inherently more efficient split could go up to A+++).

2.4 Future trends

The major non-EU air conditioner markets show that the most popular appliances (split package) can be made much more energy efficient than those available in the EU market by applying known and cost-effective techniques. For single ducts (and possibly double ducts too), an important trend is the application of evaporative cooling, which can improve cooling output at little or at no extra energy input. It does however require the addition of water that

[20] Values for 2005 based upon available models, values for 2010 based on analysis of Eurovent Certification database for split package units (not sales weighted data).

[21] There is no sales data available to allow trend analysis; data on double ducts is based on stakeholder information.

[22] E.g. the label could step up every 2 years from A to A+++ in order to harvest on the available efficiency worldwide, while the most efficient appliance available on the EU market only reaches the A class.

[23] Nor does it make sense in setting SEER/SCOP-based requirements in the lack of inverter driven units.

[24] E.g. when minimum energy efficiency requirements can not be set higher than today's 'A'.

[25] That is, indicating single and double ducts as comparatively more efficient than split appliances.

can either be extracted from condensate that forms on the evaporator or as a separate water tank to be filled in with tap water. A future trend is also the use of inverters, which has also been taken into account in the business as usual scenario. These trends have been included into the base line as a slight increase in average energy efficiency of appliances and an increase in share of inverters (which raises the average seasonal performance of appliances, more information is provided Annex 3.

No clear trend can be seen in the use of low GWP refrigerants but some first steps in this direction have been some small-sized single ducts with hydrocarbons. However, these appliances represent less than 1% of the total market. Application of hydrocarbons as refrigerant is complicated due to various safety concerns (see more on Annex 4). For common HFC appliances refrigerant losses (e.g. through leakage during installation, operational life and improper handling at end-of-life) correspond to GHG emissions of some 15-20% of the total GHG emissions. Unfortunately, leakages can not be avoided (see Annex 4) which is why the most effective measure to minimise those emissions would be the replacement by refrigerants with lower Global Warming Potential, when these refrigerants would be available for wider use. While the F-Gas Regulation, inter alia, focuses on containment of high GWP refrigerants used in these appliances by improving installation, servicing, maintenance and end-of-life aspects, ecodesign can complement this framework by ensuring that the use of low-GWP refrigerants becomes as attractive as possible, without compromising the total green house gas emissions (for more, see Annex 4).

2.5 Relevant legislation

In many countries (main countries being Japan, USA, Australia, China) air conditioners are subject to measures covering energy efficiency and noise.

In 2002, the EU introduced mandatory energy labelling of air conditioners (Directive 2002/31/EC) but due to delays in the development of the measurement standard, the label could only be implemented from the year 2004. Currently over 50% of air conditioners are estimated to be in the top energy label class A[26]. These developments are a combination of three main elements; the energy label, minimum efficiency requirements in third countries (around this same efficiency level) and in particular due to strong technological development during the last ten years (control technology, more efficient components and scientific development in thermodynamics in general). Furthermore, the EU Energy Label does not address part load performance although these appliances run most of the time in part load conditions.

As said above, many countries (Japan, USA, South-Korea, Taiwan, China, Australia) have implemented mandatory minimum energy efficiency requirements for air conditioners (on all types, except single ducts), which makes the EU the largest AC market in the world without minimum efficiency requirements. This has led to a situation where low-efficiency air conditioners that can not be sold anymore in other markets, are produced in these third countries and placed on the market in the EU. The minimum requirements that apply in these countries are set at levels well above the average efficiency of EU appliances. Seasonal energy efficiency (SEER) is already implemented in the USA and Canada, and other countries

[26] For 'double ducts' the share of appliances in class A is not known. As the annual sales are low (40.000 units), these appliances were not treated separately in the market data used in the preparatory study. However, there are models available in energy class A on the basis of web search.

are expected to follow. For international comparison of minimum energy efficiency and labelling requirements, see Annex 5.

As to low power modes of these appliances, the current Commission Regulation on standby and off mode excludes air conditioners from the list of products covered.

In 2004, Eurovent Certification established a voluntary agreement with its members to ban energy label class G appliances from the certification program as of January 2004. According to a Eurovent position paper of 2005, labelling classes E and F could be banned in 2008 and class C and D from 2010 onwards (depending on capacity). However, to date, these bans have not been implemented (for further, see Chapter 2.3).

Another voluntary initiative is the EU Ecolabel which has defined criteria (2007/742/EC) for heat pumps, including air-to-air heat pumps. Three manufacturers (Daikin, Mitsubishi and Sirius) have been awarded the label but these products are air-to-water appliances (covered by Lot 1 on central heating boilers). Therefore the EU Ecolabel is considered not to be relevant in this impact assessment (on air-to-air air conditioners).

The types of air conditioners proposed to be regulated are used in buildings covered by the recast Energy Performance of Buildings Directive[27]. The Directive prescribes measures to improve the energy efficiency of heating and cooling installations of buildings including air conditioning systems. Member States are required to set up regular inspections for air conditioning systems with a rated output larger than 12 kW and are thus outside the scope of the ecodesign measures discussed in this report. In addition Member States may set up measures to improve efficiency of smaller systems as well. The development of minimum efficiency requirements and/or energy labelling will facilitate these goals.

Given that the ecodesign requirements will not lead to changes in technology that would have impact on installation or maintenance, there will be no impact on the Buildings Directive. More efficient appliances will lead to lower energy consumption within the house (household) but they will not have impact on the efficiency of the house itself.

The F-gas Regulation sets a framework for the maintenance of appliances employing halogenated refrigerants as used in air conditioners in scope of this report. The Regulation is to be revised in 2011 but does not include changes in its current content that could impact the foreseen ecodesign or labelling regulations (such as banning of certain types of refrigerants or altering significantly the requirements on maintenance).

2.6 Market and regulatory failures

A main reason for the persistent sales of low efficiency air conditioners is that end-users base their purchase decisions on purchase costs rather than life cycle cost of the product, a situation which is not helped by the current practice not to fully include environmental costs in energy cost. Also, the information on energy efficiency of equipment available to persons buying air conditioners is limited, which introduces asymmetrical information. Cost-effective improvement potentials for the end-user are therefore often not realised. Another problem are split incentives, where the person buying the equipment (for example the building owner) does not bear the operation costs, such as a tenant paying the electricity bill.

[27] OJ L 153, 18.6.2010, p. 13.

2.6.1 Regulatory failure

The current Commission Directive 2002/31/EC on air conditioners has achieved in the last six years an energy efficiency improvement of some 28%[28]. However, as the air conditioner market is a highly global market, part of the EU efficiency improvement is estimated to have happened due to strict minimum energy efficiency requirements in other major economies. Also, due to the very low efficiency level defined for 'A' for most types of appliances, the label does not help guiding consumers towards the most efficient appliances. Furthermore, the planned voluntary Eurovent Certification has never been implemented (mainly due to the difficulty in the EU markets dominated primarily by non-European industry) and no (air-to-air) labels have been awarded under the EU Ecolabelling scheme (2007/742/EC). This regulatory failure due to an outdated labelling scheme and inexistent voluntary action creates a market vacuum without adequate incentives to further improving energy efficiency of air conditioners and consumers are not able to differentiate between best products on the basis of their energy efficiency.

In addition, the current highest energy label class A is close to minimum energy efficiency requirements applicable in many other major air-conditioning markets (single duct units excluded, since these are typical for the EU market). Manufacturers experience little incentives to offer more efficient appliances, even though this could be done close to zero additional cost to the manufacturer and would bring significant savings to the consumer and reduce CO_2 emissions.

2.6.2 Negative externality

All environmental costs are not included in electricity prices. That is why consumer (and producer) choices are made on the basis of lower electricity price not reflecting environmental costs for the society.

2.6.3 Asymmetric information and myopia

Most consumers base their choice of equipment rather on purchase price and other factors like availability, service and 'trusted' brand names than energy cost. Few people realise that energy cost can be up to 70%-90% of total life cycle cost (which includes purchase, installation and maintenance). The reasons are often related to the complexity or lack of information understandable for consumers. The necessary technical information may be available somewhere (e.g. on a web site or in a technical documentation) but is hard to locate and/or understand.

2.6.4 Split incentives

This market failure occurs where investment costs and running costs are borne by different parties. This is the case in many rented apartments and spaces where the landlord reduces investment costs by choosing low-cost and low-efficiency appliances and the tenant is confronted with higher running costs.

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[28] The 1999 EERAC study concluded that the average EER of a split package air conditioner at that time was EER 2.5. The 2010 average EER of split package units is close to EER 3.2. The improvement is therefore a factor 1.28 (3.2/2.5) or 28%.

In case the tenant is the buyer of the air conditioner, he/she may be forced to use portable less efficient appliances because structural changes to the apartment/space may not be allowed. Some municipalities with historical centres have even forbidden the use of split package air conditioning appliances (even if these are more efficient in general than single package appliances), leaving only double duct models or (portable) single duct models as alternative type of appliances.

2.7 Subsidiarity

The principle of subsidiarity as is defined in Article 5 of the Treaty establishing the European Community intends ensuring that decisions are taken as closely as possible to the citizen; the Union should take action only in areas which fall within its exclusive competence and which lead to a more effective action if taken at national, regional or local level.

It is to be expected that Member States may want to take individual (non-harmonised) action on air conditioners to speed up the increase in energy efficiency of appliances. This possibility, in the absence of EU action, is strengthened due to the continued introduction and tightening of minimum requirements in third countries. Such action would hamper the functioning of the internal market and lead to high administrative burdens and costs for manufacturers, in contradiction to the goals of the Ecodesign Directive.

Such individual Member State action would be taken closer to the citizen but would fail in ensuring level playing field in the internal market. Measures introduced under the Ecodesign and Energy Labelling Directives help bringing down barriers and simplifying existing rules to enable everyone in the EU - individuals, consumers and businesses - to make the most of the opportunities offered to them by having direct access to 27 countries and 480 million people. The two Consultation Forum meetings have shown unanimous Member State approval for EU wide regulatory framework for air conditioners.

2.8 Legal basis for EU action

The Ecodesign Directive and, more specifically its Article 16, and the Energy Label Directive provide the legal basis for the Commission to adopt implementing measures reducing energy consumption of air conditioners and in guiding consumers towards the most efficient appliances.

3. OBJECTIVES

As laid out in Section 2, the preparatory study has confirmed that a cost-effective potential for reducing energy consumption of air conditioners exists. There is potential for reducing noise and providing incentives for the use of low-GWP refrigerants. This potential is not realised with the current market measures and initiatives, as outlined above.

The **general objectives** are therefore to develop a policy which corrects the regulatory and market failures, and which:

– reduces energy consumption and CO_2 emissions due to use of air conditioners following Community environmental priorities, such as those set out in Decision 1600/2002/EC or in the Commissions European Climate Change Programme (ECCP) and;

– promotes energy efficiency hence contribute to security of supply in the framework of the Community objective of saving 20% of the EU's energy consumption by 2020.

– ensures the free movement of affected products within the internal market.

The specific objectives are to:

– remove least efficient products from the market;

– promote market take-up of the most energy efficient air conditioners in the scope;

– provide incentive for manufacturers for the investments on appliances with low-GWP appliances without inappropriately compromising with total green house gas emissions.

The **operational objectives** are to address the problems resulting from the current labelling scheme and comply with the requirements laid down in the Ecodesign Directive, Article 15:

a) there shall be no significant negative impacts on the functionality of the product, from the perspective of the user;

b) health, safety and the environment shall not be adversely affected;

c) there shall be no significant negative impact on consumers in particular as regards affordability and life cycle cost of the product;

d) there shall be no significant negative impacts on industry's competitiveness;

e) in principle, the setting of an ecodesign requirement shall not have the consequence of imposing proprietary technology on manufacturers;

f) no excessive administrative burden shall be imposed on manufacturers.

Consistency with other EU policies

Increased market take up of energy efficient air conditioners through the introduction of minimum energy efficiency requirements and a revised energy labelling scheme will contribute to reach the 20% energy savings potential identified by 2020 in the Energy Efficiency Action Plan (COM(2006)545) and to the binding target on -20% GHG.

Improving efficiency of air conditioners belongs to one of the key objectives defined in the Community Lisbon Programme for 2008-2010 (COM(2007)804), the promotion of an "industrial policy geared towards more sustainable consumption and production" as further developed in the Action Plan on Sustainable Consumption and Production and Sustainable Industrial Policy (COM(2008)397)[29].

The European Economic Recovery Plan published 26.11.2008[30] mentions energy efficiency as one of the priorities and in particular promotes the rapid take-up of "green products": *The Commission will urgently draw up measures for other products which offer very high*

[29] Published 16.7.2008.
[30] COM (2008)800

potential for energy savings such as televisions, domestic lighting, refrigerators and freezers, washing machines, boilers and air-conditioners."

In January 2008 the European Commission proposed to implement the 20-20-20 targets. This 'climate and energy package' was agreed by the European Parliament and Council in December 2008 and became law in June 2009. An increased take up of efficient air conditioners will also contribute to the non-ETS targets under the GHG Effort Sharing Decision supporting the savings decision the Member States have agreed for 2020.

4. POLICY OPTIONS

4.1 Air conditioners

In order to address the issues and meet the targets identified in Section 3 it is important that the increasing energy consumption of air conditioners is curbed and that the other relevant environmental parameters are addressed.

The following policy options to improve energy efficiency of these appliances have been assessed.

4.1.1 Option 1: No EU action (baseline scenario)

This option assumes no further measures for air conditioners in the EU. The existing energy label for air conditioners would continue to exist, without alterations. This option would have the following implications:

The market and regulatory failures would persist, although the EU Energy Label to some extent would continue increasing public awareness on the importance of energy efficiency (the current trend in rising share of class A and appliances with inverters will continue). However, consumers would not be able to differentiate between high-efficient (beyond class A) and average-efficient appliances. The increasing average efficiency in third countries due to their minimum energy efficiency requirements could also contribute to this objective in Europe, without however, reaching the same average efficiencies as in these countries. However, the opposite could also happen with low-efficient appliances placed in the EU market as they could not anymore be sold in other markets. This option is included in the impact assessment as the baseline scenario which assumes a slight increase in average efficiency of air conditioners. While the impact of this option is described in more detail in Section 2, the following can be summarised:

Energy consumption of air conditioners will raise from 30 TWh/a in 2005 to 73 TWh/a in 2020, an increase of 243%. This is due to the combined effect of a continued sales increase and a slight but diminishing increase in average energy efficiency.

It is to be expected that Member States may want to take individual (non-harmonised) action on air conditioners to speed up the increase in energy efficiency of appliances. This possibility, in the absence of EU action, is strengthened due to the continued introduction and tightening of minimum requirements in third countries. Such action would hamper the functioning of the internal market and lead to high administrative burdens and costs for manufacturers, in contradiction to the goals of the Ecodesign Directive.

The specific mandate of the Legislator would not be respected.

This option is described in the analysis of air conditioners as **baseline** scenario and serves as a reference for calculation of savings

4.1.2 Option 2: Self regulation / voluntary agreement

This option assumes the introduction of voluntary agreements by the industry.

For the reasons explained in the chapter 2.3, the industry has stated its preference for a clear legal framework and level playing field to ensure fair competition based on regulatory measures.

The specific mandate of the legislator would not be respected.

The option of voluntary agreements is discarded from further analysis.

4.1.3 Option 3: Mandatory energy labelling scheme (Labelling only)

This option envisages revision of the energy labelling of air conditioners, without the introduction of minimum energy efficiency requirements.

A revised energy labelling scheme would help to increase the market penetration of more energy efficient products by providing incentives for innovation and technology development, and help consumers to make cost effective purchasing decision by addressing running costs more properly. It would also allow upgrading the energy efficiency measurement method in addressing seasonal efficiency and auxiliary power consumption.

However, a labelling scheme alone would not prevent the entering of low-efficiency appliances into the EU market as described in the section on 'Market Failures'. Consequently there is a high risk that market transformation towards high-efficient air conditioners would take place only very slowly at the corresponding detrimental impact on environment and life cycle cost for consumer.

4.1.4 Option 4: Ecodesign requirements only

This option considers the setting of requirements on the main environmental parameters energy, sound power level and refrigerants, without changes in the current energy labelling scheme.

According the Ecodesign Directive minimum energy efficiency requirements should be set at - or close to - the least life cycle cost point. The preparatory study has shown that the LLCC-point lies at efficiency levels beyond the current Energy Label class A. As such, no meaningful minimum energy efficiency requirements can be set, if the current Energy Labelling Directive is kept in force (if the current A would be retained, then ecodesign requirements should be set at lesser level than the current A, meaning the net effect would be minimal).

The repeal of the current energy label for air conditioners would solve the problems caused by the combination of the old scheme and new minimum requirements, but would not stimulate the market penetration of energy efficient products by providing incentives for innovation and technology development, and it would remove the instrument to help consumers to make cost effective purchasing decision by addressing running costs. Minimum efficiency requirements alone can not achieve these goals.

Despite of the apparent deficiencies of this option on efficiency requirements, its impacts are analysed in Section 5 in conjunction with the other options in order to allow transparent comparison of impacts of options. To ensure comparability, the same levels are applied as in the Option 5. However, only one set of introductory dates is applied.

The ecodesign requirement levels for minimum efficiency have been identified by taking into account the following aspects:

- availability and quality of the market data;

- EU air conditioner market situation (both average and BAT efficiency levels considerably lower in the EU than in other markets);

- novelty of the seasonal efficiency measurement method (Not yet used in practice in Europe. Only the US has seasonal requirements in place for heating but with different temperature settings and without noise requirements);

- relation between the efficiency and sound power level, which will only be fully known after the application of the new measurement method on a sufficiently large quantity of appliances.

As to the setting of requirements on maximum sound power level of air conditioners, only limited data is available, as presented in Annex 4. There is no data on the impact of the use of the new seasonal efficiency measurement method on sound power level of appliances. Also, there are no sound power level requirements yet in place in other markets that could guide this work. However, while noise is an important factor in the case of air conditioners, a prudent approach to sound power level requirements is required, as there is often a link between e.g. efficiency and noise, efficiency vs. the type and quantity of refrigerants used etc. that exceeds the level of detail required for the analysis (the preparatory study describes the current state of knowledge). Nonetheless, some improvement on the average noise level is thought to be feasible and for these purposes, the industry has made an estimate for sound power level requirements in taking into account of the uncertainties related to the limited data and the novelty of the efficiency measurement method used on most appliances, as follows:

Table on maximum sound power level for air conditioners

	Room air-conditioners				**Single ducts and double ducts**	
	Peak cooling/h ≤ 6 kW		**6 < Peak cooling/h ≤12** kW		**Peak cooling ≤ 6** kW	**6 < Peak cooling ≤ 12** kW
	Indoor	**Outdoor**	**Indoor**	**Outdoor**	**Indoor**	**Indoor**
dB(A)	60	65	65	70	65	70

The impact of such sound power level requirements would have to be monitored when the foreseen measures would be revised. The implementation of the new seasonal efficiency measurement method and the measurement data gathered during the implementation phase would help to reconsider the levels of such possible future requirements.

As to the setting of minimum requirements on refrigerants, low-GWP refrigerants have been freely available since the invention of air conditioners but several factors continue limiting the use of these refrigerants in the type of appliances in the scope. Due to safety reasons the allowed charge of natural (hydrocarbon-based) refrigerants is small and the EU F-Gas Regulation 842/2006 aims at controlling environmentally damaging refrigerants, and double regulation should be avoided. There is currently not enough market share of appliances using low-GWP refrigerants that warrants setting minimum requirements. Feasible is , is a mechanism to promote the use of low-GWP refrigerants.

A 'bonus' could be implemented in form of a reduction of the level of the minimum efficiency requirements on appliances using low-GWP refrigerants. To use low-GWP refrigerants in air conditioners in scope requires investments in R&D, in new production facilities and in modified components (especially when flammable refrigerants are used). The bonus would allow manufacturers to allocate more of their resources towards the investments on the use of low-GWP refrigerants instead of towards energy efficiency. This could facilitate the market take up of these substances.

To give an idea of the impact of such requirements, two possible outcomes can be considered. The first outcome is described in the baseline analysis and assumes no change in uptake of low-GWP refrigerants. The second outcome is described in Section 5.3 in form of a 'sensitivity' analysis on the use of low-GWP refrigerants and is based on a scenario of 50% of appliances using low-GWP refrigerants in 2015. The overall contribution of direct emissions to total greenhouse gas emissions drops by 2030 from an average of 19% in the 'outcome 1' to an average of 0.1% in the 'outcome 2', and absolute direct emissions drop from around 9.4 mton CO2 to 0.1 mton. This alternative scenario does not incorporate the reduction of energy efficiency, since lower efficiency also involves a reduction of amount of refrigerants (and vice versa) which would further complicate the analysis. Therefore, it can be concluded that depending on the level of the uptake of the low-GWP refrigerants a maximum saving potential of around 9 mton of direct CO2 emissions could be expected. The reduction in indirect emissions (electricity use) depends on how many appliances actually use the bonus for milder ecodesign requirements.

The bonus would work as follows: Appliances using low-GWP refrigerants would be allowed a reduction on the energy efficiency requirements, making these less stringent. The benefit of this approach is that the extra investments of manufacturers needed to apply low-GWP refrigerants can be recouped through smaller investments in high energy efficiency. Appliances using the bonus would show lower direct CO2 emissions (low-GWP refrigerant applied) but would also show higher indirect emissions (the energy efficiency is lower). Therefore the height of the bonus should strike a balance between this raising and lowering of emissions. This balance lies for most appliances at some 10% reduction of energy efficiency requirements: A smaller bonus of for example 5% would lead to lower overall emissions, but stakeholders considered this too small an incentive for manufacturers to invest in. A higher reduction of 15% on energy efficiency requirements would make investments more attractive, but would lead to higher overall emissions since the savings from low-GWP refrigerants do not weigh up against the higher indirect emissions due to lower energy efficiency. Analysis has shown that with a 10% bonus the overall emissions of an appliance with a bonus (lower efficiency but also lower direct emissions) stays on the same level as appliances without bonus (that meet stricter efficiency levels).

As shown Chapter 5.3.2 and in Annex 4, a bonus of 5% would lead to lowest total CO2 emissions out of the four levels considered (5, 10, 15 and 20%). However, a 5% bonus would be lower than the measurement tolerances used (8% vs. 10%), which would hardly incentivise manufacturers for the necessary investments. This was confirmed by the industry response showing that such a low bonus would not provide a reduction of energy efficiency levels important enough to encourage manufacturers to invest on the use of low-GWP refrigerants. This is why a bonus of 10% is proposed.

It is considered that a reduction of 15% of the minimum energy efficiency requirements would be risky in lowering the level of ambition for energy efficiency too much and broadening the energy efficiency reduction almost twice to the lowest measurement tolerances.

The impact of such a bonus would have to be monitored when the foreseen measures would be revised. The implementation of the new seasonal efficiency measurement method and the data on appliances using various types of refrigerants gathered during the implementation phase would help to reconsider the levels, or the existence, of such possible future requirements. This information could also facilitate the possible development of horizontal requirements on F-gases within the F-gas regulatory framework.

4.1.5 Option 5: Combined ecodesign requirements and energy labelling

This option combines the setting of minimum energy efficiency requirements with the introduction of a revised labelling scheme. The impossibility of combining energy efficiency requirements with the current energy labelling scheme has been discussed under Option 4.

The main benefits of simultaneous introduction of minimum efficiency and (revised) energy labelling requirements are that:

– removal of the least efficient models from the market is guaranteed;

– labelling scheme is adapted to the levels of the ecodesign measure ensuring the label's long-term function as a market tool to drive up the air conditioner efficiency;

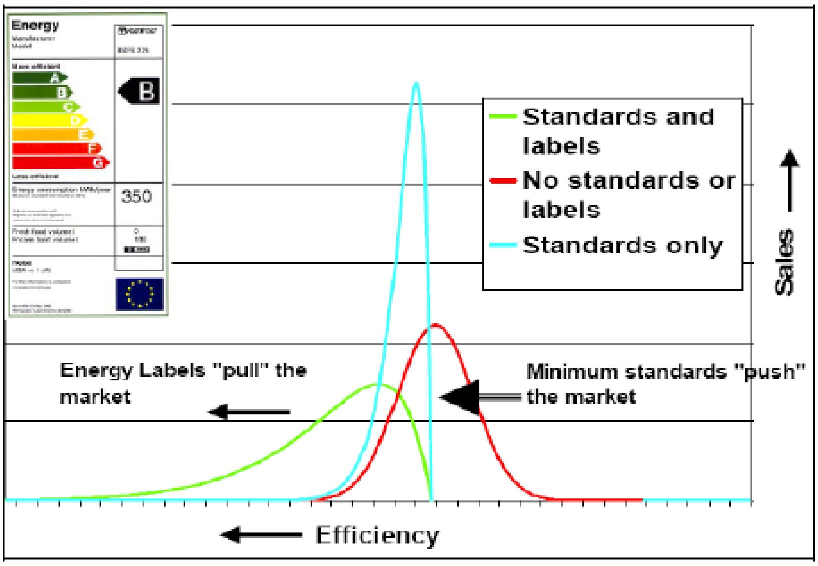
– synergic impact of the pushing effect of the eco-design specific requirements and the pulling effect of a functioning labelling scale, as demonstrated on the basis of the qualitative but well experienced relation illustrated in Figure 4.5.1. This leads to long term improvement of stock efficiency (minimum efficiency requirements define a threshold that in practice will not be lowered in the future, only raised);

– part load performance and auxiliary energy consumption can be taken into account on appliances for which a new basis of establishing energy efficiency is desirable (split, window and wall units) leading into higher real-life savings;

– auxiliary energy consumption can be taken into account on appliances for which rescaling is not possible/necessary (double and single ducts);

– complies with the demand of stakeholders for a harmonisation and rationalisation of both measures.

Figure on cumulative impact of ecodesign and labelling



Source: IEA, P. Waide, International use of policy instruments: country comparisons, Copenhagen, 05 April 2006.

Ecodesign requirements

The ecodesign requirements on efficiency were proposed by the preparatory study and conformed by the impact assessment study. The least life cycle cost level was SEER/SCOP 4.30-4.0 for split, EER 2.80 for single ducts and EER 2.60 for double ducts. Ecodesign requirements slightly lower than the LLCC level were finally proposed for following reasons:

- the SEER/SCOP measurement and calculation method is new, so the efficiency of existing appliances is not yet precisely known but will be known only when a sufficient number of appliances has been tested;
- the impact of the maximum sound power level requirements on the efficiency requirements is not fully understood but will be known only when a sufficient number of appliances has been tested;
- low-quality data on appliance efficiency was available, in particular on double ducts;
- in comparison with close to all other air conditioner markets, the proposed minimum energy efficiency are the most demanding in the world.

For these reasons, a cautious approach was taken in order to avoid a set of requirements impossible to be complied with.

Requirements in seasonal efficiency are set on split, wall and window units and in full load on single and double ducts. While the split units are mainly equipped with inverters, the single and double ducts are not.

The ecodesign requirements on sound power level were requested by stakeholders and proposed by industry during the impact assessment period. The identified levels took into account the uncertainties stemming from the new calculation method and the (probable) relation between energy efficiency and sound power level. Instead of ecodesign requirement on refrigerants, as explained above, a bonus was proposed to reduce the energy efficiency requirements of those appliances using low-GWP refrigerants. The bonus provides an innovative approach to promoting manufacturers that are willing to invest on more environmental-friendly refrigerants.

The introduction of the SEER/SCOP-based energy efficiency requirements requires time for testing of both new and all existing appliances. The industry has indicated it needs at least 18 months for these (re-)tests. Following three sub-options for combined introduction of minimum energy efficiency requirements and labelling are considered. The options differ as regards the timing (implementation date) of measures. The second tier measures always follow after two years behind the first tier. The three different options reflect the differences in savings that will occur if the measures are introduced at different dates:

1. The first sub-option considers an immediate introduction of requirements on 2011 given that entry into force of the measures is expected at earliest at the end of 2010. This option relies on the fact that industry has been part of the preparatory study and impact assessment starting from 1996, although it is claimed that no re-testing of appliances has taken place yet. This option is preferred by environmental NGOs and some Member States.

2. The second sub-option assumes introduction of measures two years after entry into force in 2012. This date is a compromise between the above and the below sub-options. This option has not received any particularly strong opinions from the stakeholders.

3. The third sub-option (with entry into force of first requirements on 2013) would give industry most time to adapt to the requirements. This option is favoured by most industry and by some Member States.

The introduction of the new energy label is also linked to testing of models and would therefore follow a similar path of sub-options.

Energy labelling requirements

The energy labelling requirements were discussed during the preparatory study and the impact assessment and aligned with the ecodesign requirements. On split appliances, they will allow showing 'A' for the current European benchmark and for 'A+++' for the world benchmark. With the gradual introduction of plusses on top of the 'A', the industry will be able to quickly move towards the most efficient technology available. The uncertainties stemming from the new seasonal energy efficiency measurement method were taken into account in the definition of efficiency levels for labelling classes.

On single and double ducts, as no downgrading of appliances was possible, an 'A+' class was defined on top of the existing A-G label. The A+ class was defined on the basis of the benchmark value for these appliances. This will ensure that these (inherently) less efficient appliances are not shown as more efficient than the rest of the air conditioners that are more efficient solutions for the cooling of a room.

Consequently, the options and sub-options considered in the impact analysis are as follows:

1. **BAU:** Business-as-Usual, i.e. continuation of current policy measures at Member State and EU level and no further action at EU level. This option assumes the continuation of the current energy label for air conditioners;

2. **Energy Label-only**: this option would include the revision of the existing Labelling Directive without ecodesign requirements. No stakeholder has expressed support to this option but for transparency it's impacts will be analysed without further sub-options;

3. **MEPS-only**: this option would include the setting of Ecodesign requirements for minimum energy efficiency, noise and information under the Ecodesign Directive. No stakeholder has expressed support for this option but for transparency its impacts will be analysed together with other options. No sub-options are considered;

4. **MEPS 2011-2013 + Labelling:** introduction of minimum energy efficiency requirements in 2011 and 2013 combined with the introduction of a revised energy label. This sub-option would start savings immediately but would leave very short time for industry to re-test appliances measured under the new seasonal efficiency measurement method. This sub-option is favoured in particular by environmental NGOs and some Member States and objected by industry;

5. **MEPS 2012-2014 + Labelling:** introduction of minimum energy efficiency requirements in 2012 and 2014 combined with the introduction of a revised energy label. This sub-option is a compromise in between the sub-options 4 and 6 with no particularly strong support or opposition by any party;

6. **MEPS 2013-2015 + Labelling:** introduction of minimum energy efficiency requirements in 2013 and 2015 combined with the introduction of a revised energy label. This sub-option would leave most time for the industry to retest appliances on which the new seasonal efficiency requirements are applied. This option is preferred by most industry and objected by environmental NGOs and some Member States.

4.2 Comfort Fans

As to comfort fans, the heart of the issue is the lack of robust data on the performance of fans sold in the EU. The preparatory study recognised this problem, and proposed as possible solution the setting of minimum efficiency (and noise) requirements as applied in China and Taiwan. These values were thought to be attainable (since applied in the manufacturing country of origin for comfort fans) leading close to 1 TWh/a savings by 2020.

However, during the impact assessment study it became apparent that the results of fan efficiency established using IEC 60879 are not compatible with the Chinese requirements. Additional input from stakeholders and experts revealed that there is no certainty to what actual measurement standards are applied when the performance of fans is declared and whether the fans actually meet the Chinese requirements. This removed the basis for the proposal to introduce minimum efficiency requirements in line with the Chinese legislation.

In the second Consultation Forum meeting three options were considered:

1) Setting efficiency requirements at similar level as in China/Taiwan with risk of removing virtually all comfort fans from the EU market;

2) Setting requirements at lower levels than proposed in the preparatory study with loss of savings potential. However, the insufficiency of data and test results would result in 'blindly-set' requirements with corresponding risk of lost savings or banning of appliances;

3) Setting information requirements only for the indication of the measured efficiency of the appliance and the measurement method used. Savings would be postponed until the setting of minimum efficiency and/or labelling requirements but the information requirements would help supporting national authorities in their market surveillance activities and provide sound basis for energy efficiency data for any future measures. Information requirements will not lead to any considerable administrative burden, as the efficiency tests will provide this information for each model anyway. While today appliances include information based on EER and COP, they will include information based on SEER and SCOP after the coming into force of requirements.

The third option was chosen, as options 1 and 2 were considered unacceptably risky.

As the setting of product information requirements is not estimated to differ significantly from the baseline scenario in terms of costs against the obvious benefits, this option is not further analysed.

5. IMPACT ANALYSIS

5.1 Economic impacts

Energy

The total energy consumption of air conditioners without further measures is expected to rise due to the increase in sales and the modest increase in average energy efficiency (BAU or baseline). The rise of efficiency will finally level off near 2030 because the sales are expected to stabilise.

The sub-options 'MEPS+Label' (requirements set for years 2011-2013, 2012-2014 and 2013-2015) lead to the highest savings of maximum 10 TWh (approximately 10% savings of baseline). It is assumed that once the tier 2 is achieved, energy efficiency continues rising because of the effects of the revised Energy Label.

Figure on electricity consumption per sub-option

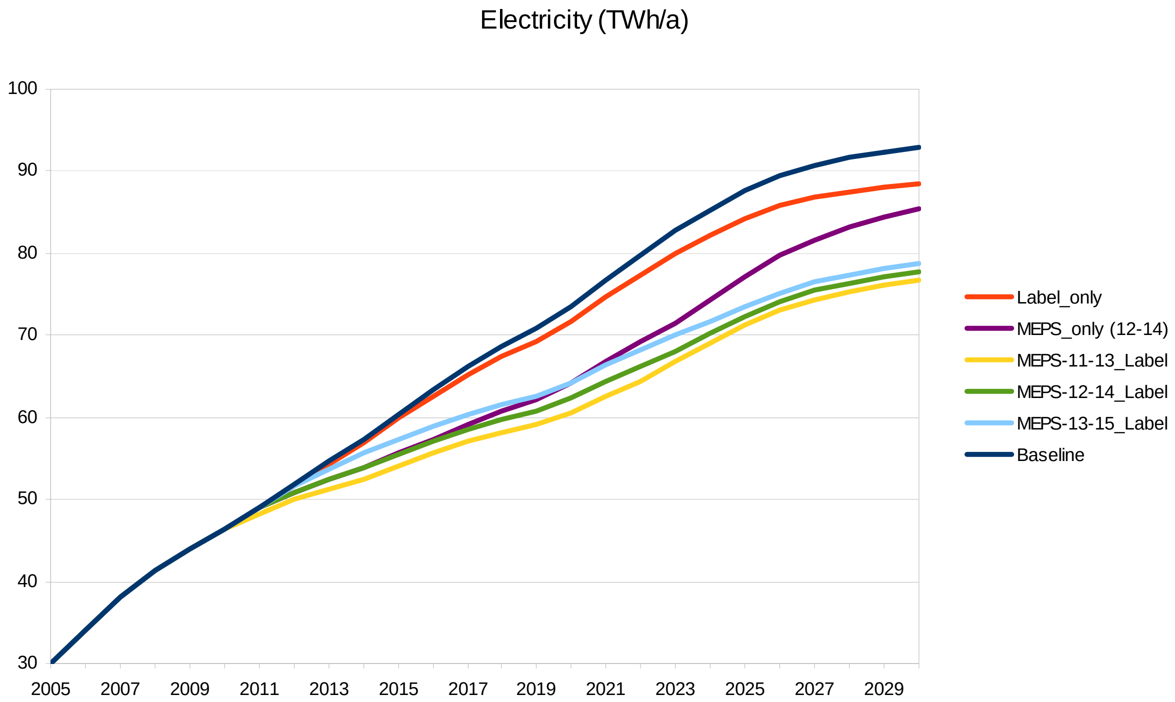
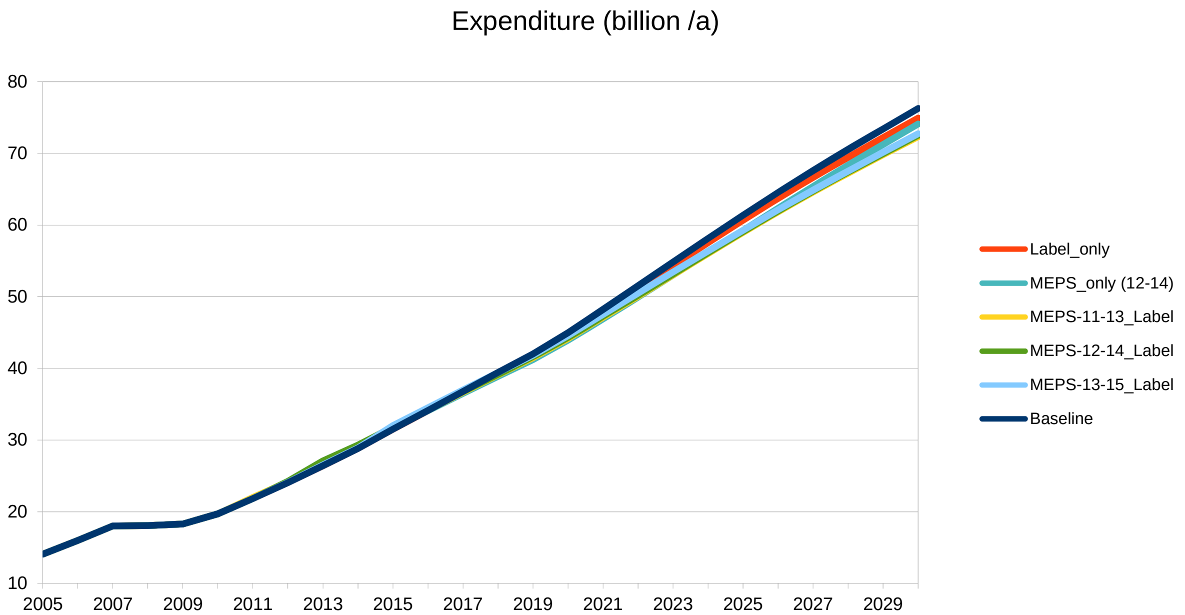
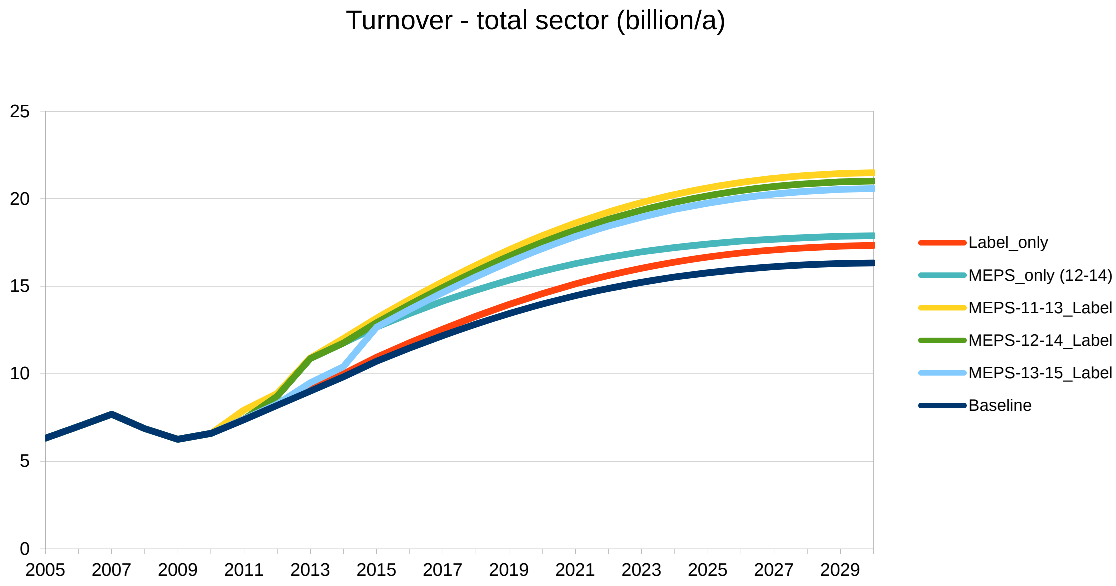


Figure on total EU expenditure (sales and stock costs)



The total expenditure (combined costs of purchase costs of new appliances and running costs of existing appliances - installed base) is expected to rise due to the sales increase. The increased energy efficiency will increase the average purchase price and reduce the running costs. The total costs are lower than the costs of the baseline scenario (no measures taken), therefore all options show a positive net effect. The maximum savings are some 3.7% in 2030 (compared to baseline), which correspond to around 2 billion euro/a.

Figure on turnover (total chain, excluding electricity companies)



The turnover of the whole sector (manufacturing industry, wholesale and retail/installers) is expected to increase for each option when compared to baseline. The main reason is the increase in average purchase price. The largest share of turnover is realised by the installers/retailers sector (some 40% of total).

Large manufacturers

The air conditioner market is a global market characterised by competition on product purchase cost (requires mass production), energy efficiency (requires investment in R&D), noise abatement (requires investment in R&D) and design/extra features (requires investment in R&D). Most manufacturers are large multinational companies who invest heavily in achieving the best results for those markets that have set stringent minimum efficiency and other product requirements in a number of third countries.

SME-sized manufacturers in the EU

As indicated above, the overwhelming majority of air conditioners sold in the EU are produced by large multinational companies. SME-sized companies may be involved in the production of these air conditioners as OEM suppliers, but stakeholders suggest that all these companies and their production locations are outside the EU, primarily in China and Japan. One Japanese manufacturer maintains two production sites in the EU, one in Oostende, Belgium, the other in Plzen, Czech Republic, to overcome shortcomings in the supply of units to the EU (market demand may shift rapidly due to heat waves[31]). Each site employs some 1200 people. The site in Belgium employs 70% blue-collar workers and 30% white-collar[32]. Both sites produce air conditioners above and below the threshold of the scope.

There are however a few SME-sized manufacturers of air conditioners in the EU focussed on producing niche-products like double duct units - a market niche where sales are so low that

31 Source: http://www.daikin.pl/news/items/europeanproductiontodouble.jsp

32 The facilities are owned by Daikin Europe located in Oostende, Belgium and in Plzen, Czech Republic. The information dates from 2004/2005.

the main market players appear to neglect this product group. Ttwo double duct production facilities are known[33]. The actual number of employees is not known but it is estimated that less than 500 employees are involved in the production of these air conditioners. Also here the trend of moving production to low-wage countries in Asia is foreseen.

There are also air conditioner production facilities in Italy that produce mainly single ducts. The production of single ducts is part of a much larger international Italian company whose total size exceeds that of SME's[34]. An unknown portion of single ducts sales by this manufacturer are imported products, which makes estimating the EU workforce complicated. However, the portion of the company involved in single duct production and marketing may very well be within SME-size.

The total number of employees worldwide (both EU and non-EU, OEM and suppliers) involved in manufacturing is believed to be close to some 13.000 people.

The impact assessment could not quantify a full cost estimate of the effect of the options on this industry since information on the costs of compliance is considered proprietary information. However, given the fact that these companies continue investing in innovation and new products instead of focusing on low-cost mass production indicates that minimum efficiency requirements will be rather of their benefit than disadvantage; the products manufactured by these companies meet the considered minimum efficiency requirements.

Retailers and installers

Retailers and installers are mostly SME-sized companies with often a limited number of employees. The impact of the proposed measures will drive up the average purchase price of the product, but this extra cost can be passed on to the end-user. No increased installation costs are expected (installation cost does not depend on the efficiency of the product).

The total number of employees in the retail chain (from wholesale, distribution to installers and maintenance) is believed to be just fewer than 37.000 people.

Administrative burden

The proposed ecodesign measure includes requirements to provide information on the efficiency of the appliances and the measurement methods and calculations. The energy labelling measure includes the provision of an energy label and a technical fiche. There is no change in administrative burden related to EER/COP-based ecodesign requirements but some do in relation to SEER and SCOP based requirements. However, as the new measurement and calculation method for SEER/SCOP simply replaces the current provision of EER/COP-based information, and as the use of the measurement method readily provides the content for the requested information anyway, administrative burden is considered limited. The new energy labelling requirements (label and fiche) simply replace the existing energy labelling requirements without adding any significant burden to manufacturers or to retailers.

Compliance cost and timing

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[33] These companies are Olimpia Splendid and Fimer, both Italian-based.

[34] This is the Italian-based company DeLonghi whose product portfolio is much much larger than air conditioners alone.

Manufacturers need time to make the necessary investments in order to ensure that appliances comply with the legal requirements. However, as the question is mainly in increasing the current production (e.g. of appliances with efficiencies not yet sold in the EU) the effort for the investment of new production lines is limited, and on the R&D even less important. However, appliances for which the efficiency must be measured in SEER/SCOP must all be re-tested, as the measurement method has not yet been used in real life. A normal design cycle for air conditioner industry is 5 years. For larger equipment (higher capacities like multipslit) the redesign cycle is longer. Also, test capacity (laboratory time) is limited, meaning that a very quick introduction (< 1 year) or requirements is not feasible. Industry has proposed a minimum period of 18 months to prepare for the first tier requirements.

Impact on internal market

EU level measures will ensure a well functioning internal market for the industry and consumers and helps to avoid market distortions due to possible introduction of national measures by some Member States. It is expected that imports of air conditioners to the EU continue as in the past, with the difference in minimum and average efficiency, as most (global) air conditioner manufacturers already have in their product offer efficiencies above the level of the minimum efficiency requirements proposed. No significant changes in trading patterns are expected due to the measure as such. However, possible changes in market shares of the main producers can not be excluded, as it depends on the market and investment strategies implemented by individual manufacturers.

5.2 Social impacts

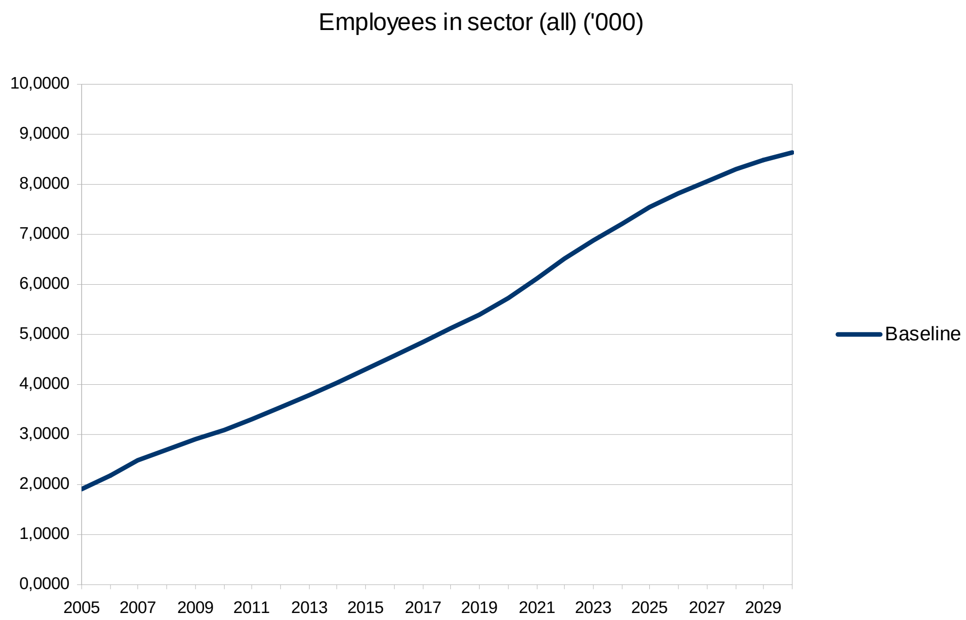
Job creation

The number of employees is only calculated for the baseline scenario, since sales are kept constant for all options and absolute sales are believed to be the prime determinant in job creation.

It is estimated that the ecodesign measure will not lead to direct job losses. As to retail chain (from wholesale to maintenance), the number of jobs is primarily a function of the absolute sales volume and not by the level of the efficiency of the appliances sold. As to jobs in R&D and manufacturing, companies involved in double duct production are operating in a market niche in which focus is on higher quality and higher efficiency appliances. Raising the level of efficiency of appliances will not change business opportunities on the short term as manufacturers already produce these appliances. As to single ducts, most of the production has already shifted to low-wage countries although there still is one manufacturer in the EU (there are many imported products). No EU air conditioner manufacturer produces low-efficient air conditioners. Thus, raising efficiency levels will have minimum impact on EU jobs.

Extra job creation by setting demanding targets is not expected for the EU, nor outside the EU, since additional R&D is not needed (efficient technologies already exist) but for some niche products like double ducts some extra efforts can be expected. However, this effort can not be quantified on the basis of the available data. Anyhow, companies involved are already using innovation and new technologies to adapt their products to the foreseen requirements. The double duct manufacturers are SMEs with a number of personnel involved in R&D being limited with expected additional jobs not surpassing 500 positions.

No major impacts on employment in manufacturing or in installation sectors are expected, as the proposed measures will not lead to changes in the production in the EU (these appliances representing the high-efficiency products) or in the technology of the appliances (e.g. increased use of inverters or better components in appliances has no impact on installation work). The installation requirements will remain unchanged.



Affordability

As to the methodology in assessing social impacts, the preparatory study indicates that in general an increase in efficiency of an appliance is accompanied by an increase in purchase price. The same mechanism is applied in this IA Report. On the basis of information of the preparatory study, the average purchase price of new sales is increased as the efficiency goes up. Some other corrections on the purchase are also applied, such as a price decrease due to improved production efficiency, reduction of production costs and depreciation of tooling costs, etc. The impact of the price increase due to efficiency increase and the price decrease due to higher overall production efficiency are combined into a single purchase price.

Several aspects can be considered as follows:

Some 2/3 of all appliances in scope are purchased by the commercial or service sector (shops, hair dressers, cafes, bars, restaurants, hotels/motels, small offices, training institutions and the like). These sales are predominantly split package units.

It is estimated that the sales to private consumers represent some one third of unit sales. Close to all single ducts are sold to private consumers, since this 'plug-and-play' unit allows spontaneous, impulse-driven sales (sales are particularly high during heat waves) without the need for permanent installation.

Double ducts are a niche product (sales are less than 1% of overall unit sales) used mainly in buildings of which no modifications on the building shell are accepted, such as in historic buildings.

Most of the non-commercial sales of the split appliances are by house owners, as these appliances require permanent installation. Most low-income consumers are not house owners. If, against the odds in the light of the split incentive, a house owner would invest in an efficient air conditioning appliance for the benefit of a tenant, the (often low-income) tenant would benefit from lower running costs.

Low-income consumers that wish to buy these appliances will face higher purchase prices but the life-cycle cost will be reduced, which benefits in particular low-income consumers (also due to asymmetric information and myopia). Member States, banks and/or financing institutes may offer specific schemes for the purchase of efficient appliances. This may happen in particular in the future, if the climate change continues warming the planet.

The total cost to acquire a split or double duct appliance is composed of the purchase and the installation cost. Ecodesign requirements do affect the purchase price but not the installation costs.

The measures keep intact the current available categories of products, where single ducts are the most affordable way of acquiring cooling capacity. Besides, if the purchase/installation price would be too high for a low-income consumer, there are alternatives for cooling, such as cooling fans, which are only a fraction of the purchase price of air conditioners and have no installation cost, and have very low running costs compared to air conditioners.

No impacts on health have been identified.

All scenarios show a reduction of expenditure, meaning that even if purchase price levels increase (which is expected will happen) the reduction of electricity costs outweigh the initial price increase, lowering the total cost of ownership.

Due to the increase in average efficiency the average purchase price of new products is expected to rise. The preparatory study provided the background analysis of the price increase per efficiency increase.

The following average purchase prices apply to air conditioners at the basecase, LLCC (Least Life Cycle Cost) and BAT (Best Available Technology) level of energy efficiency. Note that the basecase level is without inverters and that for double ducts the preparatory study did not provide details. The price and efficiency information on double ducts is based on information provided by stakeholders during the impact assessment.

Table on affordability: basecase, LLCC and BAT

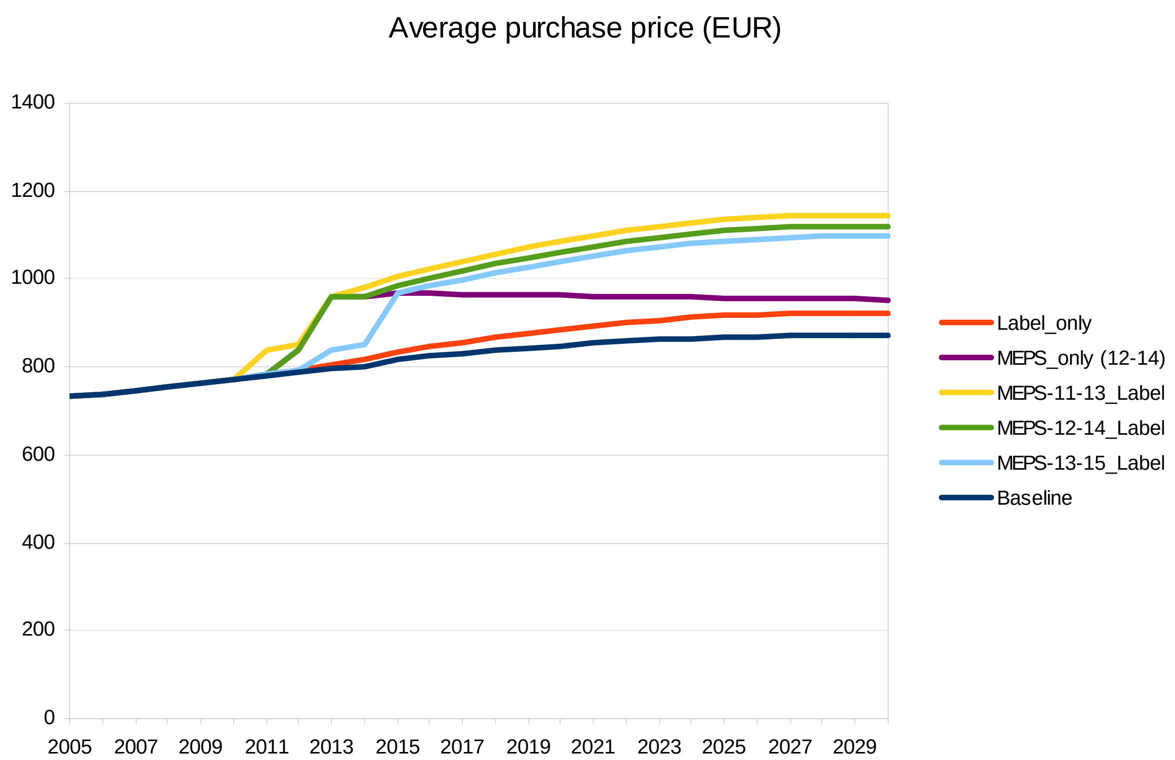
Avg. purchase price (EUR) **In 2005 prices**	**Base case**	**LLCC**	**BAT**
Split package avg 3.5 kW[35] (€)	683	1035	1398
SEER	2.8	5.4	>6

[35] Window and wall units were not separately assessed in the preparatory study but performance and pricing are considered comparable to that of an average split package of an equal capacity.

Split package avg 7.1 kW (€)	1385	2084	3351
SEER	2.7	5.3	>6
Single ducts (€)	389	530	1235
EER	2.3	2.8	>4
Double duct (€)	1000	1250	1750
EER	2.1	2.35	>2.7

The overall purchase price increase of air conditioners (all categories combined) for the options considered is presented below.

Figure on average purchase price



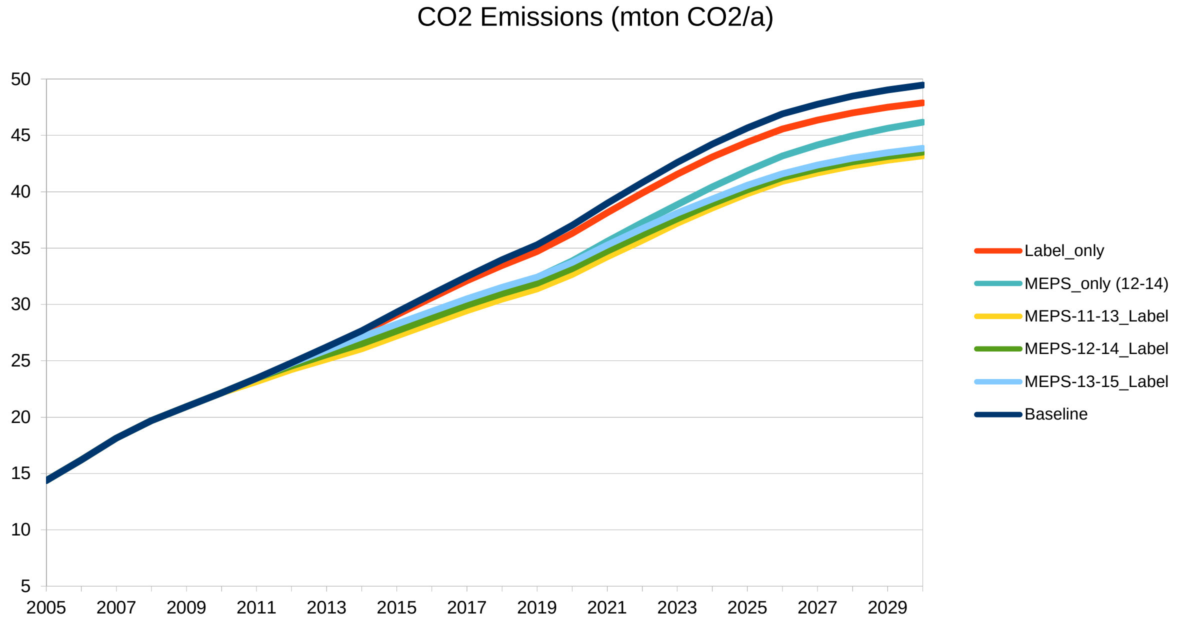
Note that for the option 'MEPS-only', the purchase price goes down after the 2nd tier. This is caused by an ongoing reduction of purchase price (which is common to all options) that is not compensated for by increasing efficiency (this option assumes no further efficiency increase, which normally drives purchase price up, as is the case in the other options, including baseline).

5.3 Environmental impacts

5.3.1 Indirect emissions

The graph below shows the CO2 equivalent emissions for the options considered (covers CO2 emissions from electricity consumption and green house gas emissions (GHG) from leakage of refrigerants over the product life).

Figure on CO2 emissions



The share of direct GHG emissions ranges from 15% (baseline 2005) to 24% (MEPS 11-13_Label, 2030). The increase of the percentage value is caused by a decrease of indirect emissions (less electricity consumption) which increases the relative share of direct emissions.

5.3.2 Direct emissions

Analysis of "Low-GWP refrigerant" options

In the policy Options, the share of appliances using low-GWP refrigerants was kept limited. For many air conditioners, propane is not a viable alternative because of its flammability and restrictions for use in larger quantities. Other low-GWP refrigerants (CO2, HFO's) are not (yet) readily available and the consequences as to pricing and performance are not sufficiently known. Therefore, a conservative estimate of a 5% share of "low-GWP" appliances in the sales of new split units was assumed for 2020. For double ducts and single ducts, a higher estimate of 15% in 2020 was assumed because the charges are smaller on average. For both groups a gradual increase (normal distribution curve) was assumed[36]. The leakage rates are assumed to stay constant (3% per annum for splits, 1% per annum for double/single ducts and 5% at end-of-life of all appliances). Combined with increasing efficiency the charges will become higher (larger heat exchangers require more refrigerant) and the indirect emissions will be lower, which leads to an overall increase of direct emissions. The impacts can be seen in the below table.

Table on BAU scenario direct GWP emissions

Policy options						
Direct CO2eq. by refrigerants	2005	2010	2015	2020	2025	2030

[36] Both split and packaged units assume a standard deviation of 4 years, with a 50% of target pivot point at year 2020. The target value is 10% low-GWP sales share for the splits (achieved in 2027) and a 25% target of low-GWP sales share for packaged (achieved in 2029).

(mton CO2/a)						
Baseline	2,2	3,5	4,9	6,6	8,5	9,4
Label_only	2,2	3,5	5,0	6,7	8,8	9,9
MEPS_only (12-14)	2,2	3,5	5,0	6,8	8,7	9,4
MEPS-11-13_Label	2,2	3,5	5,0	7,0	9,3	10,5
MEPS-12-14_Label	2,2	3,5	5,0	6,9	9,2	10,3
MEPS-13-15_Label	2,2	3,5	4,9	6,8	9,0	10,2
Share of direct emissions	2005	2010	2015	2020	2025	2030
Baseline	15%	16%	17%	18%	19%	19%
Label_only	15%	16%	17%	19%	20%	21%
MEPS_only (12-14)	15%	16%	18%	20%	21%	20%
MEPS-11-13_Label	15%	16%	18%	21%	23%	24%
MEPS-12-14_Label	15%	16%	18%	21%	23%	24%
MEPS-13-15_Label	15%	16%	17%	20%	22%	23%

The effect of a possible transition towards the use of low-GWP refrigerants was not calculated in the context of policy options, as the application of such refrigerants is entirely optional. However, for illustrative purposes, it is insightful to assume a scenario in which 50% of new appliances will use refrigerants with low GWP in 2015 gradually increasing to 100% in 2020 (50% in 2020 is chosen, as this comprises a significant share of appliances and it allows making also short-term effects visible before 2030, although this scenario should be considered unlikely in the light of the information available for this report) . . The calculated impacts are shown in the below table.

Table on direct GWP emissions if 50% sales share of low-GWP refrigerants in 2015, 100% in 2020

50% of new appliances are low-GWP at start of MEP						
Direct CO2eq. by refrigerants (mton CO2/a)	2005	2010	2015	2020	2025	2030
Baseline	2,2	3,5	4,5	3,6	1,3	0,05
Label_only	2,2	3,5	4,5	3,6	1,3	0,05
MEPS_only (12-14)	2,2	3,5	4,5	3,6	1,4	0,05
MEPS-11-13_Label	2,2	3,5	4,5	3,7	1,4	0,05
MEPS-12-14_Label	2,2	3,5	4,5	3,7	1,4	0,05
MEPS-13-15_Label	2,2	3,5	4,5	3,6	1,3	0,05
Share of direct emissions	2005	2010	2015	2020	2025	2030
Baseline	15,1%	15,8%	15,5%	10,4%	3,3%	0,1%
Label_only	15,1%	15,8%	15,7%	10,8%	3,5%	0,1%
MEPS_only (12-14)	15,1%	15,8%	16,7%	11,8%	3,9%	0,1%
MEPS-11-13_Label	15,1%	15,8%	17,0%	12,5%	4,4%	0,2%
MEPS-12-14_Label	15,1%	15,8%	16,7%	12,2%	4,2%	0,2%
MEPS-13-15_Label	15,1%	15,8%	16,1%	11,7%	4,0%	0,1%

These calculations assume that the energy efficiency is not reduced when compared to the assumptions in the policy options. If this were the case the direct emissions could drop but the indirect emissions (from electricity consumption) could increase, and the overall combined effect on GHG emissions could be lower.

Low-GWP bonus and Energy Label ranking

A GWP-related bonus linked to Energy Label performance (ie. a low-GWP appliance would be awarded a higher energy label class) is considered suboptimal, with few or no advantages and major drawbacks, as the label would not anymore convey the right information to consumers about comparative energy efficiency of the appliance (as some stakeholders argued, the label would be misleading, as the factual information on the energy efficiency is distorted by the characteristics of the refrigerant). Also, it would hamper the monitoring of the progress of the energy efficiency of appliances and the choice of a higher labelled appliance would risk not leading to higher savings for the consumer. Linking a GWP-bonus to ecodesign requirements ensures that the consumer always benefits from the fact that out of appliances of similar efficiency the one using a low-GWP refrigerant is always a better option for the environment (subject to setting the level of the bonus so that total emissions are not increased).

Cumulative savings

Cumulative savings for electricity range between 40 to 70 TWh by 2020. By 2030, savings increase to 146 vs. 228 TWh of electricity.

Electricity savings (TWh/a)	2005	2010	2015	2020	2025	2030
Baseline						
Label_only	0,0	0,0	-1,3	-7,8	-22,0	-42,6
MEPS_only (12-14)	0,0	0,0	-11,3	-50,4	-103,7	-146,1
MEPS-11-13_Label	0,0	0,0	-17,2	-69,1	-147,1	-228,4
MEPS-12-14_Label	0,0	0,0	-11,5	-55,7	-126,8	-202,9
MEPS-11-14+_Label	0,0	0,0	-10,6	-53,8	-124,3	-200,4
MEPS-13-15_Label	0,0	0,0	-5,8	-40,5	-102,7	-173,7

(Negative values correspond to savings)

By 2020, the Options save up to a maximum of 1.2 billion EUR. The expenditure increases to 0.8 billion (mainly due to increase in purchase price). By 2030, savings range in between 21 to 26 billion EUR (all savings).

Expenditure savings (billion EUR)	2005	2010	2015	2020	2025	2030
Baseline						
Label_only	0,0	0,0	0,0	-0,5	-2,9	-8,3
MEPS_only (12-14)	0,0	0,0	1,5	-1,2	-10,1	-21,0
MEPS-11-13_Label	0,0	0,0	1,4	-0,3	-9,2	-25,7
MEPS-12-14_Label	0,0	0,0	1,6	0,5	-7,8	-23,5
MEPS-11-14+_Label	0,0	0,0	1,2	0,3	-7,7	-23,5
MEPS-13-15_Label	0,0	0,0	0,7	0,8	-6,2	-21,1

(Negative values correspond to savings)

As a conclusion, the sub-option 'MEPS-12-14+_Label' offers savings comparable to the other sub-options without unnecessary burden (from retesting of appliances due to the new efficiency measurement method) to the industry that would occur in options introducing the first tier requirements earlier. Additionally, earlier introduction of EER/COP based minimum efficiency requirements could be considered in order to ensure that the least efficient appliances will be removed from the markets at an earlier stage.

Overlap with other measures

No significant overlap with other ecodesign measures has been identified. Lot 1 covers heat pumps connected to hydronic systems. Lot 10 covers fans for domestic ventilation (not for the recirculation of indoor air). Lot 21 covers air heaters but not the types using vapour compression cycle. Lot 11 focuses on fans above 125W and some of these fans could be used in outdoor units. However, savings from the Lot 11 fan measure are estimated negligible in the context of air conditioners.

5.4 International comparison

One of the objectives of this measure is to bring the EU requirements closer in line with the international levels. Today, the EU market is the only major air conditioner market without minimum requirements. However, each market has its specificities, such as the level of saturation, share of different types of air conditioning appliances due to different climates (temperature and humidity), technical requirements, etc. For these reasons, direct alignment of requirements with third countries could lead to negative impacts in the EU market. However, third country legislation and market reality has been taken duly into account through the stakeholder consultation during the preparatory study. As a result, the considered EU requirements are among the highest in the world although they may not be identical to any of the minimum energy efficiency requirements in place in third countries, including requirements on noise and the promotion of low-GWP refrigerants, which has not yet been implemented elsewhere in the world.

No minimum energy efficiency or energy labelling requirements on single ducts or double ducts are known to exist in the world on the basis of the preparatory study or the impact assessment. These products are typical for the EU market, particularly in Southern-Europe, but are rare or insignificant in other major air conditioning markets, hence probably the lack of requirements on these appliances. However, it is known that Australia is considering the introduction of requirements on single ducts once the present preparatory process to develop requirements on air conditioning appliances within the EU has delivered its results.

As to other air conditioners, as shown further in Annex 8, minimum efficiency or energy labelling requirements on air conditioners have been traditionally based on efficiency measurement standards on full load (EER/COP). However, the introduction and rapid development of control technology during the last two decades has made this type of measurement standards outdated, even misleading as an indicator of efficiency in real use. This is why the US, as the first nation in the world, introduced efficiency requirements on split package air conditioners on the basis of seasonal performance and Japan and South Korea are in a process of doing so, in line with the US and the EU. One of the main driving forces behind these developments is the air conditioner industry that has realised the shortcomings of the EER/COP-approach. Today, the use of seasonal efficiency measurement standard is requested by all stakeholders, and it is expected that the rest of the countries will gradually move towards the use of seasonal efficiency (However, to ensure a more robust international comparison, the preparatory study, and as also briefly treated in Annex 8, includes comparisons based on EER).

On the basis of the methodology agreed during the preparatory study, the proposed values for minimum requirements of SEER 3.6/4.3 equal to about EER 2.9/3.4 (assuming the use of inverters). That is, the proposed first tier requirements (SEER 3.6) equal to about the average level of requirements available in the world (requirements ranging between 2.2-3.7). The proposed second tier requirements are equal to the US requirements. Only the Japanese requirements on smaller power range are higher than in Europe.

As to heating efficiency (SCOP), the proposed requirements are understood to be below the Japanese top-runner requirements but are still aimed at phasing out low-efficient products, keeping high-efficient appliances on the market.

The IA Report shows that redesign of appliances for the EU market is most likely not an issue since equipment fulfilling the proposed EU requirements is already available in the world (major air conditioner manufacturers are global players). However, for retesting of appliances, the industry and test laboratories estimate the need of a preparatory period of some 18 months (page 25). This estimate is based on the experiences from the standardisation work run by the industry in parallel with the preparatory study.

5.5 Summary and conclusion

The analysis on air conditioners shows that the economic, social and environmental impacts of the options and sub-options save between 7 - 16 TWh in 2030 and between 2.9% - 5.4% in expenditure without job losses. However, industry needs time to test new and retest existing appliances for which minimum energy performance requirements are set on the basis of seasonal energy efficiency (more than 90% of existing and new appliances).

As the analysis shows, the difference in timing does not affect significantly the level of savings. The option (MEPS 12-14 + Labelling) has second highest savings and guarantees that industry has enough time to prepare for the first requirements. It therefore seems to offer an appropriate combination of ambition and feasibility.

The below summary table on main impacts of the considered options is presented below. Full summary table can be found in Annex 9.

Electricity savings (Twh/a)	2005	2010	2015	2020	2025	2030
Baseline						
Label_only	0	0	-1	-1,9	-3	-4
MEPS_only (12-14)	0	0	-5	-9,4	-10	-7
MEPS-11-13_Label	0	0	-6	-12,9	-16	-16
MEPS-12-14_Label	0	0	-5	-11,3[37]	-15	-15
MEPS-13-15_Label	0	0	-3	-9,3	-14	-14
Expenditure savings (bio EUR)	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Baseline						
Label_only	0,0%	0,0%	0,0%	0,5%	1,1%	1,7%
MEPS_only (12-14)	0,0%	0,0%	-0,7%	2,3%	3,5%	2,9%
MEPS-11-13_Label	0,0%	0,0%	-0,7%	1,8%	3,9%	5,1%
MEPS-12-14_Label	0,0%	0,0%	-1,0%	1,5%	3,7%	4,9%
MEPS-13-15_Label	0,0%	0,0%	-1,7%	1,0%	3,4%	4,6%

[37] The Regulatory Committee on 31 May 2011 voted to decrease the GWP bonus from the proposed 15% to 10% and to chage some levels of the efficiency requirements for air conditioners, except single and double duct air conditioners as follows: the first tier requirement for appliances with GWP of refrigerant > 150 for < 6 kW was increased from SCOP 3.20 to SCOP 3.40, the second tier requirement for appliances with GWP of refrigerant > 150 for < 6 kW was increased from SEER 4.30 to SEER 4.60 and from SCOP 3.50 to SCOP 3.80 and for appliances with GWP of refrigerant > 150 for 6-12 kW the requirement was increased from SCOP 3.50 to SCOP 3.80. The impact of these changes on the expected combined savings from the energy labelling delegated regulation and this ecodesign implementing regulation is estimated to be additional savings of somewhat below 1 TWh by 2020, increasing by this amount the previously expected savings of 11 TWh by 2020.

CO2 savings (Mton CO2)	2005	2010	2015	2020	2025	2030
Baseline						
Label_only	0,0	0,0	-0,2	-0,7	-1,3	-1,6
MEPS_only (12-14)	0,0	0,0	-1,6	-3,1	-3,8	-3,3
MEPS-11-13_Label	0,0	0,0	-2,1	-4,3	-5,8	-6,3
MEPS-12-14_Label	0,0	0,0	-1,7	-3,8	-5,5	-6,0
MEPS-13-15_Label	0,0	0,0	-1,0	-3,3	-5,1	-5,6

The assumed electricity price is based on the electricity price used in the preparatory study for the EU 27 = 0,136 Eur/kWh.

The analysis on comfort fans showed that the lack and low quality of efficiency data does not allow setting ecodesign or energy labelling requirements on comfort fans. However, information requirements can be set for the display of the efficiency of the appliance and of the measurement standards used. This information will facilitate the gathering of the efficiency data that will allow considering the setting of requirements at a later stage.

6. MONITORING AND EVALUATION

The main monitoring element will be the tests carried out to verify correct rating and labelling. Monitoring of the impact on appliances should be done by market surveillance carried out by Member State authorities. Effective market shift towards upper labelling band will be the main indicator of progress towards market take-up of more efficient air conditioners. The increase in sales of appliances using low-GWP refrigerants will provide an indicator for the impact of the bonus and will allow considering the usefulness of the bonus, its possible continuation and the suitable level of the bonus.

The appropriateness of scope, definitions, concept and possible trade-offs will be monitored by the ongoing dialogue with stakeholders and Member States. The main issues for a possible revision of the proposed energy efficiency requirements and the labelling scheme are:

– follow up of the appropriateness of the new seasonal energy efficiency rating (SEER) and possibly improved test standards (mandate CEN/ CENELEC) and measurement accuracy (tolerances), including the possible application of SEER on single and double ducts;

– possible revision of the energy efficiency and sound power requirements, impact of the bonus for appliances using low-GWP refrigerants, labelling classification scheme and labelling categorisation, taking into account the impact of other air conditioner related Ecodesign Lots;

– implementation of further measures on possible direct leakages (obligatory leakage detection, refrigerant bonuses etc).

Taking into account the time necessary for collecting, analysing and complementing the data and experiences related to the implementation of the minimum efficiency and sound power level requirements, the bonus and the labelling scheme, and the time needed to assess technological progress, including the impact of the information requirements on comfort fans, a review of the main elements of the framework could be presented 5 years after entry into force of a labelling scheme.

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY AND TRANSPORT

DIRECTORATE D - New and Renewable Energy Sources, Energy Efficiency & Inr
Energy efficiency of products & Intelligent Energy – Europe

Brussels, 03/07/09
TREN/D3/IGS (2009)

MINUTES

of the

Consultation Forum on implementing measures with regard to Ecodesign and energy labelling for room air-conditioning appliances, local air coolers and comfort fans on 22 June 2009

Centre Albert Borschette (CCAB), Brussels.

Participants: see Annex 1

The Chairman opened the meeting by recalling the aim of the proposed two implementing measures which is to improve the energy efficiency of the appliances in question, hence contribute to the 20% energy efficiency target set for 2020. *The Commission Staff Working Document on a possible Commission Regulation implementing Directive 2005/32/EC with regard to air-conditioning appliances, local air coolers and comfort fans* (Annex 2) lays done the principles to set minimum requirements phasing out the less efficient models from the market, including a revision of the labelling scheme on air-conditioning appliances in order to drive the market towards more energy efficient models.

A power point presentation[38] on the key aspects of the Commission Staff Working Document[39] was presented. In general, the approach proposed was welcomed by the stakeholders and it was agreed that the details of the efficiency calculation method would be further specified and agreed based on a working group to be launched after the meeting. Stakeholders were welcomed to express their interest in participating this technical working group.

Scope

ECOS (European Environmental Citizens' Organisation for Standardisation), speaking in the name of environmental NGO's[40], was worried about allotting a separate class for LACs and RACs[41], which could lead to increased sales of the more inefficient LACs. EPEE was concerned about LACs being in a separate category, as RACs would also be facing much

38 See Power Point presentation discussed during the meeting and available on CIRCA.
39 Annex 2.
40 Including INFORSE (International Network for Sustainable Energy), EEB (European Environmental Bureau), CAN (Climate Action Network Europe), Greenpeace European Unit, WWF-Europe.
41 LAC = local air cooler; RAC = room air-conditioning appliance.

higher requirements than LACs and requested that DDs[42] and window units be considered as RACs also below 2.2 kW output level. CECED requested the power limit for LACs should be indicated in input power rather than in output power.

IT agreed with the scope as proposed but emphasised that DDs and SD[43]s are different appliances: DDs are an important type of an appliance used in historical buildings, where no outdoor units are allowed due to local legislation, while SDs are movable and serve other purposes. IT also unfolded that fixed DDs can cool a room while SDs can not and that these appliances also exist with heating function, while window units are not movable and are very rare in the EU. If SDs and DDs were removed from the market, a group of consumers would be deprived from the service provided by these appliances. IT saw no need to change from input power to output power but to define DDs as LACs.

ANEC understood that LACs may need to be kept in a separate category but that their sales should not be promoted due to their low efficiency. ECOS requested reducing the use of LACs and even to ban if possible, especially the window and through-the-wall units, which are not needed. Eurovent was concerned that if installed DDs are considered LACs, it would lead to a replacement of all split units by DDs and suggested that split DDs be classified as package DDs. CECED explained that if this was to happen it would have already happened, as the price difference already exists. Also, this is not likely to happen due to the different service that the appliances provide.

The Chair concluded that window and through-the-wall units seem to be less important for the markets while SDs and DDs serve a specific purpose, DDs being closer to RACs than LACs. As a complement, the lower efficiency of DDs should be clearly indicated to the consumer in the energy label.

NL requested that the CF[44] category 'other fans' be specified so that all other types of comfort fans would be included in this category.

Parameters for Ecodesign measures

The Chair introduced the subject in summarising that the preparatory study identified three environmental parameters; energy in use, noise and the impacts of refrigerants. No further environmental parameters were identified by stakeholders for the planned Ecodesign measures. The Chair stressed that it is important to ensure that no overlapping requirements are set with other Community law.

Requirements on energy efficiency

ECOS reported that the proposed minimum energy efficiency requirements are too low; when the requirements are in force in the EU in five years from now the levels of ambition in third countries is already far higher. ECOS proposed to quickly go to LLCC level and to set minimum requirements at benchmark level in five years from now, including the modification of the labelling scheme accordingly. ANEC required more stringent requirements on LACs due to their inherently lower efficiency compared with RACs. The UK supported the view of low ambition level in relation to the benchmarks. EPEE informed that in Japan there are

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42 DD = double duct.

43 SD = single duct.

44 CF – Comfort fan.

energy efficiency targets for industry and that minimum requirements on air-conditioning appliances can not be further proposed due to building structure limitations; design of appliances would be very difficult if highest possible efficiency levels were required.

Eurovent informed that there is a difference in efficiency between small and large appliances and stated that there is no SCOP data available from third countries or from European test laboratories.

SE, the UK and DE stated that it is difficult to comment on the level of ambition, as the cut-off levels are not known and as the testing procedure is not yet clear. SE offered its expertise in testing appliances in lower temperatures and suggested to start the labelling scale from the level of the minimum requirements of the first stage. The Chair agreed that no empty classes should be accepted.

For clarity, a comparison of minimum requirements between the US and the proposed EU requirements was shown indicating that the levels are comparable and corresponding about to the level of the present A labelled appliances in the EU. It was also shown that mini split products sold in the US were considerably more efficient than the ones sold on the EU market. The reason is the existing minimum requirements on mini splits in the US. It was also explained that the proposed levels of the requirements will be very ambitious for non-inverter technology but clearly less demanding for inverter technology banning about 60-65% of RAC appliances currently on the market.

Eurovent considered that also a big part of inverter appliances would be banned but this would have to be confirmed by measurements in laboratories. ECOS agreed that an important part of appliances current on the market would be banned but that the European air-conditioning sales are composed of very low efficiency appliances. ECOS confirmed that based on their knowledge the US reconsiders reviewing the current minimum requirements. As manufacturers are the same in all markets, there is no significant cost for the industry to deliver more efficient appliances also to the European market.

Eurovent considered that the comparison with the US markets is not appropriate as the appliances are different and the building restrictions may differ. It also takes time to depreciate R&D costs and to invest on new product categories. Also, the number of R&D personnel is limited. The Chair welcomed further information on this issue for the needs of the impact assessment.

FR proposed that, in order to give time for the industry, the first requirements could be introduced very quickly at lower level and the second requirements later on with very high level of ambition. ANEC supported a very rapid introduction of requirements as, e.g. in Germany, the sales of air-conditioning appliances grow annually by 8%. EPEE considered the 2 year space between the introduction of the requirements is too short a period given the redesign cycle of 3-5 years.

IT requested that the levels of the minimum requirements correspond with the lower levels of the labelling classes.

On CFs, it was explained that the proposed levels corresponds with the minimum requirements in China, except as to values for minimum requirements for ceiling fans, which were incorrect and would be corrected. For ceiling fans, US and Taiwan have higher values but they are based on a different (non-international) measurement standard. For the European requirements, it is important to use an international standard, which is also used in China, as most CFs sold in Europe originate from China. The preparatory study was not able to acquire sufficient data to suggest second tier requirements despite of serious attempts. Despite of the fact that the savings from the CFs are only between 0,5-1 TWh by 2020, it was considered important to clean the market from the worst appliances and to stop even worse appliance entering into the European market, in particular, as the Chinese minimum requirements do not apply on exported products. Also, the sales of CFs strongly increase with heat waves due to very low purchase price.

It was suggested to stick to the proposed fan impeller classes in order to be in line with the international standard. It was also informed that the proposed levels of requirements for ceiling fans were not correct in the Commission Staff Working Document due to a writing mistake, which would have to be corrected.

NL enquired why SFP was not used and on what the benchmark values were based. It was replied that the SFP is useable when a fan is ducted while service value is more adapted for duct-free systems; for CFs, only velocity of the air is relevant, not pressure. Benchmarks exist also in China although there is no statistical data to back these levels in the European markets. NL further queried if it made sense in setting BAT levels on this basis. The Chair agreed that it would be necessary to consider whether benchmarks could be set on CFs.

The UK regretted that second stage requirements were not possible and wondered why the requirements on tower fans were so much lower than on other types of fans. It was confirmed that because of the different shape of the fan blade of tower fans, they were inherently less efficient than other CFs. They provide directional air flow due to which they use less floor space and are used for more targeted ventilation purposes. The same approach is taken in the minimum requirements in China.

Noise

EPEE expressed its dislike for minimum requirements on noise, as noise is considered to be self-regulated by the market; consumers require low-noise appliances. In any case, noise requirements should be divided in three classes with appropriate power ranges. ANEC voiced an opposite opinion emphasising that more ambitious noise requirements are necessary corresponding to 55 dB(A) for the indoor unit. IT wondered if noise requirements are necessary given that energy efficiency and noise are competing entities. EHI, supported by ANEC, articulated that high noise is not necessarily related with low energy consumption, and noise is essential for consumers alike with noise from other energy using products. ANEC declared the importance of noise in particular as these appliances are also used in rooms, where silence is primordial, such as bed rooms. ECOS asserted that there is a large variety of noise levels on the market and that the benchmark allows higher requirements on noise. Eurovent reminded that the benchmark depends on the size of the appliance. CECED interpreted that noise is important for consumers and expressed its support for information requirements on noise for the indoor and outdoor units but refused minimum requirements. CECED disclosed that the benchmark level does not correlate with size and technology.

The Chair concluded that noise requirements are necessary for the benefit of the consumer but they should be set at reasonable levels in order to avoid possible harm for technological development on energy efficiency. The Chair considered the proposed noise requirements low in comparison with the benchmarks of 46dB(A) and 55 dB(A).

GWP Refrigerants

The Commission staff presented the main elements of the F-Gas Regulation. The Regulation covers the use of HFCs, PFCs and SF6 in all their applications, except air conditioning in vehicles. The objective of the Regulation is to contain, prevent and thereby reduce emissions of fluorinated greenhouse gases covered by the Kyoto Protocol. The application domains are refrigeration, air-conditioning, heat pumps and fire protection units. It puts the onus of responsibility on operators to prevent leakage of F-gases and to repair any detected leaks as soon as possible. All F-gas containers will have to be labelled and recovered by certified personnel for the sake of recycling, reclamation or destruction. Certification programmes aim at making installers aware of the dangerous substances in appliances and to ensure adequate treatment.

ECOS clarified that F-gas Regulation focuses essentially on avoiding leakages but it does not promote alternative refrigerants and that Ecodesign could promote alternative refrigerants. ECOS, supported by IT and the UK, explained that an overall CO2 figures would not serve the purpose, as it includes the whole European energy mix. However, a specific pictogram could indicate the existence of low GWP refrigerants in appliances.

EPEE elucidated that appliances with low GWP refrigerants do not necessarily reach the same efficiency as appliances with traditional refrigerants. If CO2 would be indicated, the proposed approach would be appropriate.

DK stressed that installing should happen by certified installers in line with the practice in Denmark. DK agrees with the Working Document that CO2 should not be regulated but the Regulations should require that installation be made by professionals. Commission services disclosed that the F-gas Regulation already deals with these problems in requesting air conditioning appliances to be installed by certified personnel, including maintenance, service and recovery of refrigerants. As to the regulation of low GWP refrigerants, it was noted that the Ecolabel provides with 15% lower energy efficiency requirements on appliances with low GWP refrigerants than for other appliances. CECED expounded that whether the 15% figure is 'correct' or not is difficult to know; it is possible that appliances with low GWP refrigerants are already as efficient as appliances with traditional refrigerants. A bonus relative to the GWP level achieved could be more appropriate. EHPA asserted that the environmental impact is negligible with direct emissions of refrigerant due to leakages and at demolition being only 4% of the average EU total equivalent warming impact (TEWI) of air-conditioners and heat pumps.

IT added that knowing the direct emissions could be useful for the consumer but a solution should be found to indicate CO2 in the case of hermetically sealed appliances; leakages only happen when an appliance is broken or when the installation is badly handled. It may be necessary to add an additional category of hermetically sealed compressors. Eurovent supported the specification of hermetically sealed appliances (as in F-gas Regulation) independently from technology.

CECED, supported by the UK, voiced the importance in leaving the regulation of refrigerants for the F-gas Regulation to avoid overlapping legislation. Products with low GWP refrigerants should be promoted. This was supported by DE. Hydrocarbons are used today in 99% of refrigerators with an equal efficiency to other refrigerants, while the efficiency of these appliances used to be some 30% lower at the beginning when hydrocarbons were introduced in refrigerators; shift to low GWP refrigerants is possible, e.g. propane for LACs. EHPA supported the CECED view but requested to be cautious in ensuring that safety and energy efficiency do not deteriorate. EHPA also confirmed that the use of low GWP refrigerants in air-conditioning appliances is not as easy as in refrigerators. It was confirmed that hydrocarbons are already used in some split units in Australia and China. Eurovent confirmed that the structure of the appliance is not decisive but safety, e.g. in the use of propane; what ever the decision, industry will need time to innovate with new technologies.

The Chair concluded that the regulation of refrigerants should be left for F-gas Regulation and that a CO2 label could be counterproductive due to misleading information it would provide. Leakages is an issue that could be dealt with at the level of information requirements to be displayed on the packaging and technical documentation of the product to inform installers and consumers. Suggestions in these lines were welcomed by stakeholders. Also, no bonus on low GWP refrigerants should be given in the energy label, as it focuses on the energy consumption of the appliance. However, it should be considered on how to give such a bonus through the Ecodesign information requirements.

Energy labelling

The Chair recapitulated the main issues based on the Commission Power Point presentation[45]. It was also outlined that a solution should be found for the problem of oversizing, which costs up to 10-15% of the energy bill. Oversizing up to a factor of 7 is not uncommon (e.g. in apartments). Currently installers do not make a heat balance of the dwelling in two-thirds of the cases and when it is done it is often overstated. Although the load profiles S, M, L are just different names for output power classes (in kW) they would have the advantage of easier communication between consumers, better comparability between units and above all –when accompanied by appropriate promotion at MS level—they could help in fighting the one-on-one replacement (in kW) that is the current practice

EHPA responded with distaste to the proposed space heating profiles (*S, M, L…*) for the alignment of the heating function of heat pumps between Lots 1 and 10; it would not be understood by consumers or installers. Also, EHPA, supported by Eurovent, stated that appliances falling in between categories would suddenly show inefficient although in real life they could be very efficient. It is better that manufactures indicate the heat load for which appliances are suitable in terms of kWh/year. ANEC confirmed that the proposed symbols would not be understood by consumers and stressed that also the indication of the output power of the appliance (*kW*) is illegible for consumers, in particular as room seizes strongly vary between Member States.

ANEC suggested considering indicating the size of the room in *m2* or *m3*, as the customer knows the room to be cooled down. This is also supported by recent tests made by Stiftung Warentest. Eurovent expressed its preference for output power (*kW*) of the appliance, as it is clear for installers, and consumers will be able to learn its meaning, while *m2* and *m3* refer to wide range of different real life conditions e.g. in the Northern and Southern Member States of the EU. The proposed heat load profiles (*S, M, L…*) would force manufacturers to optimise appliances for these fixed points, which is not the purpose of Ecodesign. EPEE supported in comparing the difference in cooling load e.g. in a room directly under a roof and in the ground floor. BE and SE went against the indication of (*S, M, L…*) and BE considered the indications of *kWs* important but understood that consumers would also like some indication of the size of

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[45] Slides 14 -15.

the room to be cooled. ANEC supported proposing to indicate the power consumption per year and the range of room sizes and types to be cooled.

NL reminded about the importance of the difference between cooling need and the capacity of the appliance; the expression in *kW*s is not appealing for consumers. It is important to indicate both the size and capacity of the appliance but it is not useful to indicate the capacity for cooling a given space in square meters, as the quality and nature of these square meters is not known. CECED agreed that the indication of *kWs* is complicated for consumers but reminded that this information must be enforceable and understandable for market surveillance authorities. If the label would include the indication of the range of usage e.g. in *m2*, it would still not be enforceable nor would it mean the same thing in different climates and in different, e.g. in old and new buildings. For example, if a space of 150m2 need to be cooled; all appliances at least from three different ranges of capacities would do, depending on the nature of the building/room and the climate.

EPEE reiterated in comparing the proposed *M* class heating capacity for old (90m2) and new (230m2) buildings – and climate is not yet even considered in this range; capacity of the appliance provides the most correct information. EHI added preferring also output power, which is understood by specialists being responsible for installation of RACs. DK requested indicating the price of the annual energy consumption, as consumers are becoming more and more aware of the price of energy.

On the labelling scale, DK, supported by ANEC, EHPA and Eurovent, stated that if RACs and LACs are put in two separate labelling scale, consumers would be guided to buy the cheapest (less efficient) products; RACs and LACs should be in the same scale. Also, it was suggested that a specific pictogram could indicate the existence of low GWP refrigerants in the label and EHI and Eurovent proposed indoor and outdoor noise to be displayed on the label.

The Chair intervened in concluding that if RACs and LACs were presented in one labelling scale there would be a need to identify the range of capacity or usage for the appliance. The consumer need to be told for which conditions the appliance is optimised and link the A-G labelling accordingly. Also 'second-choice' usage conditions could be indicated with information on the corresponding (lower) labelling category. The choice of the number of alternative space cooling/heating profiles indicated could be left for manufacturers as long as the corresponding energy labelling classes are displayed, identifying e.g. between optimum, minimum and maximum range of usage. The Chair invited stakeholders' further suggestions.

IT reminded that the more there are size categories the more there are tests to be made, which is impossible for Member States. The Chair agreed that the amount of points to be measured must be limited.

Annex 1: List of participants

Surname	Name	Organization
AKKERMAN	Floris	Federal Institute for Materials Research and testing
ANTOINE	Pascal	EHI
BAERT	Els	EPEE
BALDONI	Giulia	Eurocommerce
BISSON	Evelyne	Délégation française
BLICKWEDEL	Peter	Federal Ministry for the Environment …
BONCHEV	Bontcho	mINistry of Economic & Energy
BÖTTCHER	Christiane	Stiftung Warentest
BOYE OIESEN	Gunnar	INFORSE Europe
BRISCHKE	Lars	dena
CALLEWAERT	Philippe	EUROVENT
CLIQUOT	Nathalie	EEB
CREVECOEUR	Guibert	Federal Public Service Economy
DE GROOT	Maya	
DIERYCKX	Martin	EUROVENT
DUPLAT	Françoise	ORGALIME
ESTVANIK	Andrej	slovak delagation
FABBRI	Mariangela	WWF EPO
FORSEN	Martin	EHPE
GALSGAARD	Christen	EUROVENT
GRÖGER	Jens	ÖKO-INSTITUUT
HERRERIAS	Enrique	Fundacion para el foment ode la innovation industrial
IPAVEC	Edvard	Ministry of the Environment
KALLIOMÄKI	Pekka	Ministry of the Environment

KATAOKA	Osami	EPEE
KULBAS	Heikki	Ministry of Economic Affairs & Comm
LE JEUNE	Pierre	TEST ACHATS
LOPES	Carlos	SWEDISH ENERGY AGENCY
MASSERDOTTI	Gianandrea	CECED
MAURER	Sylvia	ANEC/BEUC
MELI	Luigi	CECED
MENARD	Guislain	Eurocommerce
MONETA	Roberto	ENEA
NAERAA	Rikke	Danish Energy Agency
NICHOLSON	Sarah	DEFRA (UK)
NIELSEN	Pieter	Danish Energy Agency
PEDERSEN	Per Henrik	Danish Energy Agency (external expert)
POREMSKI	H-Jochem	Federal Ministry for the Environment …
PRESUTTO	Milena	ENEA
RAMBALDI	Matteo	CECED
RANSQUIN	Johan	ADEME
RODRIGUEZ	José felix	Ministerio de Industria Turismo y comercio
RUIZ	Jaime	EHI
SAHEB	Yamina	Consultant (via ECOS)
SCHUBERTH	Jens	Federal Environment Agency
SIDERIUS	Hans-Paul	SENTERNOVEM
STONKUS	Mindaugas	Lithuania
SWEENEY	Mark	Enterprise ireland
THAMM	Holger	EHPA
THIE	Stefan	EPEE
TOULOUSE	Edouard	ECOS
URSEA	Lucian	Romania

VAN EYKEN	Felix	EHI
VIT	Stefano	CECED
WASSER	Udo	EHI
WEBB	Martyn	DEFRA (UK)
WINZER	Janis	Federal Environment Agency

Draft SUMMARY MINUTES

Consultation Forum meeting under
Article 18 of the Ecodesign of Energy related Products Directive
(2009/125/EC)

31/04/2010

Centre Albert Borschette (CCAB), rue Froissart 36, 1049, Brussels.

EC participants: A. Brisaer (ENER.C.3, Chairman), K. Lichtenvort (ENTR.B.1), M. Avraamides (CLIMA.C.2), E. Kazakevicius (CLIMA.C.1), T. Haabeth, M. Kestner, I. Grönroos-Saikkala (ENER C3).

EC expert: M. Van Elburg, VHK.

The Chairman explained that a second CF meeting was called for because additional stakeholder input during the impact assessment phase has allowed identifying specific issues that could affect the foreseen legislative proposals on air-conditioning appliances. It was not intended to re-open the discussion on other issues already addressed in the first CF meeting on 22 June 2009.

Energy efficiency requirements

Commission staff proposed that the minimum efficiency requirements for double ducts below 1 kW input power (less than 0,5 % of the market considered in the scope) be lowered. For technical reasons these appliances can not reach the same efficiency levels as split and other single package appliances of the window and wall type. In specific cases, double ducts are the only solution for cooling needs, e.g. when the building shell may not be altered. The initially proposed efficiency levels would have banned all double ducts from the market. For these reasons, the energy labelling Directive 2002/31/EC gives a bonus of -0.4 to lower the efficiency levels for these appliances. Stakeholders did not oppose the proposal. ECOS stated that the proposed values for double ducts were too low.

Timing

On timing, the Commission staff proposed that the ecodesign and energy labelling requirements would come into force one year later (2013/2015) than proposed in the first CF meeting (2012/2014). Manufacturers would need time to adapt as due to the new efficiency calculation and measurement method all split and many single package appliances would have to be (re-)measured.

ECOS expressed that the timing of the initial proposal should be maintained for the 2nd stage, as re-measuring of appliances is necessary only for the first tier. EPEE and CECED stated that an introductory date of 18 months is challenging because the industry faces new measurement and calculation methods and would need more time to prepare labels and catalogues. EUROVENT confirmed and asked for a minimum time for preparation of three years.

Scope

The Commission staff proposed no changes on the scope, except that heating-only appliances of the same technology could be included, not only cooling-only and reversible ones.

IT, supported by AT, argued against the inclusion of heating-only appliances. Instead, heating-only appliances should be covered under the Lot 1, or a new label and minimum efficiency requirements should be developed. The NL argued that the scope of Lot 1 is entirely different, but the scope of other air-heating lots (20 and 21) overlapped in functionality and could be considered as suitable for the heating only appliances.

INFORSE, supported by SE, GR, EUROVENT and EPEE requested that heating-only appliances be included in the foreseen Lot 10 measure for reasons of timing and similitude in technology. It was explained that most of the units are reversible, which technically are the same product as heating-only appliances. INFORSE reported that in colder climates, such as in Denmark, air-to-air heat pumps are sometimes used as an energy saving alternative to electric heaters. Furthermore, SE requested that the heating efficiency scale should be aligned with lot 1. EPEE meant that Lot 21 should follow the conclusions of lot 10 on heating-only appliances. CECED mentioned the effect on timing if heating-only appliances remain included, and the possible disadvantage on energy efficiency, if excluded.

It was also quoted that leaving heating-only appliances out of the measure could lead to market distortions in form of low efficient heating-only appliances replacing the sales of efficient reversible appliances.

Labelling

On labelling, the Commission staff proposed on the basis of the recast labelling Directive and the CF discussions in 2009 to introduce one labelling scale for all appliances from G to A+++, with the highest classes reserved for best available technology available in the world but not yet in Europe. It was noted that, as the energy efficiency calculation and measurement method changes to seasonal efficiency (for 'room air conditioners', not for small double ducts and single ducts), the steady-state efficiency scales of the Energy Labelling Directive 2002/31/EC are not comparable with the new efficiency scales.

BE supported the proposed scale and SE could live with it given the need to host such a large range of appliances with strongly varying efficiency levels. BE and IRL were in favour of indicating plusses in order to facilitate information for consumers and market surveillance authorities.

AT, NL, GR, FR, the UK, ECOS, EPEE, BEUC/ANEC and EEB supported a single A-G scale for all products, based on rescaling; the A+-classes should be reserved for future innovation and development.

IT and CECED opposed the single scale approach and the downgrading of double and single duct appliances; the calculation method does not change for these appliances. There should be a possibility to differentiate between technologies as these products provide a different service. Although they may be less efficient, they also consume less in absolute terms. Every technology should be able to reach the A class in order to provide an incentive for improvement for the manufacturer.

EPEE explained that the SEER of 7.0, which may be achieved in Japan, could not necessarily be achieved in the EU due to the foreseen noise requirements. The best appliance in Europe could possibly reach a level between 6.0 - 6.5 once the noise requirements can be met.

EUROVENT doubted A+-classes could ever be populated in Europe. CECED stressed that defining efficiency levels for European energy labels on the basis of the market situation in third country, using different measurement methods should be made with care.

IT and CECED asked for an alignment of the energy labelling and the minimum efficiency requirements.

Annual energy consumption

The Commission staff working document proposed not to show the annual energy consumption on the label, as it could misguide consumers with signals of certain appliances consuming less energy than others while being at lower efficiency classes, the reasons for this could be just a different capacity. The definition of a common use pattern valid for most appliances is very difficult.

Stakeholders recognised the difficulty related to the indication of the annual energy consumption of air-conditioning appliances but found this information still useful. IT added that patterns of use and standby should be taken into account. ECOS added that even though the absolute values of annual consumption may be unrealistic, it can be a good indicator for comparison between different models within one category of appliances. CECED noted that the value for larger appliances would show higher annual consumption even if it would be a more efficient class.

The NL, GR, AT and BEUC/ANNEC stated that daily consumption could be a good alternative to indicating annual energy consumption. However, this would fail showing the impact of the inverter. EPEE requested that building balance be considered.

Level of Global Warming Potential (GWP) of the refrigerant

The Commission staff working document proposed a bonus for appliances using refrigerants with low-GWP for the purposes of reducing the energy efficiency requirements. The bonus should not lead to higher total green house gas emissions. It was proposed not to implement the bonus on the energy label in order to provide consumers with undistorted information on the comparative energy efficiency of appliances.

Stakeholders approved the general approach for ecodesign. ECOS stated that the level of bonus should be between 10 and 15 %, and not 5 % as suggested. A wondered why a limit of GWP=150 was chosen when several alternative refrigerants are already below GWP=10. IT and the NL suggested creating groups for different levels of GWP and defining bonuses according to these groups.

DK, A, IT, G, ECOS and EPEE were in favour of a system that raises the energy label classification, when an appliance uses a low-GWP refrigerant.

CECED and UK were against the mixing of energy performance and the level of the GWP of the refrigerant. Refrigerants should be covered by another regime.

As to including specific information on the level of the GWP of the refrigerant used in an appliance, DK, G and ECOS wanted this information to be included in the energy label, if possible. ITALY and EPEE questioned whether information on GWP would be useful and understandable for the consumer. CECED meant that the label should not be overloaded with information.

The Chair considered that information on the level of GWP would not be understood by an average consumer and stated this information could be better placed in the ecodesign measure, or possibly be indicated with help of the ecolabel.

Other issues

GERMANY asked how the higher efficiency of propane-using appliances was taken into account. Commission staff replied that although propane in general results in higher efficiency, its application is limited due to the flammability that poses restrictions on installation and production lines. Therefore the possible higher efficiencies of propane-charged units are not easily realisable in practice.

The Chairman invited delegations and stakeholders to send comments if any by 19 May.

Comfort Fans

The Commission staff tabled new information on comfort fans.

The preparatory study proposed minimum energy performance requirements in line with requirements implemented in China/Taiwan. However, based on recent manufacturer efficiency tests, it seems that the proposed levels can not be achieved by several standard fans as tested using the IEC60879 standard. There are new energy labelling and minimum efficiency requirements in Brazil but the efficiency calculation method is slightly different and the efficiency levels seem considerably lower than those in China/Taiwan. Furthermore there is a lack of reliable performance data on comfort fans in the EU market.

The unclear situation leaves three options:

- Setting minimum energy efficiency requirements on comfort fans with the proposed requirements with the risk of banning all comfort fans in the European market, except ceiling fans (expected savings slightly below 1 TWh by 2020);

- Setting lower efficiency levels without adequate technical basis and - or - setting information requirements only (indication of the efficiency of the appliance and the efficiency calculation method used) and revising the measure in 5 years, when information on the actual fan efficiency is available (expected savings ca 0.3-0.5 TWh by 2020);

- Setting no requirements now and gathering accurate information on comfort fan efficiency and test methods through a complementary study/efficiency tests with corresponding costs (savings ca 0.3-1 TWh by 2020).

Stakeholders considered that setting information requirements only (as in option 2) would be the right choice. The measure could be revised, when the necessary information on energy efficiency of the appliances in the European market would be available.

Annex 1: List of participants

Surname	Name	Organization
ARDITI	Stephane	EEB
AVRAAMIDES	Marios	EUROPEAN COMMISSION DG CLIMA
BAERT	Els	EPEE
BERGER	Jan	FEDERAL MINISTRY OF ENVIRONMENT (GERMANY)
BISSON	Evelyne	FRENCH DELEGATION
BLOHM	Michael	FEDERAL MINISTRY OF ENVIRONMENT (GERMANY)
BONCHEV	Bontcho	MINISTRY OF ECONOMY (BULGARIA)
BRAAMS	Beate	FEDERAL MINISTRY FOR ECONOMICS 1 TECHNOLOGY (GERMANY)
CREVECOEUR	Guibert	FEDERAL PUBLIC SERVICE (BELGIUM)
DAMM	Thomas	ORGALIME
DIERYCKX	Martin	EUROVENT
IRREK	Wolfgang	WUPPERTAL INSTITUTE
JASUREK	Igor	MINISTRY OF ECONOMY (SLOVAKIA)
HOOGKAMER	Johannes	EUROVENT
KATAOKA	Osami	EPEE
KAZAKEVICIUS	Eduardas	EUROPEAN COMMISSION DG CLIMA
KONGSVOLL	Ragnhild	EFTA
LEJEUNE	Pierre	BEUC
LOPES	Carlos	SWEDISH ENERGY AGENCY
MAC NULTY	Hannes	SUSTAINABLE ENERGY AUTHORITY OF IRELAND
MAURER	Sylvia	BEUC
MELI	Luigi	CECED
MONETA	Roberto	ITALIAN DELEGATION

NAERAA	Rikke	DANISH ENERGY AGENCY
NICHOLSON	Sarah	DEFRA (UNITED KINGDOM)
NIJS	Evelien	FEDERAL PUBLIC SERVICE (BELGIUM)
OLESEN	Gunnar Boye	INFORSE EUROPE
PELED	Michelle	DANISH ENERGY AGENCY
PRESUTTO	Milena	ENEA (ITALIAN DELEGATION)
RAMBALDI	Matteo	CECED
RASSELET	Anne-Claire	ORGALIME
RIMMER	Mike	DEFRA (UNITED KINGDOM)
SCHÄPPI	Bernd	AUSTRIAN ENERGY AGENCY
SCHUBERTH	Jens	FEDERAL ENVIRONMENT AGENCY (GERMANY)
SCUMPIERU	Mihai	EPEE
SIDERIUS	Hans-Paul	SENTEROVEM (THE NETHERLANDS)
TOULOUSE	Edouard	ECOS
VIT	Stefano	CECED
WEISS	Uta	GERMAN ENERGY AGENCY
WILD	Andreas	Permanent Representative CZECH REPUBLIC

ANNEX 2 – GLOSSARY, SCOPE, CATEGORIES AND TECHNOLOGY

This Annex provides details on the type of appliances in the scope of the impact assessment. Some of the most used abbreviations and concepts are listed below with further illustration of relevant product technologies further down in this Annex.

Glossary

COP - Coefficient of Performance of a heat pump is the ratio of the change in heat at the "output" (the heat reservoir of interest) to the supplied work.

DD - Double duct means an 'air conditioner' in which during cooling (heating) the condensor (evaporator) intake air is introduced from the outdoor environment to the unit by a duct and rejected to the outdoor environment by a second duct

EER - Energy Efficiency Ration of an air conditioner is the ratio of the change in cooling at the "output" (the cooling reservoir of interest) to the supplied work.

GWP - Global Warming Potential is a measure of how much a given mass of green house gas is estimated to contribute to global warming.

LLCC - Least Life Cycle Cost is a method for assessing the total cost of facility ownership taking into account all costs of acquiring, owning, and disposing of the appliance.

LAC - This expression was used in the Working Document presented to the 1st Consultation Forum meeting to group cooling-only double ducts with input power lower than 1 kW and single duct units under a common name. For clarity, in terms of distinguishing which requirements apply to what products, this concept was replaced by the technical naming used in relevant standards.

OEM - Original equipment manufacturer manufactures products or components that are purchased by a company and retailed under the purchasing company's brand name. OEM refers to the company that originally manufactured the product.

RAC - This expression was used in the Working Document presented to the 1st Consultation Forum meeting to group split package cooling-only, heating-only and reversible units, window and wall units, and double ducts with input power higher than 1 kW under a common name. For clarity, in terms of distinguishing which requirements apply to what products, this concept was replaced by the technical naming used in relevant standards.

SCOP - Seasonal Coefficient of Performance is used to measure the efficiency of an air conditioners/heat pump. It is defined in the relevant efficiency measurement standards. The SCOP rating of a unit for the heating output during a typical heating-season divided by the total electric energy input in watt-hours during the same period. The higher the unit's SCOP rating the more energy efficient it is.

SEER - Seasonal Energy Efficiency Ratio is used to measure the efficiency of an air conditioners. It is defined in the relevant efficiency measurement standards. The SEER rating of a unit for the cooling output during a typical cooling-season divided by the total electric energy input in watt-hours during the same period. The higher the unit's SEER rating the more energy efficient it is.

Split means an 'air conditioner' in which the components of the refrigeration cycle are a factory assembly on two or more mountings to form a discrete matched functional unit and of which one mounting is installed outside the space to be conditioned and which is connected by lines carrying refrigerant to the other mounting(s) that is/are installed inside the space to be conditioned. Multi-split refers to a split with several indoor units

SD - Single duct means an 'air conditioner' in which during cooling (heating) the condenser (evaporator) intake air is introduced from the space containing the unit and discharged outside this space

W/W - Window and wall units/appliances means an 'air conditioner' in which the components of the refrigeration cycle are a factory assembly on a common mounting to form a discrete unit and which is placed on a window sill or in an aptly shaped hole through a wall.

GHG - means 'green house gases', which are gases that contribute to global warming, characterised by a GWP.

Scope of the impact assessment

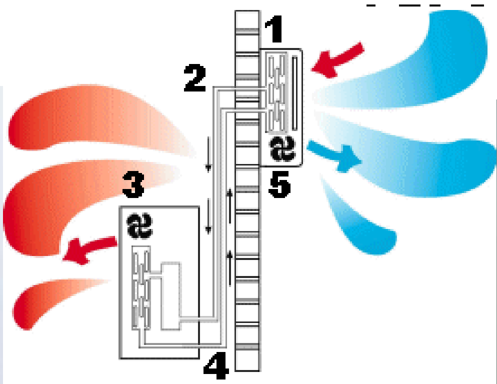
The scope of the IA are air conditioners (AC) that use vapour compression cycle with electrically driven compressors and which can deliver a maximum 12 kW of cooling and/or heating power. More powerful appliances are covered by ENTR Lot 6. Air-to-water and water-to-air appliances are excluded from the scope since these are mainly part of larger, building-size systems, and also included in ENTR Lot 6.

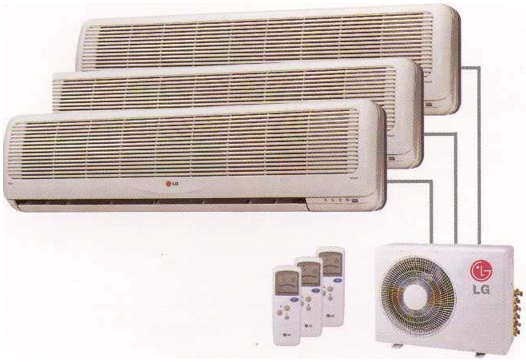
Air-to-air heat pumps (heating only) are included in the scope since the operation and performance is exactly the same as for reversible appliances in heating mode and a differential treatment between these two product groups is considered inappropriate[46].

Small air conditioners can be categorised according their main design principle in being either ‘split package’ or ‘single package’ or ‘single duct’.

1) the **Split package** has one heat exchanger unit (evaporator side when cooling) located inside the building shell and the other heat exchanger unit (often plus compressor) located outside the building shell (condensor side when cooling). The inside and outside units are connected by refrigerant lines, which often are assembled on site. If multiple indoor units are connected to a single outdoor unit they are called “multi-splits”. If the indoor unit is delivering the cold air to the rooms through air ducts the adjective “ducted” is applied. Split package units can also be made portable, with handles and/or castors, and the (flexible) refrigerant line is then led through an open window or door.

[46] Some stakeholders questioned the choice of including 'heating-only' appliances, fearing an overlap with local heating appliances. However, air-to-air heat pumps should not be confused with air-source heat pumps, which extract energy from outside (or from ventilation air) and transfer this (after temperature lift) to the hydronic heating system of a building. These air-source heat pumps are covered by lot 1 “central heating boilers” (and lot 2 “water heaters”, when applicable). Local air heaters that rely solely on resistance heating elements are also covered by another lot.

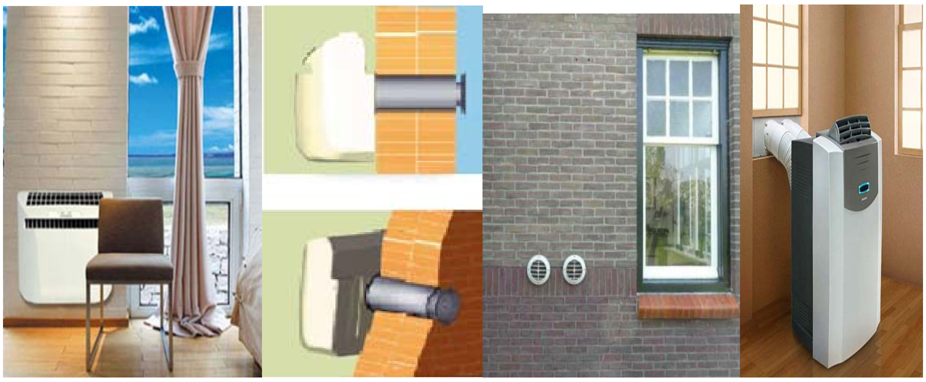




2) The second principle is the so called '**<u>Single package</u>**' or 'unitary' designs. Both the condensor and evaporator are combined in one housing (share a common frame) which avoids the need to connect the indoor and outdoor unit during installation - the unit can remain hermetically sealed. The single package is available in two variants:

a) Very common in other major AC markets, but rare in the EU is the "window/wall unit". This unit is positioned on the window sill or in a recess in the wall. For optimal performance the in- and outdoor air should remain separated (by closing gaps in window, etc.). The installation of these appliances may require major modifications in the building shell like in the case of split appliances.

b) Also rare is the so called 'double duct' (DD), which is often purchased for specific needs. This unit is placed completely indoors but remains connected to the outside air through dedicated intake and exhaust ducts. The unit may be portable (flexible ducts apply) but is usually wall-mounted to the inner side of an outside facing wall. The appliances are unobtrusive when viewed from outside, only showing a double or concentric duct outlet. For that reason, they are the only choice for buildings under legal restrictions for any modifications, such as historic buildings. Because of these installation requirements, the unit is in general less efficient than split packages: The heat exchanger frontal area is only 1/5th of the normal size, its geometry is less optimal, and the compressor and fans are smaller and constrained because of noise limitations. The airflow is restricted due to the ducts and higher internal air resistance and the unit can only be installed on a outside facing wall. In comparison the double duct is less efficient, noisier and more expensive than its split package counterpart.



3) The third principle is the so called **single duct** (SD). This is also a single package design in the sense that the evaporator and condensor share a common frame but there is a major difference: The condensor (that rejects the heat from the vapour compression cycle) is cooled down by air taken from the room in which the unit is placed. This air is then expelled outdoors by a dedicated duct, often placed through an opened window or door. Expelling indoor air means that warm air from outside is drawn into the room, often through the same opening through which the exhaust duct is led, or else from other parts of the building. This makes the single ducts less efficient for cooling rooms. The benefit of these appliances is that they are moveable and require no installation. For this, despite of their clearly lower efficiency compared with the other appliances described above, they can in certain conditions lead to lower total energy consumption than the permanently installed appliances. Because the energy efficiency of single ducts is measured at different conditions than double ducts or split packages (EN 14511) they can show high efficiencies, whereas in reality they need more energy and can not cool an entire room but only part of it.

The categorisation of these three main types of appliances can be expanded upon by considering capacity classes (from 0 to max 12 kW), reversibility (heat pump function) and/or extra options for air treatment like an additional heating function (electric resistance heating), dehumidification, air-ionisation / purification, etc.

In many market research studies a classification according to ‘portability’ is applied, resulting in two groups: ‘fixed’ or ‘moveable’ appliances. For energy consumption portability is however not a defining parameter since castors and handles can be added or removed without affecting energy performance[47].

For the purpose of this impact assessment the types presented above are further subdivided by reversibility (yes/no) and capacity (for cooling only: above/below 1 kW input power).

Table on categories of air conditioners

Main design principle	Secundary design principle	Further categorisation	Designation for the IA*
Split package	Mono-split, Multi-split, Ducted	By any design principle By function: cooling only or reversible or heating only By capacity: capacity up to max 12 kW By portability: portable or fixed	split_rev_small (3.5 kW)
			split_rev_large (7.1 kW)
			split_co
Single package	Window and wall unit		w/w_rev
			w/w_co_small
			w/w_co_large
	Double duct		DD _rev
			DD _co_small
			DD _co_large
	Single duct		SD_rev
			SD _co_small
			SD _co_large
*: ‘_rev’ means reversible units (vapour compression heating, incl. air-to-air heat pumps), ‘_co’ means cooling only, ‘_he’ means heating-only, ‘small’ means max. 1 kW electric input power and ‘large’ means above 1 kW input power.			

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[47] Both main design principles ‘split package’ and ‘single package’ contain ‘portable’ products. And although removing or adding castors does not alter the energy efficiency of the unit per se, increasing energy efficiency does affect portability. More efficient design often result in larger, heavier products that reduce portability. Since single package units can not distribute the extra weight over separate indoor- and outdoor-units and the limits of portability are reached faster.

COMMISSION STAFF WORKING DOCUMENT

Full Impact Assessment

Accompanying the document

Proposal for a Commission Regulation

implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for air conditioners and comfort fans

Annex 3 – Baseline- additional information

Sales and stock

The sales of air conditioners have been assessed by the preparatory study on the basis of PRODCOM EU trade data and have been checked with stakeholders involved in the preparatory study. Projections of future sales have been established by extrapolating the current sales, taking into account "national saturation" levels. These saturation levels are governed by the development of household income (expected to rise) and national heating/cooling needs (based on climate predictions and characteristics of building stock) and indicate the ownership levels of air conditioners per country.

In this impact assessment some corrections have been applied to the sales figures in the preparatory study.

First, the projections for future sales have been adjusted for the recent **economic crisis**. The downturn is based on 2010 PRIMES projections which essentially describe a dip in economic activity in the year 2008-2010 and an increasing economic activity from 2010 onwards. For the impact assessment this has translated to 2010 sales being equal to 2005 sales with an S-curve shaped sales curve in between (sales increase up to 2007, sales decline as of 2008 and rise again after 2010). The impact is particularly felt in the category of split packages air conditioners since these are by far the largest market category.

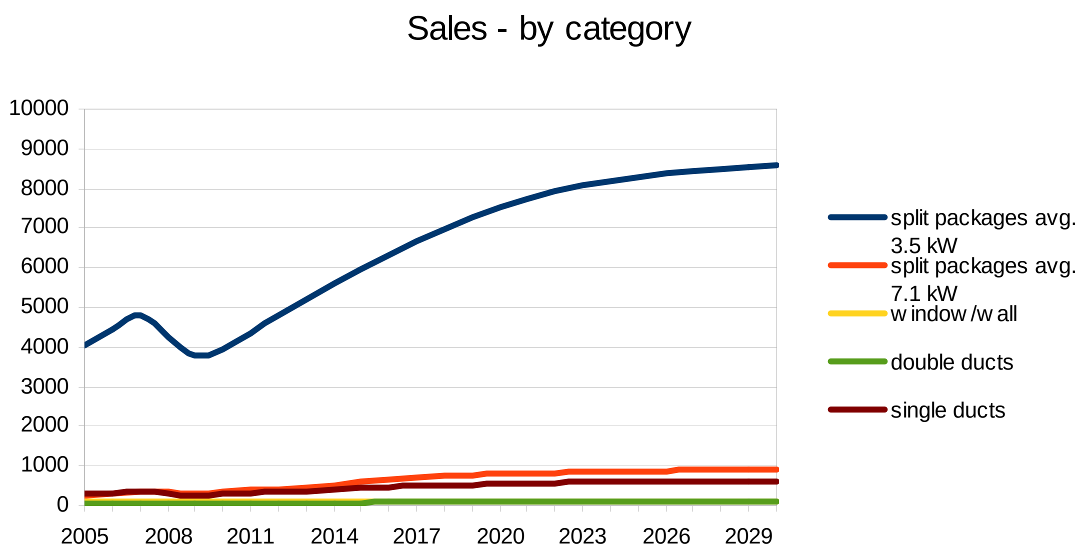
Second, the sales of single ducts have been reduced when compared to the preparatory study. The preparatory study described sales of almost 1 million units in 2010[48], whereas actual sales in the EU in period 2005-2008 have remained close to 300.000 (for a 'good year', according stakeholders). Therefore the impact assessment assumes a constant share of sales of single ducts of 6%, giving a good fit to 2005 data (almost 300.000) and a limited absolute increase in sales up to almost 600.000 in 2020.

Third, the sales of double duct units have been separated from the total sales. In the period 2005-2008 sales have remained close to around 40.000 units per year, which corresponds to 0.9% of the total in 2005. The projections are based upon the assumption that this market share will remain fairly constant, which leads to doubling of sales to 90.000 units in 2020.

The sales of split package units and window/wall units make up the rest or 92% of the total sales, being 4.3 million units in 2005 and projected to be 8.4 million units in 2020.

Figure on Sales of air conditioners by main category ('000 units)

48 The preparatory study assumed that sales of cooling-only split packages were to be replaced by single ducts for cooling only. This assumption has been contradicted by stakeholders during the impact assessment. Stakeholders supported their arguments with sales data and therefore, in this impact assessment, cooling-only split package sales are instead replaced by reversible split package sales and the heat load has been adjusted accordinly.



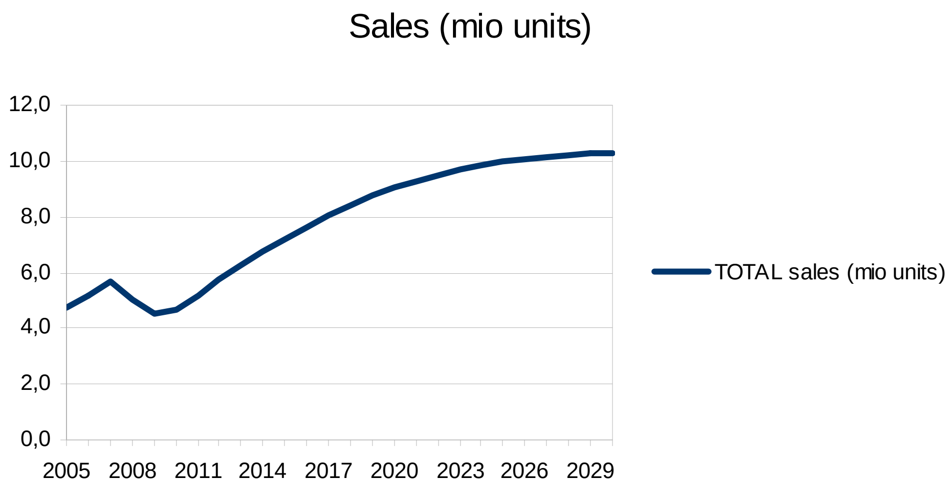
Air-to-air heat pumps (providing heating only) are also within the scope of the impact assessment, but no 'heating-only' sales have been identified or indicated by manufacturers (desk research shows that virtually all air-to-air heat pumps can provide both cooling and are thus labelled ‘reversible’). Therefore, it is considered that sales of air-to-air heat pumps are covered by reversible units.

Most of the split package units are assumed to be reversible (market share >90% in 2010) and equipped with inverters (market share >65% in 2010). It is estimated that not all reversible units are used for heating. A significant share of sales concerns replacement sales of cooling-only units. In total, it is assumed that 20 to 35% is not used for heating. Otherwise the total number of heaters in the EU would add up to a much larger number of heaters than estimated in other studies.

There are no reversible single ducts currently on the market (note that 'resistance heating' does not count as reversible). Stakeholders have indicated that single ducts are used only on very hot days, where part load operation is not that important, and that the unit is stored away after the cooling season. For double ducts, reversibility could be feasible, as they are also installed permanently and may be used in winter for heating.

The total air conditioner sales are 4,7 million units in 2005, rising to 9 million in 2020 and 10,3 million in 2030. With a product life of 12 year the stock increases from 49 million units in 2005, to 82 million in 2020 and 117 million in 2030.

Figure on total sales of air conditioners < 12 kW (million units)



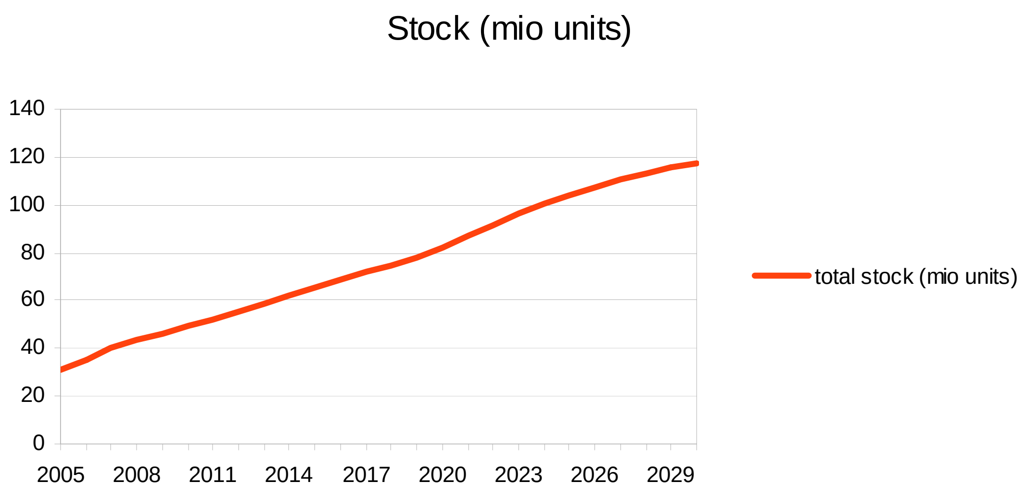


Figure on total stock (installed base) of air conditioners < 12 kW (million units)

About one-third of the units are installed in residential applications, leaving the majority of two-thirds installed in non-residential applications, such as offices and retail (small shops, hotels, holiday homes, etc.).

Energy efficiency in EER and COP

The efficiency of air conditioners is expressed as the ratio of the amount of cold (or heat) produced by the unit divided by its electric power input. These values are referred to as EER for cooling and COP for heating mode and form the basis of the Energy Label classification of 2002/31/EC. An EER=3 means that 1 kW of electricity is needed to produce 3 kW of cold, etc.

The average EER of a split package unit is approximately 3.2 and the COP is 3.5 (2010). Single ducts are estimated to have an average EER of 2.3. The rapidly increasing share of class-A labelled appliances suggests a higher value but consumer organisations have repeatedly shown that not all appliances perform in conformity with their classification. For double ducts, no general market data is available, but stakeholders have indicated that the average EER is approximately 2.2 and the average COP 2.4. The current highest EERs for single ducts are 3.1, and 2.6 for double ducts (in 2010, a model with EER 2.7 will be introduced). For split, the highest EERs are around 5-5.5.

EER/COP values are not good indicators of real-life efficiency because the values are established in a steady-state measurement under fixed operating conditions (extreme outdoor temperatures). Therefore, EER/COP values do not include part load performance or energy consumption in low power modes.

Energy efficiency in SEER and SCOP

Seasonal efficiency indicators (SEER for cooling and SCOP for heating) have been developed in order to address seasonal efficiency of appliances (taking into account varying temperatures and the capacity of the appliance to response these changes). The SEER/SCOP is calculated as the ratio of a reference heating or cooling load (kWh/season) divided by the calculated seasonal electricity consumption (kWh/season). This seasonal electricity consumption takes into account the range in outdoor temperatures and how often these occur[49], the type of control (on/off, staged or inverters) and low power modes. The calculation and the required tests needed to provide input data are described in prEN14825 which will be finalised later this year, parallel to the probable ecodesign and energy labelling measures.

The preparatory study recognised the benefit of having this "all-in-one" efficiency indicator and therefore based its analysis on these values. However, due to the novelty of the method the conclusions could not be checked against actual market data. However, stakeholders involved in the study endorsed the method and the conclusions of the study.

The study showed that the SEER of the average split package without inverter was around 2.8 and the SEER of an inverter model around 4.0. The average SEER of a 2010 split package is therefore (taking the share of inverter models into account) approximately 3.6. The average SCOP is around 2.9. The least life cycle cost is at SEER 4.3. The benchmark was identified at SEER 7.1. This level is currently not achieved by models available in the EU (2005 database gives max SEER 5.1) but in some third countries (e.g. in Japan but in a slightly different climate and with lower sound power requirements).

For the single ducts, the least life cycle cost level is achieved at EER 2.8 (corresponding to a SEER of 4.0, if inverters would be applied. No single ducts with inverters currently exist). The benchmark is EER 4.0 or above.

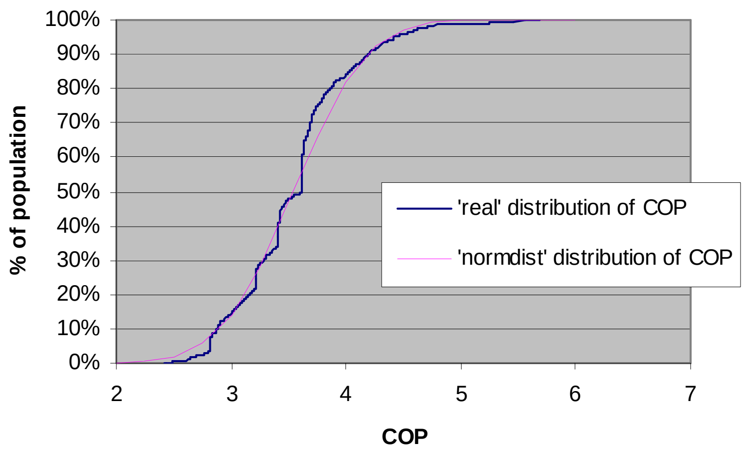
For double ducts, no least life cycle cost was established in the preparatory study, but the impact assessment identified together with the stakeholders a least life cycle cost point of slightly above EER 2.5.

For the average split (reversible split unit of 3.5 kW), the increase of the seasonal energy efficiency by a factor of 1.5 (from SEER 3.6 to SEER 5.4) can be achieved against lower life cycle costs (down from almost 5000 euro/life to 4200 euro/life representing a 17% reduction in life cycle costs). The purchase price goes up from 683 euro to 1035 euro (50% increase in purchase cost), but the energy costs will go down from 240 euro/a to 129 euro/a (46% reduction in energy costs). The price difference is recovered in 3.3 years (simple payback). Similar conclusions can be drawn for cooling-only units and single ducts.

[49] The climates considered are a cooling season and three heating seasons (average, warmer and colder).

During the course of the impact assessment study, information was received showing that the average SEER and especially SCOP would be higher than presented in the preparatory study. This new information was related to tests on air conditioner efficiency in Sweden.

The preparatory study SEER and SCOP values for the basecase are presented in the paragraphs above. For the impact assessment, new data was retrieved from Eurovent Certification indicating that the average COP for reversible single split units is COP 3.54 (based on 1643 units, Eurovent 2010 data). According the relationship between COPon and SCOP as established in the preparatory study this gives a SCOP of 2.8 (assuming the use of an inverter and thermostatic expansion valve, Task 7, p.43). A SCOP of 3.4 (Swedish data) is achievable, if the COP is close to 4.0 (with electronic expansion valve etc., Task 7, p.43). The Eurovent dataset gives a standard deviation of 0.5. That is, the difference with an average appliance is 4.0-3.54 = 0.46 is 0.92 sd. Assuming that the population of appliances follows standard normal distribution (graph inserted below) this means that a COP of 4 would phase out 82% of appliances currently on the market.



Cross-checking with Eurovent data confirms this: the cut-off value is 84% (only 16% is above COP 4). However, these results do not include considerations on the impact of the proposed noise requirements. The average noise level for units COP > 4 are for outdoor is 62.6 dB(A) and for indoor is 56.5 dB(A). These values are both well above the Swedish proposals, so it probable indicates that an unknown share of appliances lower than 16% would remain on the market.

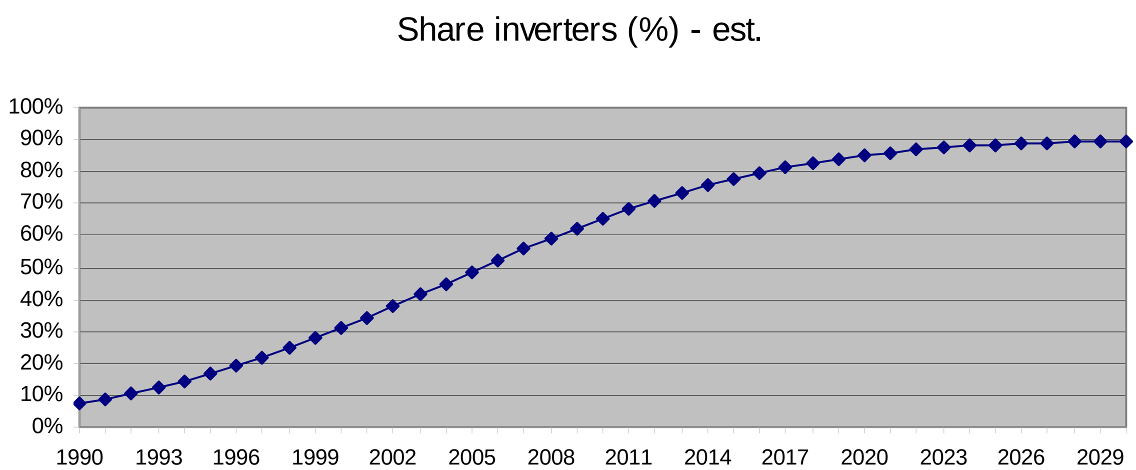
The above show that large differences on what constitutes the average efficiency of appliances may exist and that the results strongly depend on the dataset analysed (e.g. 51 models tested in the Swedish measurements vs. 1643 models in the Eurovent data). Unfortunately, sales weighted datasets of air conditioner performance do not exist. For these reasons, the impact assessment is based on the Eurovent data used in the preparatory study and approved by stakeholders.

As regards the level of BAT (Best Available Technology) for SCOP, Sweden indicated that BAT for SCOP is 5.8. The preparatory study calculated a SCOP of 4.8 as highest. However, there is not enough information to explain these differences. Consequently, it is suggested that this issue be investigated in more detail at the revision of the proposed measures.

Part load performance

The efficiency of an air conditioner depends on the operating conditions, especially on the outdoor temperature (the indoor temperature can be assumed constant). Given that outdoor temperatures vary throughout the cooling (or heating) season, the unit will run most of the season in part load conditions. Simpler units will turn on and off to achieve the desired indoor temperatures or provide a staged capacity performance (e.g. in two running levels) but the trend is to apply inverters. Inverters are essentially variable speed drives for the compressor, which can vary the capacity of the unit in 80 to 100 steps. This means the unit experiences less start-ups and shut-downs and is better capable of achieving the desired indoor temperatures. Besides higher comfort this also means a more efficient and less noisy appliance. For the Baseline a steady increase of appliances with inverters (mainly split packages) is taken into account.

Figure on share of air conditioners with inverters (million units)



Low power modes

Besides the on-mode (when the appliance is active and actually producing heat or cold) most air conditioners also have:

- thermostat-off-mode (when the unit is active but waiting for a signal of the thermostat to enter on-mode – generally 30 W),
- standby-mode (when the unit is waiting for input to either enter off-mode or become active – generally 2-7 W),
- off-mode (when the unit is switched off in its lowest energy setting achievable by the user without unplugging the chord – generally 0-3W) and
- crankcase heating mode (when the unit activates an internal heating element to drive refrigerant from the compressor oil for safer starting- generally 60 W).

Air conditioners are exempted from the Regulation on standby and off-mode, so these low power modes are currently unregulated.

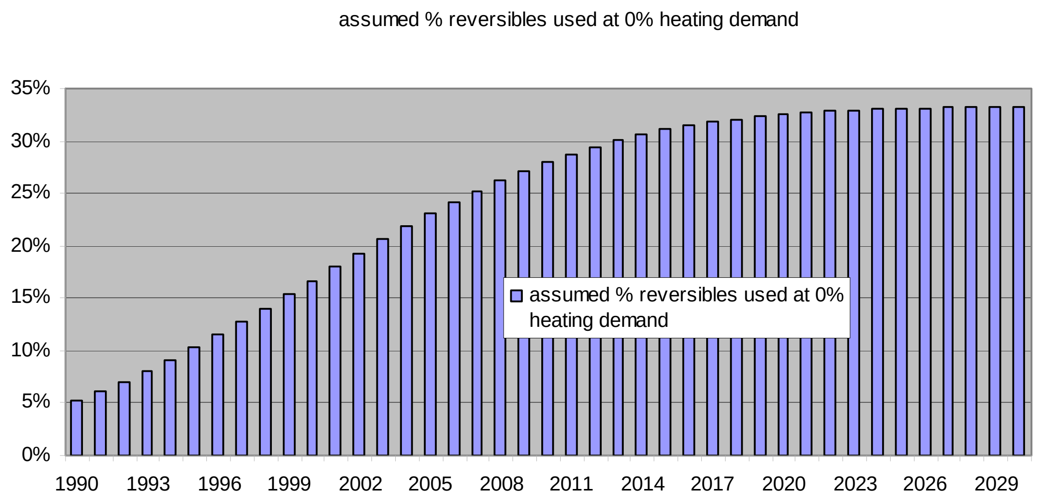
Energy consumption

The annual energy consumption of air conditioners is calculated by first identifying a cooling and heating demand. The preparatory study did so by looking at trends in climate, end-users (residential, small office and retail), the building characteristics, and sales projections. The result is an annual average cooling and heating demand, expressed in kWh/a for the main types of air conditioners.

An average annual electricity consumption can be calculated by dividing the cooling (heating) demand by the average seasonal efficiency of the air conditioner. The actual consumption varies per type of appliance (fixed appliances are assumed to run for longer periods) and per capacity (more powerful appliances fulfil a higher cooling or heating demand). For cooling, the average split consumes between 348-733 kWh/a, double duct 372-512 kWh/a and single duct 259-363 kWh/a (mainly due to fewer operating hours/a).

For heating, energy consumption is higher since the heating demand is higher than the cooling demand. For heating, the average split consumes between 745-1118 kWh/a, double duct around 1150 kWh/a and single duct 510 kWh/a (2010). These figures are based on calculation assumption that a certain percentage of reversible appliances will not be used (or only partially) for heating. This assumption is based on various market drivers: First, more and more reversible appliances are bought, because reversibility is a low-cost addition allowing both cooling and heating. Second, more and more of the sales of these reversible are bought by users that already have a main heating system and some of them will therefore use the heating function only rarely, or at all. No robust consumer research exists describing the actual use of the heating function of reversible units in Europe. This impact assessment assumes based on stakeholder input that a maximum 33% of reversibles are not used as heaters.

Figure on share of reversible air conditioners NOT used for heating (estimate)



Ecodesign requirements

Below is presented figures that provide the average efficiency of new appliances for the calculation of the stock energy consumption for the baseline and the options considered (describing effects of different policy options)

Figure on development of average energy efficiency for new split air conditioners by option

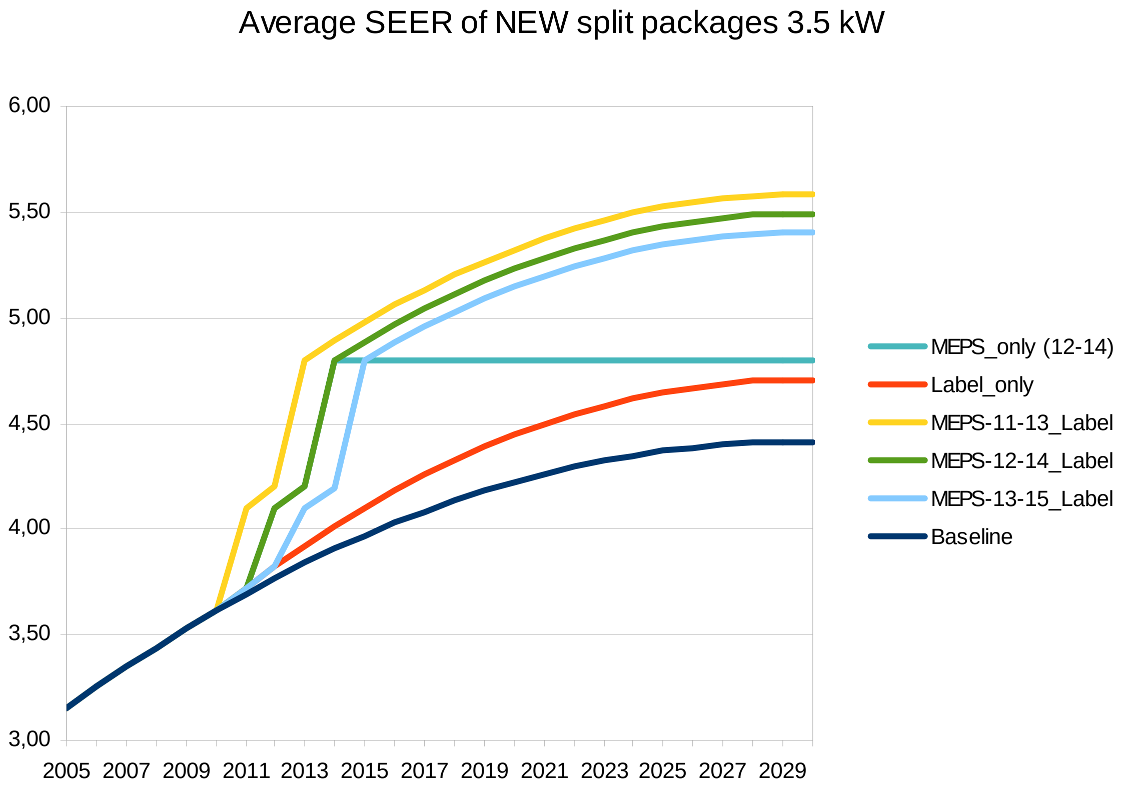


Figure on development of average energy efficiency for new double duct air conditioners by option.

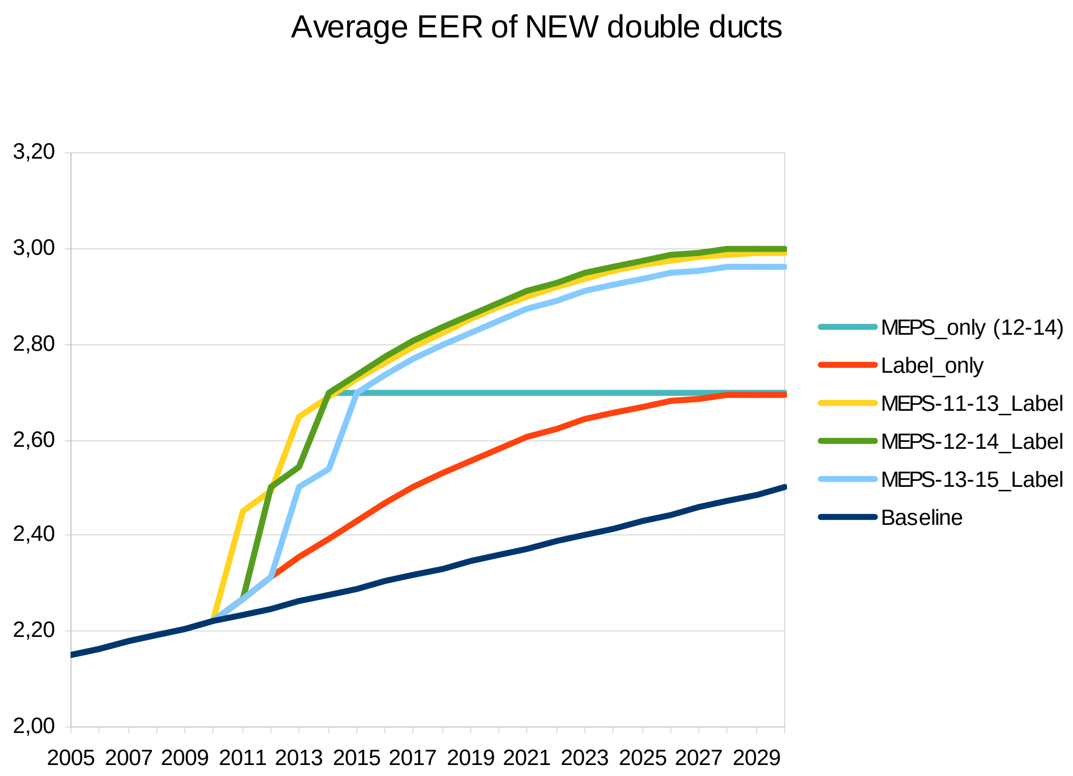
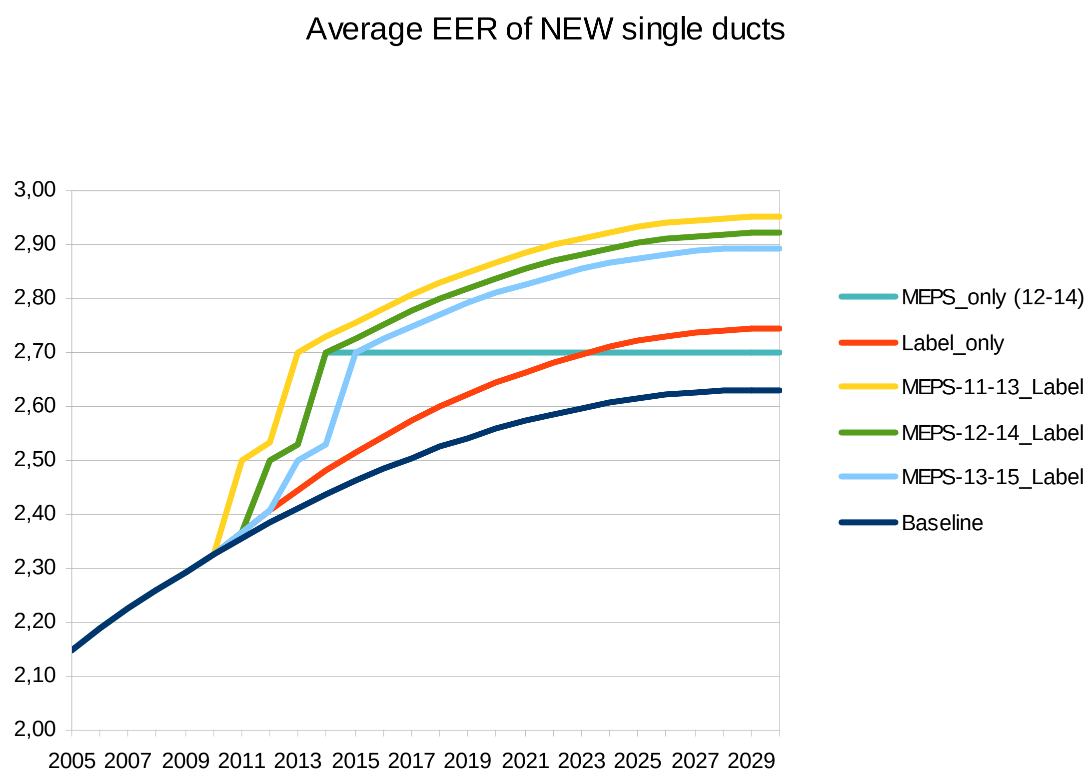


Figure on development of average energy efficiency for new single duct air conditioners by option.



Annex 4 – On refrigerants and sound power level

Refrigerants

Today's most common refrigerants have a high global warming potential and their leakage contributes directly to overall greenhouse gas emissions. Indirect greenhouse gas emissions stem from electricity consumption. In general, direct (refrigerant-related) emissions contribute around 15-20% of the total emissions, depending on air-conditioning type and characteristics.

Most conventional AC units use high GWP hydrofluorocarbons (HFC) such as R410a and R407C as refrigerant. These substances, when released into the atmosphere, contribute to global warming by retaining infrared radiation from earth's surface. Their level of contribution to this effect can be expressed in kg CO2 equivalents. Since substances may break down in earth's atmosphere, usually the GWP values are related to a given time horizon. In existing legislation a time horizon of 100 years is applied. The scientific community (IPCC) has concluded that if 1 kg of CO2 has a GWP of 1 (100 yrs). For example, the GWP of the most commonly used refrigerants R-407c and R-410a correspond to GWP of 1774 and 2088 respectively. In small capacity appliances (mostly single ducts) also R290 (propane) is used. The GWP of refrigerants already used or which may be commercialised are presented below[50].

refrigerant	R410A HFC	R407C HFC	R1234yfHFO	R290 propane	R744 CO_2 carbon dioxide
kg CO_2 eq.	2088	1774	4	3	1
These GWP values relate to a time horizon of 100 years and are expressed as kg CO2 equivalents.					

The use of certain refrigerants with significant GWP is regulated under the EU F-Gas Regulation 842/2006 and its existing measures focus on containment, recovery, certification and the provision of a technical label. Given the technical characteristics of the products some leakage during use and recovery is unavoidable, especially from split package units. The most common causes are leakages from connections between lines and pipes that carry refrigerants and openings in the system for filling, recharging, measurement of pressure, etc. Annual leakage rates during the use phase are assumed to be 3%/a for split systems and 1%/a for single package and single ducts. In addition, for all units, 5% leakage is assumed due to improper treatment during end-of-life.

Impact of possible direct emissions

The relative share of direct refrigerant emissions in the total (direct and indirect) greenhouse gas emissions depends on various factors such as type of refrigerant and its efficiency, type of air conditioner and its efficiency and the use of the functionalities. Globally, the contribution of refrigerants in total GHG emissions from these appliances is estimated in the range 15-20%.

Table on direct GHG emissions per type of appliance

for units using R410a	single duct		split_co		split_rev	
	average	BAT	average	BAT	average	BAT

[50] Technology and Economic Assessment Panel 2010 Progress Report - Volume 1. See also, latest report from TEAP lists refrigerants expected to be used for these appliances. See p. 61-65: http://ozone.unep.org/Assessment_Panels/TEAP/Reports/TEAP_Reports/teap-2010-progress-report-volume1-May2010.pdf

share of direct emissions (TEWI based)	10%	30%	27%	56%	10%	20%

The preparatory study shows that alternatives to conventional refrigerants exist, but are still at a very early stage of development (HFO and CO_2) or not universally applicable (hydrocarbons such as propane).

Table: Examples of air conditioners using alternative refrigerants

R290 / propane	DeLonghi is currently the only known manufacturer to place onto the market new air conditioners using R290[51]. The PAC W110 eco is a single duct with a 300 g charge. The purchase price is twice as high as for average single ducts but the performance is also higher. Single ducts with similar performance but using conventional refrigerants (R410A, R407C) employ a charge that is often more than twice as large (500-900 g).
	Manufacturer GREE (CN) planned to introduce in December 2009 propane-split units[52]. According GREE the price can be lower than for R410A units because the heat exchangers require less material and the refrigerant is cheaper. The charge varies from 265-330 g. An interesting feature is the electronic refrigerant-leakage alarm.
	An UK seller, installer and consultancy of 'natural refrigerants' advertises since 1998 with succesful conversions of split-package units using propane or other blends of hydrocarbons[53].
	An installer in NL advertises with propane-retrofit solutions (the existing installation is emptied and filled with propane)[54]. The exemplary charge of a 3.5 kW split package unit with R290 is 0.5 kg whereas the R407C would require a 1.05 kg charge. They report an increase of efficiency when compared to R407C.
	Although not actually an air conditioner, Unilever is employing R290 in over 366.000 ice-cream cabinets, which shows that the refrigerant can be used safely in refrigeration circuits on a large scale.
R744 / CO2	Researchers have shown that R744 (CO2) can be applied in split-package systems, delivering comparable performance and efficiency as standard equipment[55]. This was an experimental set-up to show "proof-of-concept".
HFO1234yf	This refrigerant has only very recently been presented to the market and has not been used in air conditioners yet.
Other	According to Earthcare, there are many natural refrigerants (pure substances,

51 Source: http://www.delonghi.it
52 Source: http://www.gtz.de/de/dokumente/en-gree-ac-unit-hydrocarbons.pdf
53 Source: http://www.earthcare.co.uk
54 Source: http://www.airned.nl
55 Source: Reversible Residential Air-Conditioners and Heat Pumps Using Carbon Dioxide (CO2, R744) as Working Fluid, A. HAFNER, P. NEKSÅ, J. STENE, SINTEF Energy Research, 7465 Trondheim, Norway, 2009.

refrigerants	blends with other HC's and also HFCs) that can relatively easy be used as drop-in replacement for conventional refrigerants and often offer better performance and efficiencies.

Below is an example of the features of a split package unit using propane.

2.1 General Introduction

GREE Gree Electric

Capacity and Size of R290 units

Capacity kw (Btu)	COP w/w	Charge gram	Max noise (Inside) Db	Max noise (Outside) Db	Size mm
2.7 (9K)	3.55	265	38	52	Outdoor unit 830x284x205 Indoor unit 760x257x541
3.2 (11K)	3.54	310	41	52	
3.5 (12K)	3.52	330	41	52	

The COP is ≥ 3.52

This is better than the “A” rating of the EU efficiency labelling for air conditioners

From GREE GTZ-ProKlima presentation 10 May 2009

While the regulation of potentially environmentally harmful refrigerants takes place within the F-Gas Regulation, ecodesign can complement this framework by providing an incentive in form of a bonus for the take up of low-GWP refrigerants, without compromising with the level of the total green house gas emissions.

Bonus for products using low-GWP refrigerants

Different refrigerants have different efficiency properties. Propane (R290) is some 7% more efficient than traditional synthetic refrigerants but it is a flammable refrigerant, whose application is governed by strict safety rules in production facilities and installation. Manufacturers need to invest in safer production lines. Up to 300g charge appliances can be installed without much constraint. Currently propane is used only in one single duct model.

The refrigerant charge for most popular split package models is however much higher, and introduces safety concerns. Requirements relate to minimum room size, height of installation and maximum allowable refrigerant charge. Manufacturers may find ways to overcome such constraints (for instance by limiting circulation of refrigerants to components positioned outside) but this requires new design. Such designs (an extra hydronic circuit for instance) are thought to lower the efficiency when compared to non-redesigned units. For these and other situations a bonus could be applied.

During the course of the study there has been discussion on whether different bonuses should be applied to different refrigerants according their GWP. Intermediate calculations have shown however that the difference in direct emissions for refrigerants with GWP 150, GWP 5 or GWP 1 are so small that a differential treatment is not needed.

Example: An air conditioner may have 20% of its total GHG emissions caused by refrigerant leakage. If these are caused by conventional refrigerants (GWP between 2088 and 1774 kg CO2 eq.), the replacement by a refrigerant with GWP 150 kg CO2 eq. would mean a ten-fold reduction of the direct GHG emissions and the share of direct GHG emissions would be reduced to just over 1%. If the refrigerants are replaced by substances with even lower GWP values (propane of HFO ave a GWP between 3-6 kg CO2 eq.), the share of direct GHG emissions would be reduced to less than 1%. The relative difference between replacement by substances with GWP 150 or GWP 4-6 is therefore not as significant as replacement of todays synthetic refrigerants by refrigerants with lower GWP than 150. For such a small gain it is not considered worth the extra complication of introducing bonuses at several levels, nor to set too demanding levels in order to leave sufficient freedom for innovation for the industry. Furthermore, the experience of the car AC market has shown that manufacturers are inclined to strive for 'better than required' solutions (HFO 1234yf), instead of aiming at the bare minimum.

The stakeholders have agreed that a bonus based on the Ecodesign minimum energy efficiency requirements is a good way of promoting appliances to use low GWP refrigerants. The height of the bonus should be chosen at such a level that no negative effects of the reduced energy efficiency of appliances are expected. This is shown in the analysis below.

The figures below present the outcomes of an assessment of various types of air conditioners by policy option (policy options being: basecase/BAU, 1st tier, 2nd tier, 5% / 10% / 15% reduction of minimum efficiency requirements)

Figure on total CO2 emissions for reversible split package air conditioners by policy option

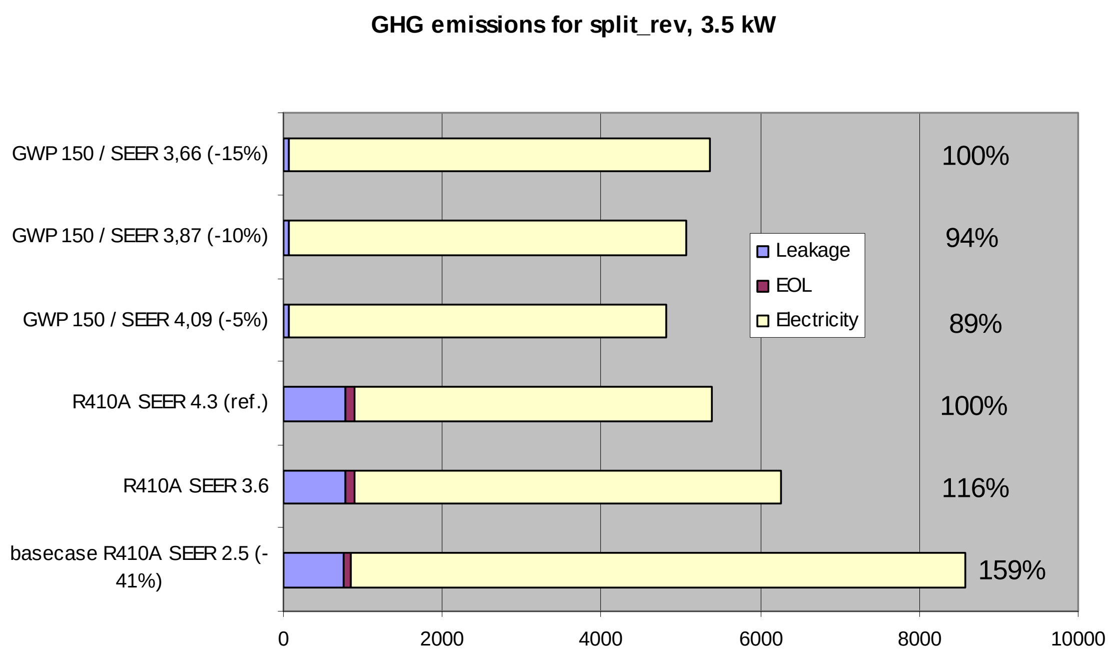


Figure on total CO2 emissions for cooling-only split package air conditioners by policy option

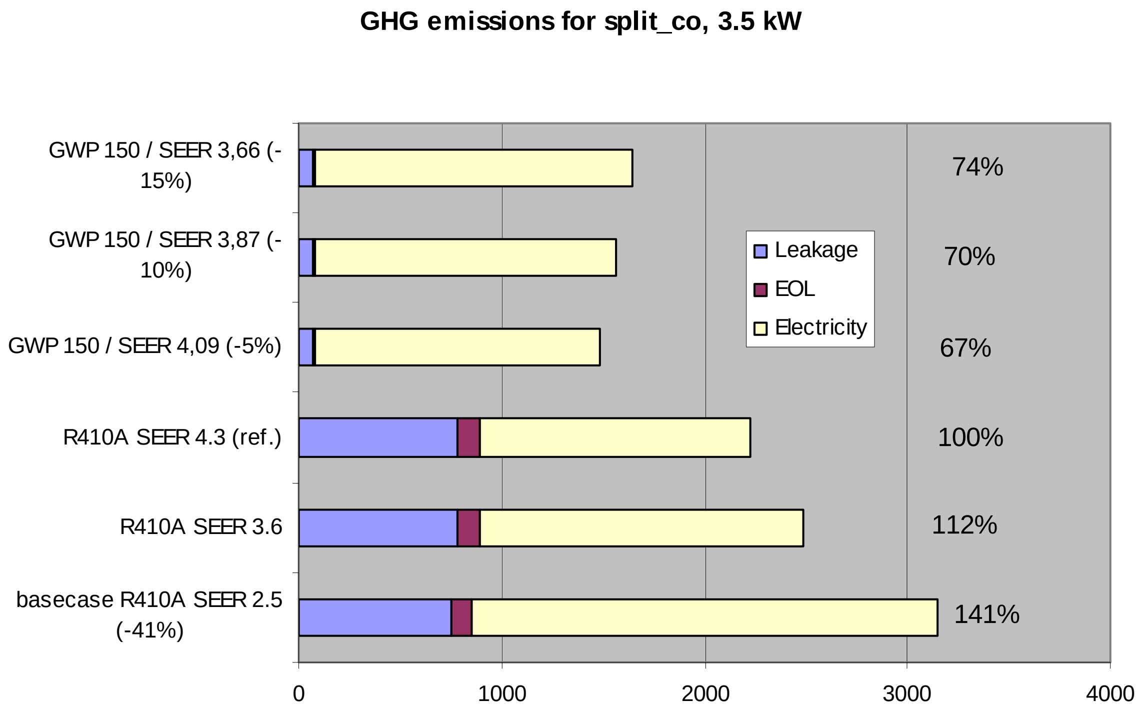


Figure on total CO2 emissions for double duct air conditioners by policy option

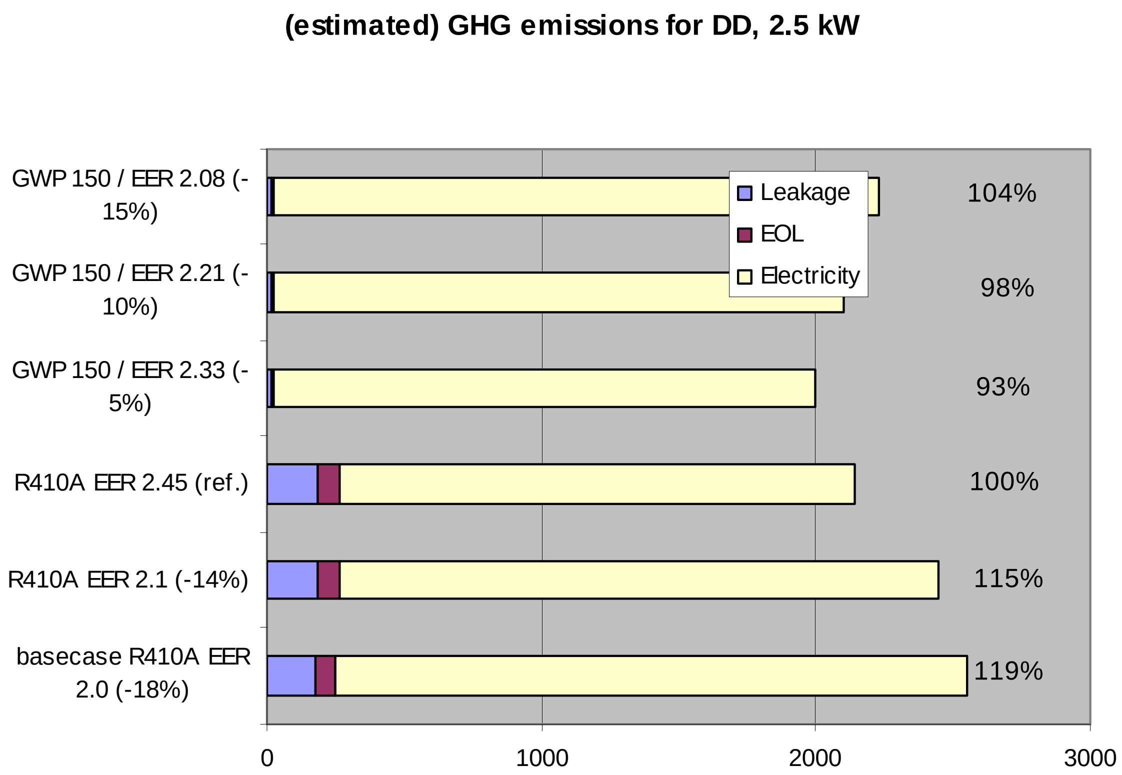


Figure on total CO2 emissions for single duct air conditioners by policy option

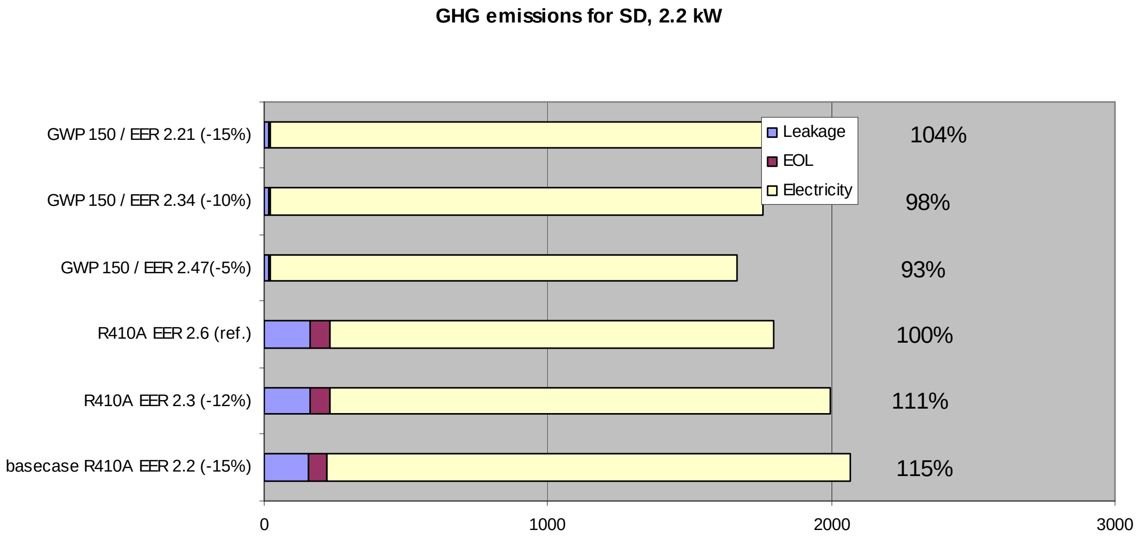


Figure on total CO2 emissions for all air conditioners combined (based on sales share)

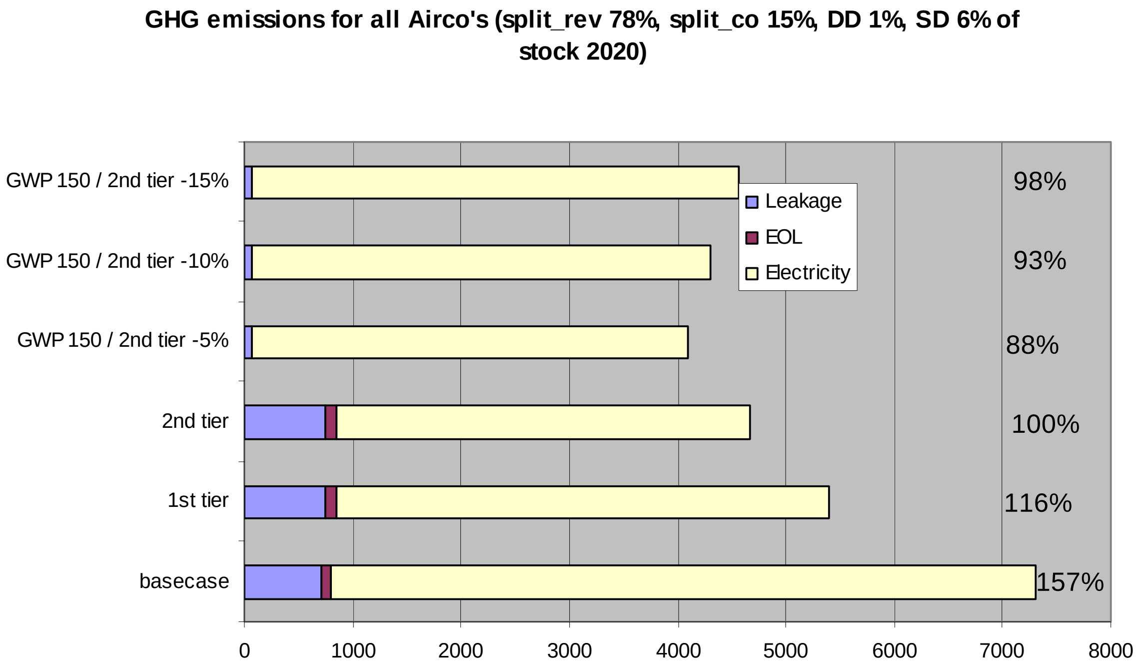


Table on total CO2 emissions for main types of air conditioners for basecase, 1st and 2nd tier and options for reduced MEPS if using low-GWP refrigerants (expressed in %, with 2nd tier as reference)

Table : Total direct and indirect CO2 emissions (relative to tier 2 values) per type of appliance and possible 'GWP bonus'

	split_rev	split_co	DD	SD	combined
basecase	159%	141%	119%	115%	157%
1st tier	116%	112%	115%	111%	116%
2nd tier	100%	100%	100%	100%	100%
bonus -5%	89%	67%	93%	93%	88%
bonus -10%	94%	70%	98%	98%	93%

bonus -15%	100%	74%	104%	104%	98%

The table shows that a bonus of 15% still leads to lower total emissions than without the bonus

As stated above, once the refrigerants drops below GWP 150 the extra benefit of even lower GWP's is hardly visible in the environmental profile. As with the Car AC's we can expect manufacturers to not introduce refrigerants very close to the 150 threshold, but instantly leap towards even lower refrigerants below GWP 10. Any bonus for GWP below 150 would thus have similar effects.

GWP and Labelling

Some stakeholders suggested including references to the use of low-GWP refrigerants in the Energy Label. For this, several options would exist:

1. Standard text, for example in style: "This appliance (does not) use(s) a low-GWP refrigerant". This information is easy to introduce but it is questionable how far consumers understand the content or benefits of "low-GWP" refrigerants.

2. A numerical informational element, for example in style: "This appliance uses a refrigerant with GWP = X kgCO2 eq.". This is also easy to implement (the same information is already required in form of an ecodesign information requirement) but few consumers understand such technical information.

3. Information on the level of the total GHG emissions. The so called TEWI (Total Environmental Warming Impact) concept combines GHG emissions from refrigerant leakage and electricity consumption in one number (expressed as kg CO2 eq.). This concept requires a calculation that takes into account the GWP of refrigerants, refrigerant charge, average leakage rate, average product life, calculation of annual electricity consumption and kg CO2 per kWh electricity. The end-result is a number that is dependent on the size of the appliance (larger systems have higher charges and therefore higher absolute emissions). While useful for professionals, it is assumend that the TEWI concept is not useful for consumers.

4. Variation of the above TEWI concept could be used, e.g. TEWI per kW cooling/heating output (this partly compensates the effect of the capacity: larger systems always have higher GHG emissions) or TEWI per kWh annual consumption (this partly compensates the effect of capacity and efficiency). The latter is probably the most 'neutral' form of expressing TEWI, but is also complex and difficult to understand for consumers.

The arguments above can be taken into account when discussing options to include information on direct GHG emissions on the Energy Label. These options did not form part of the impact analysis, as the quantification of effects remains too much a matter of speculation between different assumptions and options.

Leakage detection

Some stakeholders requested a mandatory ecodesign requirement for leakage detection, which currently is used for safety reasons in some (soon to be introduced) appliances using hydrocarbons. Such a leakage detection devise could be used also for environmental reasons in appliances using other high-GWP refrigerants. However:

- leak detection system is rather expensive and would not stop the leakage, it would only indicate to the persons servicing or using the equipment that something has gone wrong. It has been argued that this system could be an excuse to stop investing on systems that are tight and reliable;

- leak detection system would have only a very limited impact. The system works on indoor unit leaving other areas such as outdoor units, connection pipes etc. uncovered, while most leakages take place in these areas, which contain about 80% of the refrigerant. That is, only about 20% of the refrigerant amount could be saved in stopping the compressor;

- The F-Gas Regulation already prescribes a proper preventive approach, requiring systems to limit the emissions through regular inspection - prevention by regular inspections is however only requested for units carrying over 3 kg refrigerant charge (in practice over 10 kW cooling power);

- Within the European standardisation activities (TC 182) a standard is up for a vote to determine the tightness level of components. Other standards, such as EN 378 will then refer to the new standard in order to ensure that components will be tight enough to avoid/minimise leakages.

Based on the above reasons and recent developments, it is estimated that leakage protection systems would be an expensive solution that would only partially be able to meet its objectives.

Sound power level (noise)

Air conditioners emit acoustic sound during operation (air flow induced sound and sound coming from electric compressors). The most important contributor to sound power is the air flow over the fan blades, which grows if air flow increases. In addition, the electric compressor, usually located outdoors, contains moving parts that produce a humming sound.

In theory, there is a clear and well-understood relationship between sound and efficiency. An appliance becomes more efficient, if the air flow over the heat exchanger is increased, but this would increase the sound levels as well. However, on the basis of the sound levels and performance declared by manufacturers this relationship does not seem so obvious. Two reasons may apply: first, sound levels vary with the cooling (or heating) capacity of the unit. At higher settings, more sound is produced than at lower settings. Manufacturers sometimes indicate sound levels at several settings, but the energy efficiency at these settings is often not known. Second, it appears that even if appliances have similar efficiencies there can be difference in sound levels that can more easily be explained through different approaches in design (type and material of fan, design of housing and air channels, location of components in the housing, anti-noise measures taken etc.). Thus, sound levels vary according to actual capacity (which also affects efficiency) and design choices (can affect efficiency in ways that are still not fully understood today). The following figures demonstrate the relation identified between efficiency and sound in existing appliances as declared by manufacturers.

Figure on sound power levels of reversible split package units < 6kW cooling power (Task 4, p. 41, fig 4-33)

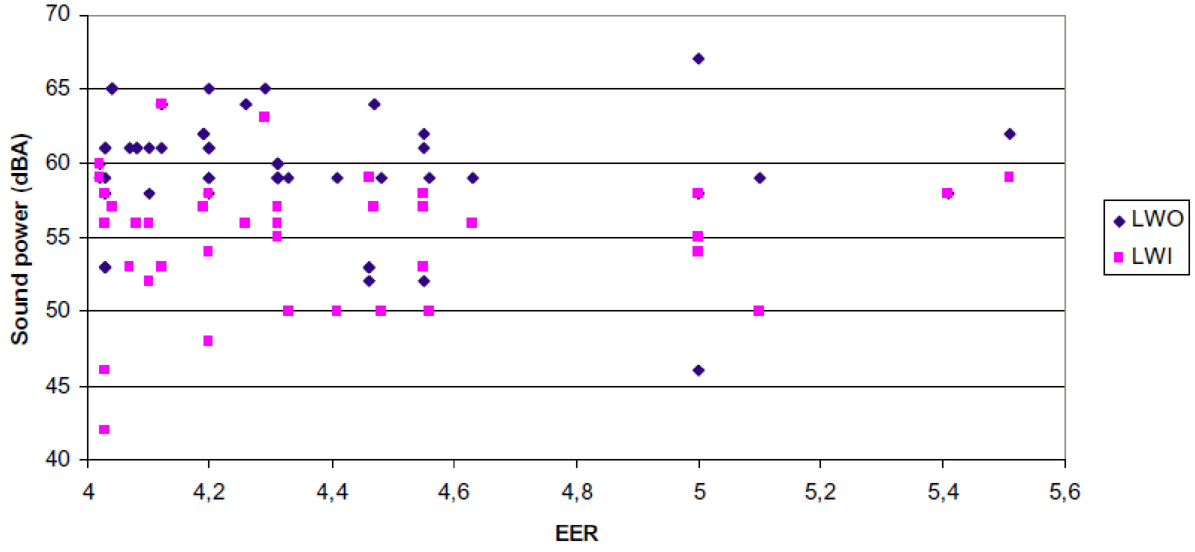


Figure on sound power levels of reversible split package units > 6kW cooling power (Task 4, p. 42, fig 4-34)

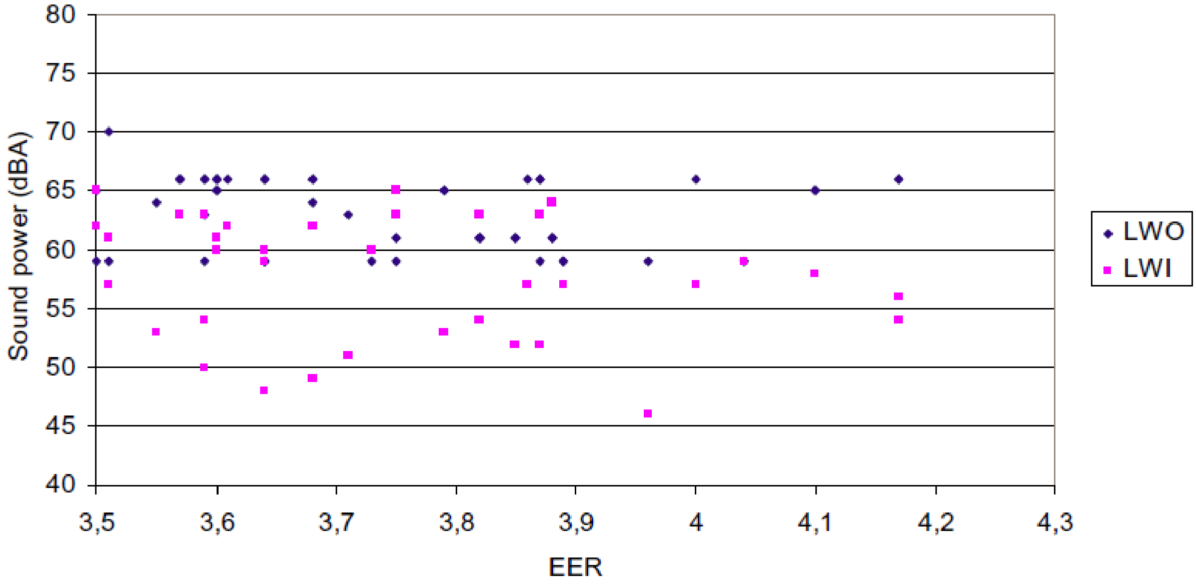


Figure on sound power levels of reversible multisplit package units > 6kW cooling power (Task 4, p.42, fig.4-35)

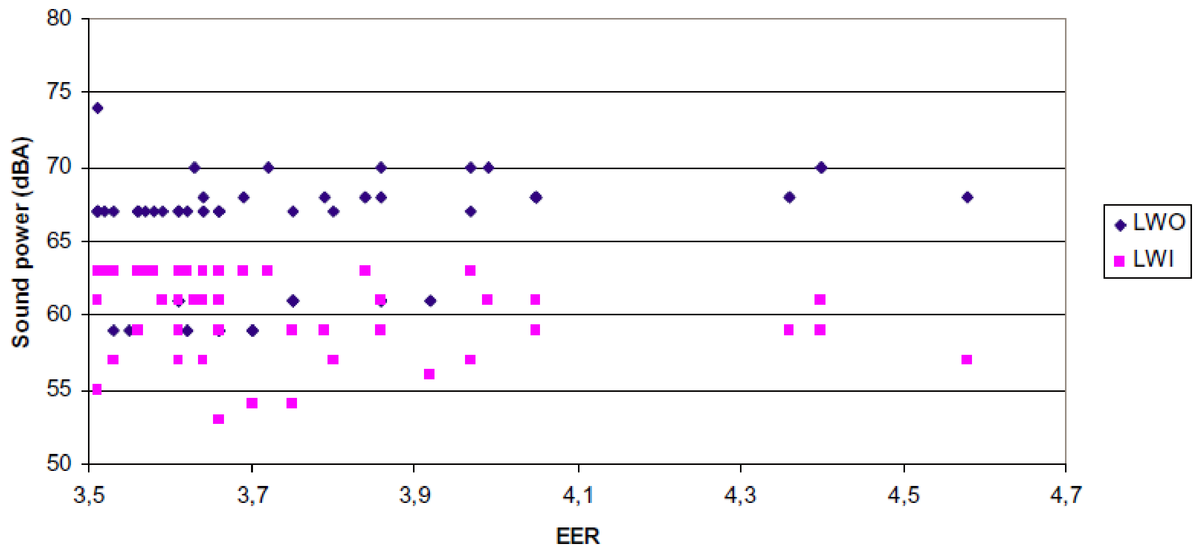
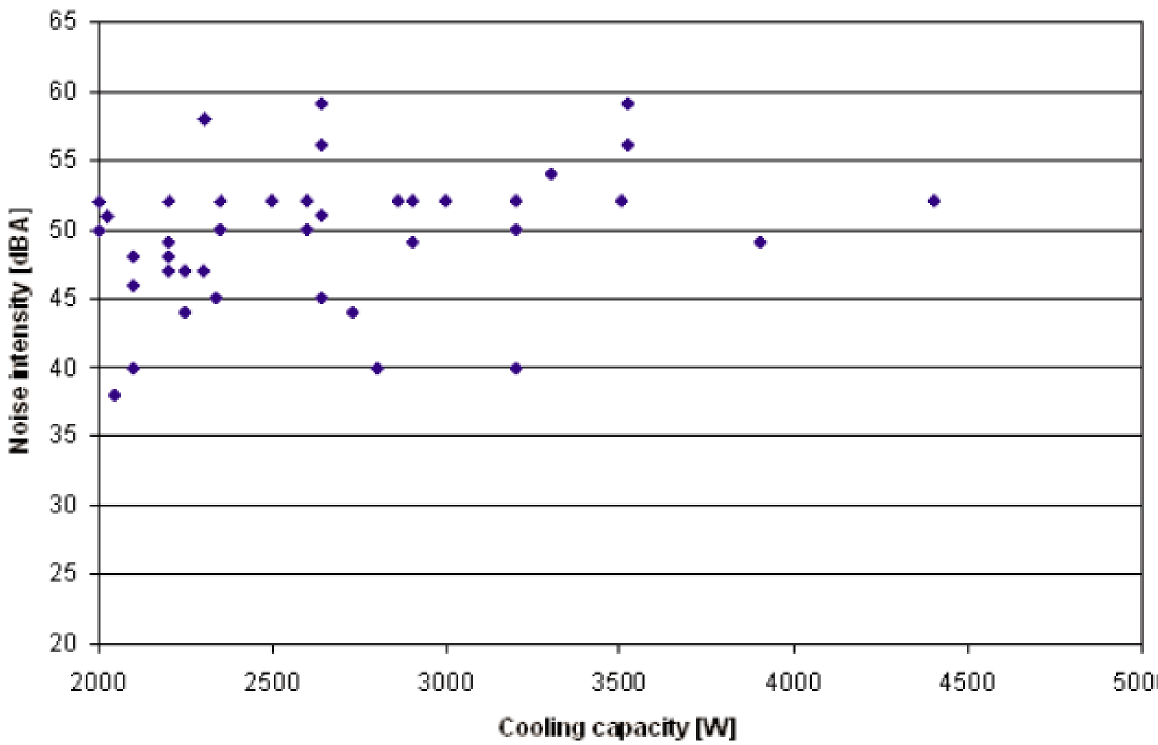


Figure on sound power levels of single duct units at maximum capacity (Task 4, p. 40, fig 4-31)



For single ducts, no such graph (data) is available, but similar patters are estimated.

Benchmarks for sound power level

Benchmark levels for sound production are not available, although the figures above give an indication of lowest sound levels, it is not certain that these can always be achieved by units that fulfil certain energy efficiency requirements. A main reason is that the available data is not robust enough to define benchmarks that apply uniformly across the range of 0-12 kW capacity, when combined with increased energy efficiency.

Sound pressure vs. sound power

There are two ways of measuring sound. Sound **power** rating is determined in an acoustics laboratory, usually by the manufacturer. Specific standards qualify testing facilities and methods to promote data uniformity and objective comparisons of different units across the industry. By contrast, sound **pressure** can be measured in any existing space with a sound meter, or predicted for a space not yet constructed by means of an acoustical analysis. Since the only accurate sound data a manufacturer can provide is sound power, the challenge of designing for quality sound is to examine the effect of environmental factors.

Maximum sound power levels recognised internationally

WHO guidelines (1999) state that "If negative effects on sleep are to be avoided the equivalent sound pressure level should not exceed 30dBA indoors for continuous noise. If the sound is not continuous, sleep disturbance correlates best with $L_A$max and effects have been observed at 45dB or less. This is particularly true if the background level is low. Sound power level exceeding 45dBA should therefore be limited".

These values are assumed to relate to sound pressure levels, which are not the same as sound power (power is like the total sound output, pressure is like the sound level in a given position in a given environment). The values above therefore must be related to an environment (eg. anechoic room) and position (eg. 1 meter in front of sound source). From the few data on air conditioner noise that is available[56] it seems that sound pressure is some 10dB(A) lower than sound power, if sound power is measured in a reverberant room and sound pressure in an anechoic room, with microphone 1 m. in front of the sound source.

So a sound pressure level of 45dB(A) at 1 meter directly in front of the unit, may relate to a sound power level of approximately 55dB(A). Whereas the sound power remains the same regardless the distance, the sound pressure goes down with every extra meter distance between the listener and the source. If the maximum indoor sound power level of an appliance is for example 58dB(A), the corresponding sound pressure level could be 48dB(A), in an anechoic room, at 1 m. distance, at maximum capacity. At minimum capacity, the sound power level is 51dB(A) and the sound pressure level is 42dB(A). So if one would be sleeping 1 m. in front of the unit (unobstructed), the sound level would still fall within WHO requirements.

For outside noise, a similar calculation can be applied, where one should note that, even if people sleep with windows opened, there is a general reduction of sound pressure of approximately 15dB(A). According to WHO, a maximum sound pressure level of 55dB(A) applies outside (see table below on outdoor noise), which may me translated into a maximum sound power level could be 65 (if the same shift in dB(A) applies).

Average night sound pressure level over a year, Lnight, outside	Health effects observed in the population
Up to 30 dB	Although individual sensitivities and circumstances may differ, it appears that up to this level no substantial biological effects are observed Lnight, outside of 30 dB is equivalent to the no observed effect level (NOEL) for night noise.

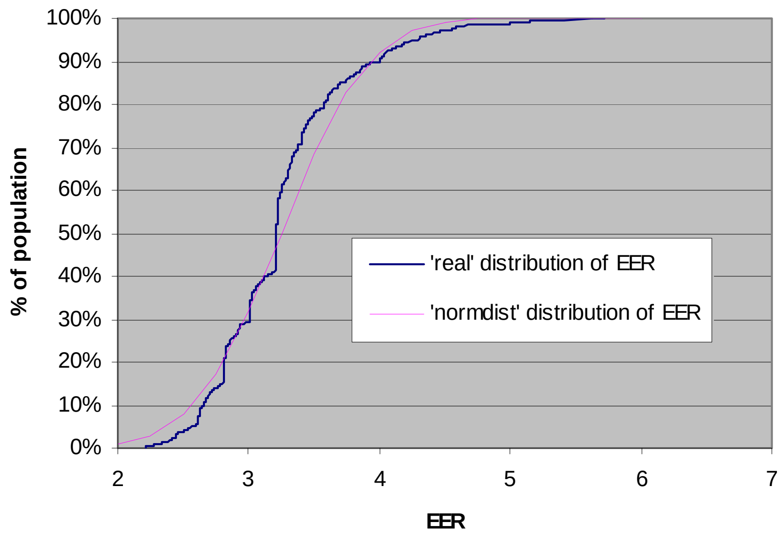
56 Double duct manufacturer Olympia Splendid lists both levels (power and pressure) for the described test set-ups.

30 to 40 dB	A number of effects on sleep are observed from this range: body movements, awakening, self-reported sleep disturbance, arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (for example children, the chronically ill and the elderly) are more susceptible. However, even in the worst cases the effects seem modest. Lnight, outside of 40 dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise.
40 to 55 dB	Adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected.
Above 55 dB	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases.

Annex 5 – Minimum Energy Efficiency Requirements (MEPS)

In Section 4 of the main text, the level of minimum energy efficiency requirements has been indicated. This Annex shows in more detail what cut-off percentages can be expected from these minimum requirements and about specific issues raised during stakeholder consultation.

For the purpose of this impact assessment, a dataset for reversible split package units (almost 75% of sales) has been created on the basis of Eurovent Certification data. The available data is limited to EER (and COP) values. It appears that the dataset of n=1643 entries follows closely the cumulative normal distribution.



In the above figure, the blue line is the distribution of EER in the dataset (n=1643) used in the preparatory study and in the impact assessment. The pink line is the 'normal' (cumulative) distribution with the same 'mean' and 'standard deviation' of the same dataset.

The two lines are very close together and only beyond the average EER of the dataset (3.25, at 50% population) the EER for the real data is somewhat lower than for the 'normalised' data (meaning there are in reality slightly more models closer to the average than expected in normal distribution). Note that these are not sales-weighted data. There might be more popular high efficiency models, but also more popular low efficiency models. For the purpose of this impact assessment an average EER of 3.31 was calculated for the new models in 2010 (slightly above the level in the Eurovent dataset).

The average SEER for 2010 is calculated to 3.61 (this takes into account the average EER of 3.31 and 65% appliances with inverters). It is assumed that the standard deviation (sd) is linked to the EER values, so recalculation of EER to SEER gives sd = 0.658 for SEER. This means that a SEER value of 3.6 can be translated into a cut-off percentage of the population of **49%**. For SEER 4.3 the cut-off is **85%**. The table below gives the cut-off percentages for specific SEER levels. Note: these values are not sales weighted but approximate values.

BAU 2010	**EER**	**SEER**	**normdist**
mean average	3,31	3,61	
st.dev	0,526	0,6575	

		1,70	0%
		1,90	0%
		2,10	1%
		2,30	2%
		2,50	5%
		2,70	8%
		2,90	14%
		3,10	22%
		3,30	32%
		3,50	43%
		3,60	49%
		3,70	55%
		3,90	67%
		4,10	77%
		4,30	85%
		4,50	91%
		4,70	95%
		4,90	97%
		5,10	99%

Eurovent does not include single duct appliances in their database and none of the double duct appliances known to the team has been found in the Eurovent database. Therefore the impact of requirements for single ducts were assessed on the basis of energy label data.

For **single duct** market data from Italy 2009 suggests that already 63% of 'portable units' (mainly single ducts) were labelled class A (EER >2.6), some 13% was class b (EER>2.4). This means that if the Italian market is representative of the EU market for single ducts (the Italian market is indeed the largest single duct market in the EU) a requirement of EER 2.4 would cut-off 24% of the market and a requirement of EER 2.6 would cut-off 37% of the market (current appliances). It may well be that in reality more than 37% of appliances will be removed since it is know that overoptimistic labelling does occur (see also comments related to Self Regulation / Voluntary Agreements). Furthermore, the values relate to portable units of which some 38% may be portable splits (see Task 2 of preparatory study) that are often more efficient than single ducts. Therefore this Impact Assessment is based on a more conservative value of EER 2.33 for single ducts. This value is higher than the EER of 6 out of 7 single ducts tested by Stiftung Warentest in June 2008. Stakeholders have argued that an EER of 2.6 will remove over 50% of appliances from the market.

For **double ducts** there is no overview of the energy efficiency of the current available appliances. One manufacturer consulted during the Impact Assessment confirmed that the average double ducts has an EER 2.1 and the best appliances have an EER of 2.6. There is however no indication of the percentage of sales these values relate to (the market is so small that such information is considered proprietory since they can be traced back to models and manufacturers). Therefore the authors of the impact assessment concluded that EER 2.4 will most likely ban over 50% of available models and an EER of 2.6 will most likely ban over 80% of available models. These values are however assumptions and should be checked with real market data whenever these become available.

The preparatory study identified for **splits** a least life cycle cost (LLCC) between SEER 4 (for cooling only split package) to 5.4 (for reversible split package). As the EU market is characterised by relatively low energy efficiency appliances, a direct transition to LLCC levels would lead to a strong disruption of the market and most likely to sever damage on affordability. Therefore, considerable but less extreme in crease in energy efficiency to SEER level 4.3 and SCOP 3.5 were proposed as 2nd tier. As 1st tier, SEER 3.6 and SCOP 3.2 were proposed. Stakeholders largely agreed with these values. However, appliances on which seasonal efficiency will be applied will have to be given sufficient time in order to allow all models to be (re-)measured with the new measurement method.

For single ducts and double ducts, ecodesign requirements based on SEER (and SCOP) were considered but finally disregarded in favour of EER based requirements. The main reason is that single and double ducts currently do not employ inverters. The added benefit of SEER-based values showing better part load performance would therefore be lost. Additionally, single ducts in particular are thought to have a much smaller operational season with relatively less part load conditions. Furthermore, the measurement method of single ducts is not suited for measurement at different outdoor temperatures (single ducts take the evaporator and condensor air from the same room so they have the same temperature). The requirements are thus EER-based upon the same measurement method as under the existing energy label.

During the impact assessment the industry indicated their preference for minimum requirements for heating (COP values) as well, although no such appliance currently exists (SDs with resistance heating exist but appliances with a heat pump function would be more efficient). Therefore, during the impact assessment, COP of 1.8 and 2.0 were identified in agreement with stakeholders.

As regards DDs, stakeholders showed during the impact assessment that this product would be instantly phased out if the same requirements were set as on the other air conditioners. These appliances are less efficient due to design constraints. Double ducts can essentially cool the space they are placed in like splits can, but are designed to function without an outdoor unit. This allows them to be placed in some historic centres, where splits are not allowed.

Double ducts are completely positioned inside the room to be conditioned and therefore experience technical constraints that are different to split package units. The air can not flow as freely over the heat exchangers (both evaporator and condensor) as in split package units, because the unit must combine all components into a single housing. Typically the heat exchangers are only 1/5th of the normal frontal area size and geometrically less optimal. The air flow is forced through small ducts and therefore requires more energy to be moved and produces higher sound levels. Also, as these units are produced in small quantities (less than 1% of the market), manufacturers are confronted with higher investment costs in efficient technology. All in all, double ducts are more costly, less efficient and noisier than the split, and can only be installed on outside facing walls. Therefore these products can not compete against split but are necessary in some specific situation, where split units can not be installed.

For double ducts the proposed requirements are not identified on the basis of the least life cycle cost (double ducts were not properly addressed in the preparatory study) but on the basis of estimates in agreement with stakeholders.

Proposed energy efficiency requirements on the basis of the results of the preparatory study and impact assessment

	Airco <12kW		Double Ducts*		Single Ducts	
	SEER	SCOP	EER	COP	EER	COP
First tier	3.60	3.20	2.40	2.36	2.40	1.80
Second tier	4.30	3.50	2.60	2.60	2.60	2.04

The SEER requirement applies to the cooling season. The SCOP values apply to the 'average' heating season. Declaring performance for other seasons (warmer vs. colder) is optional.

Low power modes

For splits, energy consumption in low power modes is included in the calculation of SEER/SCOP. For SD and DD, efficiency is expressed as EER/COP, and low power modes are not included. For any minimum efficiency requirements on low power modes, they would have to be set separately.

Hard on/off button

Some stakeholders suggested the mandatory installation of hard on/off buttons on air conditioners. While these buttons can be useful in some cases (e.g. window, wall or double duct units within reach for the user), most appliance types and user contexts would not benefit of such a button for reasons as follows:

- a main switch is foreseen in most split appliances for the fuse cabinet (for reasons see below) in order to be disconnected, when needed (e.g. during repair).When an air conditioner is turned on, it needs some time to heat up before use. Without such pre-heating period, refrigerant fluid could be present in the compressor and damage it. Units that rely on crankcase heaters for safe operation do not have an zero-Watt switch;

- when an on/off button is used, thermostat function and comfort features like response to remote controls and eco-modes are lost. End-users need to be fully aware of the full impact of the button;

- most indoor units of split packages are installed close to the ceiling. An on/off button on the unit would be unpractical;

- outdoor units are installed on the roof, outdoor wall or on other places where it is not possible or not practical to have an on/off button installed;

- despite of this, some national legislation require a specific on/off button for the outdoor unit so that the installer can shut the system down while working on it. This alleviates the risk of somebody turning the system back on at the fuse-box. This is a safety requirement foreseen for bigger installations, which however is not accessible for consumers;

- the new seasonal energy efficiency measurement method (SEER) takes into account all auxiliary consumption, which reduces the energy saving effect of an on/off button;

- identical requirements to those in the Commission standby and off mode Regulation 1275/2008/EC will be set on appliances measured on steady state (EER);

- single duct units are normally unplugged from the wall after use due to their movability and temporary use patterns.

Based on the above aspects, mandatory requirement for an on/off button are estimated to be overambitious and too costly.

Sound power level requirements

The sound power levels identified for ecodesign requirements are set at levels not limit energy efficiency improvements. It is estimated that some 75% of the models in the EU market comply with these requirements. A main purpose of setting sound power level requirements is to avoid a race towards higher efficiencies at the expense of higher sound levels. The requirements are not meant to indicate the best available technology but to phase out the worst appliances. More robust data would be needed for stricter requirements. The market forces (driven by consumer demand for low-noise appliances) drive also themselves the markets towards less noisy appliances, above the minimum levels required.

Outdoor units are sometimes subjected to sound power level legislations on national, regional, provincial and even more in city legislation. As such, Ecodesign can help in harmonisation the minimum sound power levels in the internal market.

Minimum sound power level requirements are also set in the Machinery Directive through sound pressure levels at 70dBA, however this level can not to be compared with sound power levels. 70dBA sound pressure is a much higher a noise level than 70dBA sound power level.

Table on maximum sound power level for air conditioners

	Room air-conditioners				Single ducts and double ducts	
	Peak cooling/h ≤ 6 kW		6 < Peak cooling/h ≤12 kW		Peak cooling ≤ 6 kW	6 < Peak cooling ≤ 12 kW
	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor
dB(A)	60	65	65	70	65	70

Extra Energy Savings from 'early' EER requirements.

For the purpose of this impact assessment, one alternative option for split package appliances involved an introduction of an extra EER requirement at a very early stage (one year after entry into force) for 'large' split packages only (with cooling output average 7.1 kW). The rationale is to remove from the market the least efficient appliances at relatively little effort. The option was calculated as variant of the sub-option MEPS 12-14+Label and involved setting an EER > 2.6 requirement for the larger appliances. The calculations however showed that the extra savings from this early-EER requirement were modest at best (0.2 TWh in 2020). The reasons for this modest savings are: The share of large appliances in the total stock is limited, the energy efficiency increase from this measure, when compared to Baseline, is also modest, the savings are limited on the short term due to the large existing stock and the increase of sales. This option of introducing early EER requirements before SEER requirements has therefore not been included in the Impact Analysis of Section 5.

Annex 6 – Energy labelling

This Annex further explains issues in relation to energy labelling of air conditioners based on key issues raised by stakeholders.

Commission Directive 2002/31/EC covers the appliances regulated in this delegated Regulation; it defines 5 different classifications for the following types of air conditioners:

- Air cooled split and multi-splits
- Air cooled packaged (window, wall and double duct units)
- Air cooled single ducts
- Water-cooled split and multi-splits
- Water cooled packaged

The efficiency measurement method used under 2002/31/EC to define the classes is based on an EER (energy efficiency ratio).

For split, window and wall appliances, that provide the same function[57] (cooling/heating of a room) a new efficiency measurement method (SEER for cooling efficiency, SCOP for heating efficiency) is introduced which does not allow direct comparison with the existing efficiency levels.

The preparatory study has shown that the LLCC (Least LifeCycle Cost) point of these appliances (split package) is reached at levels far higher than the today's energy class 'A'.

Both points open the possibility to introduce a completely new ranking scale and to develop a new label based on A-G, with the European benchmark (SEER=5.1) equal to class A. The benchmark for split appliances in the world market is higher (SEER=7.1) but is reached in a different climate and without respecting the sound power level limits that will be imposed by the Ecodesign Regulation. Considering the technological improvement potential, higher efficiency classes A+ to A+++ will be defined from the beginning so as to encourage manufacturers to develop more performing appliances. Those upper classes will be introduced on the label in phases of 2-3 years.

In view of minimising confusion for consumers and unfair comparison for newly labelled appliances with current models showing still the old label, it is proposed to stop the labelling under Directive 2002/31/EC for the splits and packaged appliances for a period of 6 months prior to the coming into force of the delegated Regulation.

For single ducts, the preparatory study has shown that the least lifecycle cost point is reached at efficiency level EER 2.8, which is one class higher than current 'class A' for single duct appliances. Market data shows that in Italy, which is the EU largest single duct market, more

[57] Single duct units are excluded as their primary function is to cool only an area of a room. Double duct units serve the needs of consumers that need cooling in buildings of which the building shell can not be modified. The SEER efficiency requirements would ban all of these appliances from the market.

than 50% of single ducts on sale are better than class 'A". However, this information is not available for other national markets.

Furthermore, the load profile of single ducts is different to other air conditioners for which it makes sense in calculating energy efficiency in SEER/SCOP; single ducts allow outside air to enter the room, which introduces a free cooling effect at days when the outside temperature is below that of the test standard indoor temperature of 27ºC. It has been calculated that only 15% of the total of running hours (in 'average' climate) is related to outside temperatures above 27ºC. Therefore, the climate profiles and the resulting heat load in the SEER/SCOP calculations are not characteristic for the load profile of single ducts.

Double duct appliances have not been separately assessed in the preparatory study but stakeholder consultation during the impact assessment indicates that the least lifecycle point is most likely below the current class 'A'. The benchmark however could be above class A given that evaporative cooling is a feasible 'efficiency-increasing' technical option for double ducts (currently not yet applied in double ducts).

Stakeholders have confirmed that none of the currently available single or double ducts are equipped with inverters. Therefore, the introduction of SEER/SCOP-based efficiency measurement tests is not useful.

Consequently, the measurement method for single and double ducts has been kept unchanged for labelling purposes (except for the tightening of the tolerances). Given that the foreseen Ecodesign measure will set a minimum efficiency requirement at EER=2.60 in the second tier, which corresponds to the current class A, and that the benchmark for these appliances is EER=3.10, with very little scope for improvement, only one more class above the current A is expected to be populated with today's technology. However, it is proposed to define two more classes (A++/+++) to be shown on the label. Thais means that the 'A' class would be shown in yellow in the label. The purpose is to make consumers aware of, despite of being an appliance e.g. in the class A, that the appliances cannot be considered as efficient as other types of air conditioners in A class (that would be shown in dark green colour on the label for other air conditioners).

The possibility of creating **one single classification** for all types of air conditioners was considered but not proposed further for the following reasons:

1. The measurement method to establish energy efficiency is different for split and single duct appliances.

2. In a single classification where the A class would be set at the benchmark level for split appliances, the best double and single ducts should be downgraded to classes F or G. Such a label would fail to provide incentives for the manufacturers of single and double duct units. It would fail to capture the attention of consumers who would be looking for the best performing single or double duct unit.

3. Single duct units provide a different function (cooling only a limited area in a room), have a different use pattern (limited seasonal use, can easily be unplugged and stored at the end of the season) and a limited annual consumption, though being less efficient.

4. Double duct units can be considered not to compete with split package units although they fulfil similar functions (both condition a single room). The main reason is that double ducts are specifically designed for those situations where an outside unit (essential to split package units) can not be installed. For houses in which other types of air conditioners can not be used double ducts are the only choise. Because of this constraint (no outside unit or large heat exchanger areas exposed on the facade of the building) means that the double duct can not be as efficient, silent and cheap as split packages. If double duct units where to be regulated under the same efficiency method as split packages, none of the existing appliances would remain on the market.

5. Separate labels for different types of air conditioners have not proven to distort the market. The largest growth is seen and expected for split packages. Single ducts and especially double ducts appear to remain a niche market with relatively constant sales, despite of the increased sales of air conditioner in general. Therefore the existence of separate labels has not distorted the sales nor is it expected to do so in the future. However, it is suggested that the relative market shares of these appliances be re-looked at the revision of the measure.

Consequently, the impact assessment identifies efficiency classes as follows:

Energy labelling classes for air conditioners, excluding single and double ducts

Energy Efficiency Class	**Air conditioners below 12kW, excluding single and double ducts**	
	SEER	**SCOP**
A+++	7.00	5,10
A++	> 6.10	> 4.60
A+	> 5.60	> 4.00
A	> 5.10	> 3.40
B	> 4.60	> 3.10
C	> 4.10	> 2.80
D	> 3.60	> 2.50
E	> 3.10	> 2.20
F	≥ 2.60	≥ 1.90
G		

A+, A++ and A+++ classes to be indicated 2, 4 and 6 years after the coming into force of the labelling requirements.

Energy labelling classes for double and single ducts

Energy Efficiency Class	**Double ducts**		**Single ducts**	
	EER	COP	EER	COP
A+++	4.10	4.60	4.10	3.60
A++	3.60	4.10	3.60	3.10

A+	3.10	3.60	3.10	2.60
A	2.60	3.10	2.60	2.30
B	2.40	2.60	2.40	2.00
C	2.10	2.40	2.10	1.80
D	1.80	2.00	1.80	1.60
E	1.60	1.80	1.60	1.40
F	1.40	1.60	1.40	1.20
G	< 1.40	< 1.60	< 1.40	< 1.20

Labelling of sound power levels

As shown in the Annex, the sound power range for the most popular split is between 45 to 60dB(A) for the indoor unit (the most extreme outliers neglected). The difference is some 15dB(A) which could be divided in some 7 classes, giving an shift of some 2 dB(A) per class. The shift would thus be 3% - 4% of the total value. According to EN14511-3, air flow is measured assuming a tolerance of +/- 5%.

Outdoor levels rarely exceed 65dB(A) sound power and could be labelled in similar fashion.

It should be remembered that air conditioners produce the highest sound levels at the hottest moments of the day (normally in the afternoon). During night-time, appliances operate at considerably lower capacity levels, with correspondingly reduced sound power levels.

As tolerances are set in the measurement standard at -2dB(A), the width of the labelling classes must be more than 3dB(A), which leads to proposal as shown in below tables.

Tables on possible sound power labelling levels for small and large appliances

(I/U = indoor unit, O/U = outdoor unit)

	A/C ≤ 6kW			
	I/U		O/U	
A	42	0	47	0
B	45	1	50	0
C	48	1	53	0
D	51	3	56	0
E	54	12	59	1
F	57	24	62	61
G	60	15	65	0
fail		7		1
TOTAL		63		63

	6kW > A/C ≤ 12kW			
	I/U		O/U	
A	42	0	47	0
B	45	0	50	0
C	48	13	53	0
D	51	31	56	8
E	54	30	59	20
F	57	23	62	68
G	60	6	65	9
fail		0		0
TOTAL		103		105

Annex 7 – Calculation and measurement method

General methodology

The methodology for measuring energy efficiency of split, wall and window units (above 90% of appliances) is based on seasonal energy efficiency ratio (SEER) for cooling and seasonal coefficient of performance (SCOP) for heating. For these purposes, a new measurement standard (prEN14825) has/is been developed. Additionally, a transitory calculation method has been developed in collaboration with stakeholders. This will ensure that the measured and indicated efficiency of the appliance more closely correspond with real use conditions.

For double and single duct units that do not use inverters, a steady state measurement (EER and COP) is used: EN14511:2004. For single ducts the possibility to establish EER values for units with evaporatoratively cooled condensers will be included into the standard through a Commission mandate with reference to EN15218:2007.

The sound intensity values are to be measured in agreement with EN12102.

Verification procedure for market surveillances purposes

This proposal includes, in line with the preparatory study a reduction of the tolerance for appliances tested in seasonal efficiency from 15% to 8%. These values have been selected taking into account that a revised seasonal energy efficiency standard is close to be voted. A further reduction in the allowed tolerance is deemed not appropriate without having collected experience of the actual measurement activities. The issue of tolerances can be reconsidered at the revision of the foreseen measures.

Annual electricity consumption

A number of stakeholders have asked for the inclusion of the 'annual electricity consumption' of air conditioners on the energy label, as it is used in the current energy label (2002/31/EC), and the inclusion of this information in the ecodesign information requirements. Other stakeholders see this information possibly misleading, as the declared energy consumption will always be different from the real-life consumption. Stakeholders in favour of the inclusion of this information into the label find that consumers are well aware of the difference between stated and real energy consumption and that this difference has not been a problem in the context of other labelled products. These stakeholders consider that this information can help consumers to give attention also to the absolute energy consumption.

Annual electricity consumption can consist of electricity consumption for cooling (season), for heating or for both, which needs to be reflected in the label (e.g. to allow comparison of consumption between reversible and mono-functional units).

Appliances for which SEER and SCOP values are measured, the calculation of annual electricity consumption is part of the measured efficiency and also includes part load performance and low power modes. The approach has been approved during the preparatory study and can be used for the draft Regulation.

Appliances for which the energy efficiency is established on the basis of EER and COP, the calculation method as defined in 2002/31/EC (electricity consumption = electric input power

* equivalent hours in on-mode, to which low power mode energy consumption is added). The method gives the same results as multiplying the cooling power output by the equivalent hours in on-mode and dividing the result by an approximation of SEERon (constructed on the basis of EER), which in essence is the same approach as applied in SEER/SCOP calculation (when a conversion from EER to SEERon equals '1'). Low power mode energy consumption should be added. The method used under 2002/31/EC uses 500 hrs as equivalent on-mode hours. A working group of experts contributing to the preparatory study and the Commission working documents proposed as equivalent on-mode hours 350 hrs, which is closer to typical equivalent on-mode hours than that calculated in the preparatory study (to be described in prEN14825 in detail).

The advantage of this approach is that the equivalent on-mode hrs * Pdesign is easy to calculate. The disadvantage is that the savings of more efficient appliances (higher EER values) do not show through lower annual consumption.

Given that the approach has been implemented under the Directive 2002/31/EC and under the preparatory study it is proposed that the method is also applied under the delegated Regulation. However, due to the disadvantage of the method, it is suggested that the method be rethought at the revision of the measure.

Annex 8 – International comparison

With a calculated stock of some 40 mio units and approximately 450 million inhabitants, the EU diffusion of these air conditioners is 40/450 = 9%. In 2030, the stock is expected to have risen to 117 mio units. As the population remains fairly constant at 460 mio inhabitants, the expected diffusion will be around 25%. For households alone, the diffusion is most likely some 39 million units (1/3 of 117 million) for some 210 million households, which gives 19%.

Even with this spectacular growth (stock almost triples in 25 years), the EU air conditioner diffusion is still limited when compared to the major markets EU and Japan, that show household diffusion rates of over 80%.

Table 1: Air-conditioners possessed per 100 households

Countries	1999	2000	2001	2002	2003	2004
Japan	84.14	85.59	87.11	88.30	89.94	91.32
New Zealand	74.77	76.60	77.59	78.29	78.85	79.56
Taiwan	72.09	72.36	72.65	72.79	73.00	73.16
Hong Kong	67.32	67.57	67.79	68.02	68.74	69.15
Australia	63.55	64.53	65.55	66.31	67.46	68.39
Singapore	55.16	55.39	55.66	55.89	56.16	56.44
South Korea	51.85	51.63	51.43	51.67	51.98	52.26
Malaysia	45.02	45.19	45.29	45.38	45.47	45.56
Thailand	23.51	23.88	24.21	24.46	24.84	25.20
Philippines	3.46	3.69	3.88	4.11	4.33	4.54
Indonesia	1.89	2.03	2.12	2.26	2.35	2.48
India	0.37	0.38	0.40	0.49	0.52	0.59
China	0.28	0.27	0.27	0.29	0.34	0.32
Vietnam	0.17	0.21	0.17	0.19	0.19	0.23

Source: Euromonitor International

Requirements on efficiency

The Figure below gives an overview of countries where MEPS are applicable and some details of the requirements. EU is one of the few markets among the world's major air conditioner markets without minimum efficiency requirements (see below tables).

The requirements set in other markets are based on different measurement and calculation methods, which make direct comparison of requirements difficult. However, the preparatory study provides some examples of comparison on the basis of EER. The proposed EU requirements for SEER of 3.6 and 4.3 roughly compare to an EER of 2.8 and 3.4. These levels put the EU close to the USA requirements and slightly below the Japanese minimum requirements (not shown in graph, but discussed further below. In the graphs, Japanese 2005 requirements are indicated).

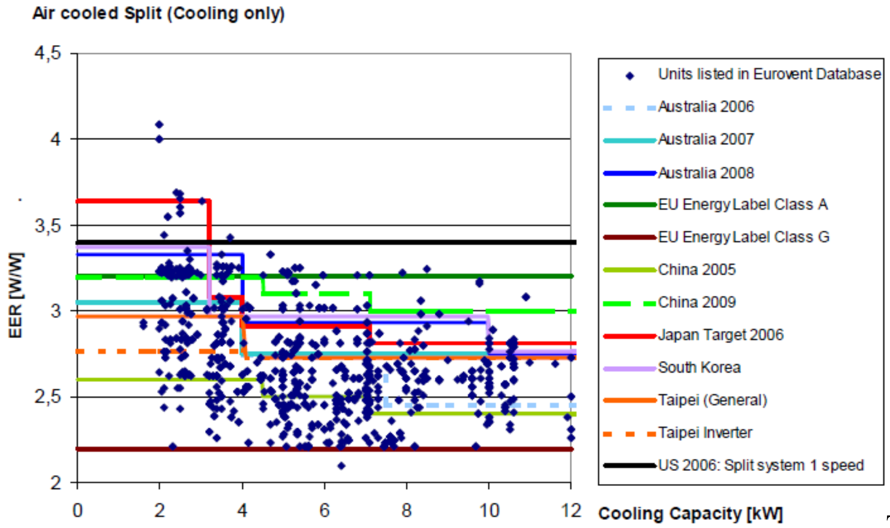
Tables on comparing minimum requirements

	Split units	**packaged (window/wall)**
USA	SEER 3.8	EER 2.49-2.84
Canada	SEER 3.8	SEER 3.2-3.5
Australia	EER/COP 2.75-2.93-3.33	EER 2.84
Japan	cooling EER 2.81 - 2.91 - 3.08 - 3.64	cooling EER 2.67

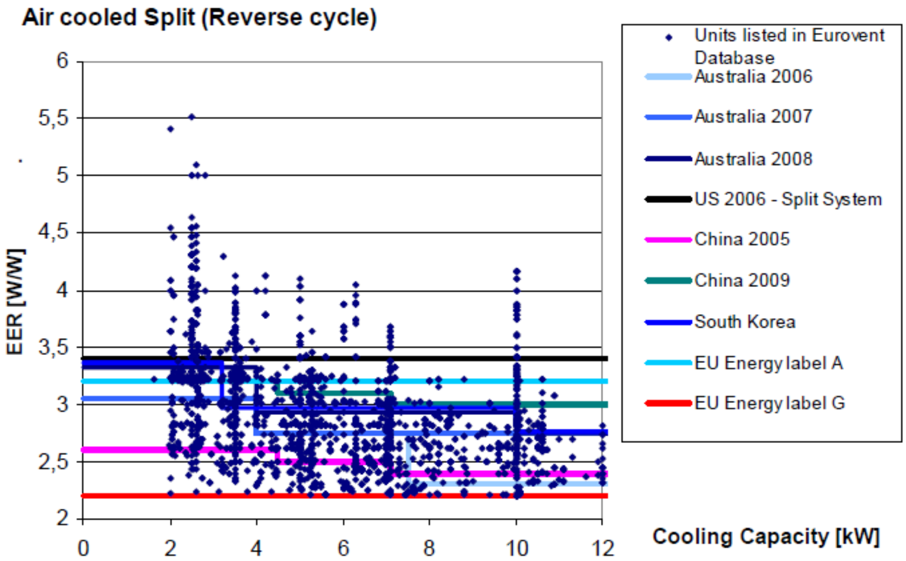
	heat pump: EER 3.1-3.17-3.65-4.90-5.27	heat pump EER 2.85
S-Korea	EER 2.76-2.97-3.37	EER 2.88
China	EER 2.4-2.5-2.6	EER 2.30

Region or country	Stand-by	Cooling MEPS	Heating MEPS	Tolerances	Specificity of rating
Australia	Yes (Considered for legislation)	Y	N	10 % EER	Full load
China	No	Y	Y	N/A	Full load
Japan	Yes (0-4 kW) 1 W voluntary agreement	Y	Y	20 % EER and (EER+COP)/2 15 % on the APF (annual performance factor)[3]	Moving to seasonal perf
South Korea	Yes (0-4 kW) 1 W voluntary agreement	Y	N	20 % EER N/A for seasonal performances	Moving to seasonal perf
USA	No	Y	Y	0 %	Seasonal perf
EC	No	N	N	15 % EER & COP	Full load

The figure below shows the levels of international minimum efficiency requirements applicable to cooling-only split package air conditioners.



The figure below shows the levels of minimum energy efficiency requirements in slected countries applicable to reversible split package air conditioners.



The figure below gives an overview of the best performing products in the EU and Japan, for HSPF (a variant of SCOP) and SEER.

The graphs show that most of the European market EER declared products would not comply with legislation in third countries. To illustrate the gap, Korean of Japanese requirements for cooling only split air conditioners would remove more than 90% of the Eurovent database products. Only the very best products present in the EU database of Eurovent would meet the minimum standards in these countries.

The minimum requirements in Japan for small air conditioners (strictly speaking not mandatory, since "top runner" approach is voluntary) are close to SEER-level of 6.8. These requirements are however not combined with requirements on noise. The Japanes Top-Runner heat pumps (small capacity) are beyond SCOP 4.6.

Another difference between the EU requirements and the requirements in third countries is that third markets do not set requirements on single and double duct units, which are rare in these markets. On the other hand, window and wall unit are dominant in many other markets but rare in the EU.

Requirements on sound power level

The preparatory study and the stakeholders consulted during the Impact Assessment did not identify maximum sound power requirements (noise levels) in third countries. The EU will be the first market to combine the measures on energy efficiency and noise.

Several stakeholders have pointed out that there is a technical relationship between energy efficiency and noise (higher efficiency would result in higher noise levels).

Although this relationship could not be proven with the available data, manufacturers claim that they must take measures not to increase noise levels while increasing energy efficiency. This is one of the reasons of not aiming at highest possible efficiency and lowest existing sound power levels. There is no third country experience to guide in this work. Additionally, the EU seasonal energy efficiency calculation and measurement method is completely new until sufficient number of appliances has been tested.

Low-GWP refrigerants

No third country has provided incentives for the use of low-GWP refrigerants. Technically there is no constraint for using low-GWP refrigerants in air conditioners within the scope of this impact assessment report. However, hydrocarbons are reluctantly applied because of their flammable properties. HFO's are so new that actual applications in air conditioners do not yet exist. Also, application of Carbon dioxide as refrigerant is limited to one experimental set-up only.

Therefore the proposed measures do not aim at forbidding the use of common refrigerants but instead aim at promoting the use of alternative refrigerants by making the application more attractive in lowering the energy efficiency requirements. The level for the bonus is defined so that effects on the total GHG emissions are inexistent or insignificant.

Annex 9 – Summary tables on impacts

Summary tables

Sales ('000 units)	2005	2010	2015	2020	2025	2030
split packages avg. 3.5 kW	4058	3933	5954	7509	8302	8582
split packages avg. 7.1 kW	259	342	625	788	871	901
window/wall	95	82	108	113	110	103
double ducts	43	44	72	90	100	103
single ducts	284	281	431	543	599	618
TOTAL sales (mio units)	5	5	7	9	10	10
total stock (mio units)	31	49	65	82	104	117

total purchase cost	2005	2010	2015	2020	2025	2030
Baseline	7933	8077	12798	16395	18297	18932
Label_only	7933	8077	12927	16725	18788	19475
MEPS_only (12-14)	7933	8077	13870	17425	19200	19786
MEPS-11-13_Label	7933	8077	14151	18538	20962	21762
MEPS-12-14_Label	7933	8077	14004	18328	20713	21501
MEPS-13-15_Label	7933	8077	13870	18135	20485	21262

Electricity (TWh/a)	2005	2010	2015	2020	2025	2030
Baseline	30	46	60	74	88	93
Label_only	30	46	60	72	84	88
MEPS_only (12-14)	30	46	56	64	77	86
MEPS-11-13_Label	30	46	54	61	71	77
MEPS-12-14_Label	30	46	56	62	72	78
MEPS-13-15_Label	30	46	57	64	74	79
Elelctricity savings (Twh/a)	2005	2010	2015	2020	2025	2030
Baseline	0	0	0	0,0	0	0
Label_only	0	0	-1	-1,9	-3	-4
MEPS_only (12-14)	0	0	-5	-9,4	-10	-7
MEPS-11-13_Label	0	0	-6	-12,9	-16	-16
MEPS-12-14_Label	0	0	-5	-11,3	-15	-15
MEPS-13-15_Label	0	0	-3	-9,3	-14	-14
Total expenditure (bio EUR/a)	2005	2010	2015	2020	2025	2030
Baseline	14	20	31	45	61	76
Label_only	14	20	31	45	61	75
MEPS_only (12-14)	14	20	32	44	59	74
MEPS-11-13_Label	14	20	32	44	59	72
MEPS-12-14_Label	14	20	32	44	59	73
MEPS-13-15_Label	14	20	32	45	59	73
Expenditure savings (bio EUR)	2005	2010	2015	2020	2025	2030
Baseline	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Label_only	0,0%	0,0%	0,0%	0,5%	1,1%	1,7%
MEPS_only (12-14)	0,0%	0,0%	-0,7%	2,3%	3,5%	2,9%
MEPS-11-13_Label	0,0%	0,0%	-0,7%	1,8%	3,9%	5,1%
MEPS-12-14_Label	0,0%	0,0%	-1,0%	1,5%	3,7%	4,9%
MEPS-13-15_Label	0,0%	0,0%	-1,7%	1,0%	3,4%	4,6%
Avg. Purchase Price EUR/unit)	2005	2010	2015	2020	2025	2030
Baseline	732	772	818	849	867	870
Label_only	732	772	836	885	916	923
MEPS_only (12-14)	732	772	967	962	958	953

MEPS-11-13_Label	732	772	1006	1086	1134	1145
MEPS-12-14_Label	732	772	986	1062	1109	1119
MEPS-13-15_Label	732	772	967	1041	1086	1096
Purchase price increase (%)	0	0	0	0	0	0
Baseline	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Label_only	0,0%	0,0%	2,2%	4,3%	5,7%	6,1%
MEPS_only (12-14)	0,0%	0,0%	18,2%	13,4%	10,4%	9,5%
MEPS-11-13_Label	0,0%	0,0%	23,0%	27,9%	30,8%	31,6%
MEPS-12-14_Label	0,0%	0,0%	20,5%	25,2%	27,9%	28,7%
MEPS-13-15_Label	0,0%	0,0%	18,2%	22,7%	25,3%	26,0%
Total CO2 emissions (mton CO2/a)	2005	2010	2015	2020	2025	2030
Baseline	14,4	22,2	29,3	37,0	45,7	49,5
Label_only	14,4	22,2	29,1	36,3	44,4	47,9
MEPS_only (12-14)	14,4	22,2	27,7	33,9	41,9	46,2
MEPS-11-13_Label	14,4	22,2	27,2	32,7	39,8	43,2
MEPS-12-14_Label	14,4	22,2	27,7	33,2	40,2	43,5
MEPS-13-15_Label	14,4	22,2	28,3	33,7	40,6	43,9
CO2 savings	2005	2010	2015	2020	2025	2030
Baseline						
Label_only	0,0	0,0	-0,2	-0,7	-1,3	-1,6
MEPS_only (12-14)	0,0	0,0	-1,6	-3,1	-3,8	-3,3
MEPS-11-13_Label	0,0	0,0	-2,1	-4,3	-5,8	-6,3
MEPS-12-14_Label	0,0	0,0	-1,7	-3,8	-5,5	-6,0
MEPS-13-15_Label	0,0	0,0	-1,0	-3,3	-5,1	-5,6
Direct CO2eq. by refrigerants (mton CO2/a)	2005	2010	2015	2020	2025	2030
Baseline	2,2	3,5	4,9	6,6	8,5	9,4
Label_only	2,2	3,5	5,0	6,7	8,8	9,9
MEPS_only (12-14)	2,2	3,5	5,0	6,8	8,7	9,4
MEPS-11-13_Label	2,2	3,5	5,0	7,0	9,3	10,5
MEPS-12-14_Label	2,2	3,5	5,0	6,9	9,2	10,3
MEPS-13-15_Label	2,2	3,5	4,9	6,8	9,0	10,2
Direct CO2 savings mton CO2)	2005	2010	2015	2020	2025	2030
Baseline						
Label_only	0,0%	0,0%	-0,7%	-2,2%	-3,9%	-4,9%
MEPS_only (12-14)	0,0%	0,0%	-1,7%	-3,1%	-2,6%	0,1%
MEPS-11-13_Label	0,0%	0,0%	-2,1%	-6,3%	-10,4%	-11,0%
MEPS-12-14_Label	0,0%	0,0%	-1,8%	-5,4%	-8,8%	-9,5%
MEPS-13-15_Label	0,0%	0,0%	0,0%	-3,1%	-6,6%	-8,1%
Job creation ('000)	2005	2010	2015	2020	2025	2030
Baseline	49,6	51,7	84,1	109,7	123,7	128,2
Label_only	49,6	51,7	85,9	114,4	130,8	136,0
MEPS_only (12-14)	38,2	51,7	99,4	124,4	136,7	140,4
MEPS-11-13_Label	49,6	51,7	103,4	140,3	161,8	168,6
MEPS-12-14_Label	49,6	51,7	101,3	137,3	158,3	164,9
MEPS-13-15_Label	49,6	51,7	99,4	134,6	155,0	161,5
Extra jobs ('000)	0	0	0	0	0	0
Baseline	0,0	0,0	0,0	0,0	0,0	0,0
Label_only	0,0	0,0	1,8	4,7	7,0	7,8

MEPS_only (12-14)	-11,4	0,0	15,3	14,7	12,9	12,2
MEPS-11-13_Label	0,0	0,0	19,3	30,6	38,1	40,5
MEPS-12-14_Label	0,0	0,0	17,2	27,6	34,5	36,7
MEPS-13-15_Label	0,0	0,0	15,3	24,9	31,3	33,3
Turnover of industry+retail (not electricity) (mio)	2005	2010	2015	2020	2025	2030
Baseline	6319	6584	10714	13981	15771	16338
Label_only	6319	6584	10949	14581	16666	17328
MEPS_only (12-14)	6319	6584	12668	15857	17416	17894
MEPS-11-13_Label	6319	6584	13180	17885	20625	21493
MEPS-12-14_Label	6319	6584	12913	17502	20172	21019
MEPS-13-15_Label	6319	6584	12668	17150	19756	20582
Extra turnover (mio)	0	0	0	0	0	0
Baseline	6269	6532	10630	13871	15647	16209
Label_only	6269	6532	10865	14471	16542	17200
MEPS_only (12-14)	6269	6532	12584	15747	17292	17766
MEPS-11-13_Label	6269	6532	13096	17776	20502	21365
MEPS-12-14_Label	6269	6532	12828	17392	20049	20890
MEPS-13-15_Label	6269	6532	12584	17040	19633	20454
split eff. (SEER)	2005	2010	2015	2020	2025	2030
Baseline	3,15	3,61	3,97	4,22	4,37	4,41
Label_only	3,15	3,61	4,10	4,45	4,65	4,70
MEPS_only (12-14)	3,15	3,61	4,80	4,80	4,80	4,80
MEPS-11-13_Label	3,15	3,61	4,98	5,32	5,52	5,58
MEPS-12-14_Label	3,15	3,61	4,89	5,23	5,43	5,49
MEPS-13-15_Label	3,15	3,61	4,80	5,15	5,35	5,40
DD eff. (EER)	2005	2010	2015	2020	2025	2030
Baseline	2,15	2,22	2,29	2,36	2,43	2,50
Label_only	2,15	2,22	2,43	2,58	2,67	2,70
MEPS_only (12-14)	2,15	2,22	2,70	2,70	2,70	2,70
MEPS-11-13_Label	2,15	2,22	2,73	2,88	2,97	2,99
MEPS-12-14_Label	2,15	2,22	2,74	2,89	2,98	3,00
MEPS-13-15_Label	2,15	2,22	2,70	2,85	2,94	2,96
SD eff. (EER)	2005	2010	2015	2020	2025	2030
Baseline	2,15	2,33	2,46	2,56	2,61	2,63
Label_only	2,15	2,33	2,51	2,65	2,72	2,74
MEPS_only (12-14)	2,15	2,33	2,70	2,70	2,70	2,70
MEPS-11-13_Label	2,15	2,33	2,76	2,87	2,93	2,95
MEPS-12-14_Label	2,15	2,33	2,73	2,84	2,90	2,92
MEPS-13-15_Label	2,15	2,33	2,70	2,81	2,88	2,89

Share of direct emissions	2005	2010	2015	2020	2025	2030
Baseline	24%	22%	21%	21%	21%	23%
Label_only	24%	22%	21%	22%	23%	24%
MEPS_only (12-14)	23%	22%	22%	23%	24%	24%
MEPS-11-13_Label	24%	22%	23%	25%	27%	29%
MEPS-12-14_Label	23%	22%	22%	24%	26%	28%
MEPS-13-15_Label	24%	22%	22%	23%	26%	28%

Share of AC categories in sales	2005	2010	2015	2020	2025	2030
split packages avg. 3.5 kW	86%	84%	83%	83%	83%	83%
split packages avg. 7.1 kW	5%	7%	9%	9%	9%	9%
window/wall	2%	2%	2%	1%	1%	1%
double ducts	1%	1%	1%	1%	1%	1%
single ducts	6%	6%	6%	6%	6%	6%

The assumed electricity price is based on the electricity price used in the preparatory study for the EU 27 = 0,136 Eur/kWh.