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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Commission Regulation implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for air heating products, cooling products and high temperature process chillers

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Contents

This report commits only the Commission's services involved in its preparation and does not prejudge the final form of any decision to be taken by the Commission.

1. INTRODUCTION

Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the setting of ecodesign requirements for energy-related products[1] provides a framework for the Commission, assisted by a regulatory committee to set Ecodesign requirements for energy-related products.

An energy-related product, or a group of energy-related products, shall be covered by Ecodesign implementing measures, or by self-regulation (cf. criteria in Article 17), if the energy-related product represents significant sales volumes, while having a significant environmental impact and significant improvement potential (Article 15). The structure and content of an Ecodesign implementing measure shall follow the provisions of the Ecodesign Directive (Annex VII).

This study assesses the impacts of different policy options, in the context of the Ecodesign Directive 2009/125/EC for air heating products, cooling products and high temperature process chillers[2].

Air heating products have been analysed in two different preparatory studies: the preparatory study on "ENER Lot 21 – Central heating products that use hot air to distribute heat" which covered all air heating products covered by the proposal, and the preparatory study on "ENER Lot 20 – Local Room Heating Products" which covered 'warm air heaters' that are not ducted.

The studies showed that certain warm air heaters allow installation as either local space heater or as ducted heater, depending on the preferences of the user and installation requirements. In order to avoid confusion, it was decided to treat warm air heaters, for central or local heating in a similar manner.

Cooling products and terminal equipment (fan coils) have been analysed in the preparatory study "ENTR Lot 6 - Air-conditioning and ventilation systems".

High temperature process chillers have been analysed in the preparatory study "ENTR Lot 1 - Refrigerating and freezing equipment" and a supplementary analysis for specifically high temperature process chillers and condensing units carried out in the frame of the development of the impact assessment analysing the impact of proposed ecodesign measures for process chillers.

The above mentioned studies concluded that these products comply with the criteria in Art. 15, sub 1, of the Ecodesign Directive and are therefore a candidate for measures under this Directive.

The scope of this report therefore includes air heating products, i.e. space heating devices that convert electric, gaseous or liquid energy carriers[3] into heat which is then distributed to the

1 OJ L 285, 31.10.2009, p. 10.
2 See definition of the product group in Section 2
3 Products using solid fuels are excluded from the scope

final place of use[4] by mains of an air-based heating system in order to provide heating comfort, cooling products that provide in space cooling and high temperature process chillers that provide in cooling power for certain high temperature process applications and terminal equipment such as fan coils.

The proposed initiative complements existing measures for space heating products covered by Regulation 813/2013 with regard to ecodesign requirements for space heaters and combination heaters[5] and cooling products covered by Regulation 206/2012 with regard to ecodesign requirements for air conditioners and comfort fans[6], and other initiatives covering space heating products using solid fuels, local space heaters, or other process chillers.

2. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

2.1. Organisation and timing

The implementing measure for air heating products, cooling products and high temperature process chillers is one of the priorities of the Action Plan on Energy Efficiency[7], and the Energy Efficiency Plan 2011[8] . The legal basis for the implementing measures is Article 114 TFEU[9] (internal market).

The inter-service Impact Assessment Steering Committee[10] was consulted on this impact assessment. The present impact assessment takes into account the recommendations formulated by the Impact Assessment Board on 19 February 2014 which stressed the importance of providing relevant information regarding the feasibility of implementing the proposed options and inquired about the compliance costs of the different options.

Article 19 of the Directive 2009/125/EC foresees a regulatory procedure with scrutiny for the adoption of implementing measures. Subject to qualified majority support in the regulatory committee and after scrutiny of the European Parliament and of the Council, the adoption of the measure by the Commission is planned by end of 2014.

2.2. Consultation and expertise

External expertise on air heating and cooling products was gathered in particular in the framework of in total four studies providing the technical, environmental and economic analysis (in the following called "preparatory study") carried out by external consultants on behalf of the Commission's Directorate General for Energy (DG ENER):

- ENER Lot 20 – Local Room Heating Products;

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4 This definition does not apply to warm air heaters that are not ducted. They are nonetheless included in the scope and a more adequate definition has been provided in Section 2.

5 OJ L 239, 6.9.2013, p. 136.

6 OJ L 72, 10.3.2012, p. 7.

7 COM(2006)545 final. Priority Action 1: Appliance and equipment labelling and minimum energy performance standards

8. COM(2011)109 final. Energy Efficiency Plan 2011, Brussels, 8.3.2011.

9 Treaty on the European Communities (TEC) was replaced by the Treaty on the functioning of the European Union (TFEU) which entered into force on 1st December 2009 (content of Article 95 TEC was moved to Article 114 TFEU).

10 Chaired by DG Energy. Other Commission Directorates General who were part of this group included Secretariat-General, DG Climate Action, DG Communication Networks, Content and Technology, DG Competition, DG Employment, DG Enterprise and Industry, DG Environment, DG Health and Consumers, DG Market, DG Trade and the Joint Research Centre.

- ENER Lot 21 – Central heating products that use hot air to distribute heat;
- ENTR Lot 1 - Refrigerating and freezing equipment;
- ENTR Lot 6 - Air-conditioning and ventilation systems.

The preparatory studies followed the structure of the "MEEuP" Ecodesign methodology[11] developed for the Commission's Directorate General for Enterprise and Industry (DG ENTR) and endorsed by stakeholders.

The purpose of the preparatory studies was to perform a technical, environmental and economic analysis for the products in order to assess options for improving their environmental performance, within the framework of the Ecodesign Directive and the Energy Labelling Directive.

The preparatory studies were developed in an open process, taking into account input from relevant stakeholders including manufacturers and their associations, environmental NGOs, consumer organisations and EU Member State experts. All studies provided dedicated websites where interim results and further relevant materials were published regularly for timely stakeholder consultation and input. The study websites were promoted on the Ecodesign-specific websites of DG ENER and DG ENTR.

In the context of the ENER Lot 20 study, open consultation meetings for directly affected stakeholders were organised at the Commission's premises in Brussels on 18 April 2011, 28 September 2011 and 16 April 2012 for discussing and validating the preliminary results of the studies.

In the context of the ENER Lot 21 study, stakeholder meetings were organised at the Commission's premises in Brussels on 19 April 2011, 27 September 2011 and 17 April 2012.

In the context of the ENTR Lot 1 study, stakeholder meetings were organised at the Commission's premises in Brussels on 15 July 2009, 4 June 2010 and 5 October 2010

In the context of the ENTR Lot 6 study stakeholder meetings were organised at the Commission's premises in Brussels on 5 July 2010, 30 September 2011 and 16 April 2012.

Building on the results of the preparatory studies, the Commission services presented a Working Document suggesting ecodesign requirements based on scenarios developed under the preparatory studies. The products were discussed in the formal consultation of stakeholders (Ecodesign Consultation Forum, consisting of a balanced participation of Member States' representatives and all interested parties concerned with the product group of local room heating products, further to Article 18 of the 2009/125/EC Directive) on 25 September 2013.

The working documents were circulated duly before the meetings to the members of the Ecodesign 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 documents were included in the Commission's CIRCA system alongside the stakeholder comments received in writing before

[11] "Methodology for the Ecodesign of Energy Using Products", Methodology Report, final of 28 November 2005, VHK.

and after the Consultation Forum meeting. Minutes of the Consultation Forum meetings can be found in Annex I.

Internal consultation was carried out following that and all relevant Commission services (ENER, ENTR, ENV, CNECT, SANCO, CLIMA, COMP, SG, and TRADE) were consulted on this draft Impact Assessment.

Results of stakeholder consultation

The stakeholder consultation on the basis of the Working Documents discussed on 25 September 2013, showed that Member States were in general supporting the introduction of ecodesign requirements. However, regarding noise requirements some Member States stated that this could better be handled at local or state level.

Environmental NGO's and consumer associations supported the introduction of ecodesign requirements for these products, but asked for more stringent requirements to be considered.

Industry associations were in general supportive of the idea of introducing ecodesign requirements, but could not accept the level of (most of) the proposed energy efficiency requirements. They opposed noise requirements as these were considered to be counter productive to the objective of realising energy savings and some products should be placed outside the scope.

In the period following the meeting, the Commission Services have studied the comments and has tried to accommodate the various concerns in its proposals or, through bilateral meetings and additional analysis, has tried to reach compromise solutions. These alternative approaches are reflected in the policy options presented under Section 5.

3. PROBLEM DEFINITION

3.1. What is the issue or problem that may require action?

The use of air heating and cooling products and high temperature process chillers results in significant and growing energy consumption in the EU-28. This increase in energy consumption does not contribute to EU objectives known as the 20-20-20 objectives for a 20% reduction in EU greenhouse gas emissions from 1990 levels; a 20% improvement in the EU's energy efficiency and raising the share of EU energy consumption produced from renewable resources to 20% by 2020.

Air heating products and cooling products and high temperature process chillers that rely on a vapour compression cycle using refrigerants may also contribute to greenhouse gas emissions through direct emissions of refrigerants that are potent greenhouse gases, such as various hydro-fluorocarbons (HFC's). Although the production and use of such substances is also the subject of the (currently to be revised) F-Gas Directive, the preparatory studies ENER Lot 21 and ENTR Lot 6 identified the emissions of such substances to be relevant.

Gaseous or liquid fuel fired products affect EU air quality as they emit nitrogen oxides (NO_x). Although the installed base of gaseous and liquid fuel fired warm air heaters is in decline, contrary to rising sales of the other products within scope, the emissions are nonetheless considered significant.

An improvement in energy efficiency of and a reduction of emissions to air by these products, would increase the security of supply of energy sources and would help abating emissions of greenhouse gases. The preparatory studies have provided evidence that these goals can be met at lower societal costs than currently experienced. The products can therefore be improved so that, when placed on the market, they will result in lower energy consumption, emissions and costs.

Furthermore preparatory studies suggested to reduce the sound power levels of air heating and cooling products, in particular those using a vapour compression cycle, plus terminal equipment (such as fan coil units).

3.2. What are the underlying drivers of the problem?

The market for air conditioners, comfort and process chillers and warm air heaters appears to be driven primarily by purchase price. This happens despite the fact that cost-effective energy-saving technologies are available and that the majority of products are bought by professionals who might have higher expertise than the average consumer, and could therefore be better placed to correctly value the trade-offs between purchase price and cost of use. There are multiple reasons behind this situation.

3.2.1. Regulatory failure

Currently, there is no EU legislation specifically dealing with the energy consumption and the emissions of air heating products or cooling products and high temperature process chillers. This may lead to a situation where individual Member States address environmental parameters of air heating products or cooling products and high temperature process chillers through national measures which could cause internal market related problems due to regulatory fragmentation.

3.2.2. Negative externality[12]

There is also a lack of a common interest to reduce energy consumption and related emissions like greenhouse gases or nitrogen oxides, because emitting these substances to the ambient is free of charge for most applications. This situation is fostered by the fact that external costs (e.g. health costs) are not included in the electricity or fuel prices or other operation costs or purchase cost of products. And as most customer and producer choices are commonly made on the basis of the purchase costs, the fact that these are not reflecting environmental or health costs for the society does not give the right incentives for product improvements. This effect applies to products using fuels (gaseous or liquid) as well as electricity (as part of the electricity consumed in the EU is generated by power plants using fossil fuels).

Further detail on negative externality in this context is provided in the impact assessment accompanying the Commission proposal for the Ecodesign Directive.[13]

3.2.3. Asymmetric information and myopia

The market analysis shows the sales of low efficiency air heating products, cooling products and high temperature process chillers are expected to persist, even if business clients should be aware of the fact that purchase of more costly equipment could result in lower overall life

[12] Side effect or consequence of an industrial or commercial activity that affects other parties without this being reflected in the cost of the goods or services involved.

[13] SEC(2008)2115

cycle costs. Instead, most buyers base their choice rather on purchase price only and on other factors like availability, service or installation requirements / conditions. Few people realise that energy costs are commonly the major part of total life cycle cost (65% of total costs in 2010).

There may be multiple reasons for purchase decisions not being based on optimal life cycle costs of products (which include purchase, installation, operation and maintenance). This behaviour, the decision to invest in equipment that is ultimately more costly, is referred to 'bounded rationality' and 'myopia'.

One reason may be that for many users the electricity bill represents a small percentage of their total costs, so that they have little incentive to focus on them. Electricity prices vary considerably across the EU Member States and therefore the life cycle costs will be different as well. If a business needs a commercial loan for acquisition of equipment, the lifecycle costs are also influenced. Nonetheless the preparatory study showed that the conclusions on which technology leads to least life cycle cost are fairly robust.

Additionally, business decisions can be completely rational and still result in purchase of equipment with higher life cycle costs, in the case this decision is weighted against other business investment decisions which have a more profitable return of investment (ROI) rate; For many business investments the required ROI is usually of 3 to 5 years, whereas the LCC calculations within the context of Ecodesign measures are based upon a technical product life, (e.g. 15-20 years) which means they may take longer to recuperate their costs.

As information asymmetries may play a role in such decisions, this puts emphasis on the level of simplicity to understand the information and to realise its value in relation to purchaser preferences in comparison with other (similar) products or investment opportunities. Most buyers need to invest a great deal of time and effort to acquire the information necessary to compare the energy performance of different products, since there is no easily usable performance information to do so, and the declared energy performance is expressed in a metric that does not reflect performance in real use with varying ambient temperatures and loading patterns.

The impact assessment accompanying the Commission proposal for the Energy Labelling Directive gives further details on bounded rationality, asymmetric information and myopia.[14]

3.2.4. Other barriers

Split incentives may be another reason that the efficiency of heating and cooling products within scope is not cost optimal as in many cases the purchaser or owner of the equipment is not the user or person responsible for paying the energy bill. The existence of such split incentives is commonly referred to in the economic literature as the principal-agent problem.

In addition, there are issues regarding the correct installation and use of air heating products, cooling products and high temperature process chillers that cannot be addressed by an Ecodesign implementing measure. In particular, these problems refer to the identification of the optimal heating or cooling system for a specific site or building. The consideration of such 'system level' aspects go beyond the mere improvement of the product itself and are deemed to be addressed under Directive 2010/31/EC regarding the energy performance of buildings.

[14] SEC(2008)2862

As regards the use of F-gases, most products that rely on such gases for proper operation still use these as they allow such products to attain the highest energy efficiencies, with the least additional problems related to the flammable (hydrocarbons and HFO's) or poisonous (ammonia) nature of alternative gases.

3.3. What is the scale of the problem?

As required by Article 15 of the Ecodesign Directive, the preparatory studies identified the relevant environmental aspects of air heating products, cooling products and high temperature process chillers. The assessment showed that of the total product lifecycle, the emissions are dominated by the use phase (typically 95% of impacts related to use phase, depending on impact category). Responsible for these impacts are energy consumption and emissions during use.

Some environmental impact categories are dominated by impacts that occur during the production phase, and can be related to the use of (stainless) steel and other metals or processes. As a significant share of products are produced outside the EU these latter emissions do not always occur within EU borders.

The combined total energy consumption related to the use of air conditioners and heat pumps is estimated to be 627 PJ in the year 2010. The energy consumption of air conditioners and heat pumps therefore makes up 1% of the total EU energy consumption in 2010 of 50 000 PJ[15] and 2% of EU electricity consumption of 2780 TWh/yr.

The combined total energy consumption related to the use of comfort chillers is estimated in the combined preparatory studies to be 285 PJ in the year 2010. The energy consumption of comfort chillers therefore makes up almost 1% of the total EU electricity consumption in 2010.

The combined total energy consumption related to the use of high temperature process chillers is estimated in the combined preparatory studies to be 867 PJ in the year 2010. The energy consumption of high temperature process chillers therefore makes up 3% of the total EU electricity consumption in 2010.

The gas-fired and electric warm air heaters are estimated to have a total energy consumption of 697 PJ in year 2010, representing almost 3% of the total electricity consumption in 2010.

Furthermore, gaseous and liquid fuel fired products (mainly warm air heating products) release acidifying emissions of NO_x (oxides of nitrogen) with a total of 36 kton/yr (in kton SOx equivalent) in 2010. Allthough total NOx emission levels of the products in scope are falling due to a decrease in sales of (gas fired) warm air heaters, unnecessary emissions still take place.

Many of the products within scope also emit noise during use, which can be both indoor noise or outdoor noise. These emissions could not be quantified.

[15] The 50 000 PJ was calculated on the basis of the data provided in the MEErP Part 1 report (November 2011), which calculated for 2010 some 2780 TWh electricity consumption (equals 25 000 PJ primary energy) and 24 720 PJ fuel energy consumption.

3.4. Who is affected, in what ways and to what extent?

Every user of air heating products, cooling products or high temperature process chillers will carry the energy costs related to the use of these products. Promoting the use of more energy efficient products is expected to reduce overall running costs.

The energy consumption of air heating products, cooling products and high temperature process chillers makes the EU economy more prone to issues related to security of supply, because of the economies' dependence on (fossil) fuel imports. Promoting the use of more energy efficient products will reduce the EU's dependency on (fossil) fuels.

The energy consumption of fuel fired (and indirectly also electric) air heating products, cooling products and high temperature process chillers and the fugitive emissions of refrigerants is linked to emissions of greenhouse gases which are (to a large degree) responsible for global climate change. Promoting the use of more energy efficient products, possibly with less climate-warming refrigerants, will reduce the EU's contribution to climate change.

The energy consumption of fuel fired air heating products and cooling products is linked to emissions of polluting substances, especially nitrogen oxides, which cause (among others) acidification. The measures discussed will contribute to improved air quality in Europe.

3.5. How are existing policies and legislation affecting the issue?

At the moment a few Member States (e.g. United Kingdom, France) address these issues through legislation but their national approaches are not harmonised and apply to a selection of the products in scope, hampering the internal market for these products.

As the products are part of building installations they affect the overall energy performance of buildings. The Energy Efficiency Directive 2012/27/EU[16] (EED) and the Energy Performance of Buildings Directive 2012/27/EU[17] (EPBD) and the Construction Products Regulation No 305/2011 (CPR) [18] set requirements related to the energy performance of buildings and/or their components, but do not contain requirements as regards energy efficiency or emissions to air for these products specifically.

Regarding cooling, most countries, following the requirements of Directive 2010/31 on the energy performance of buildings[19] (EPBD), have adopted requirements for summer comfort, which includes the evaluation of the risk of overheating, limitation of the cooling needs by improving the building envelope and a calculation methodology for cooling requirements. However, only a few Member States have introduced explicit requirements for cooling systems. The reason being that the requirements are generally set upon the total primary energy consumption of the building. Hence, cooling systems as well as other end uses of the building are constrained without individual requirements on the components of the systems.

Directive 2001/81/EC[20] of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants (NECD) and its forthcoming

16 OJ L 315, 14.11.2012, p. 1.
17 OJ L 315, 14.11.2012, p. 1.
18 OJ L 88, 4.4.2011, p. 5.
19 OJ L 153, 18.6.2010, p. 13.
20 OJ L 88, 4.4.2011, p. 5.
20 OJ L 153, 18.6.2010, p. 13.
20 OJ L 309, 27.11.2009, p. 22.

revision limit emissions of pollutants from all sources combined arising as a result of human activities in the territory of the Member States. This Directive is expected to contribute to an indirect limitation of emissions of nitrogen oxides from fuel fired air heating products and cooling products. The approach for limiting the relevant emissions from fuel fired air heating products and cooling products varies to a great extent amongst Member States. NECD is expected to contribute to a general, but unspecific reduction of emissions in the residential sector.

Directive 2009/142/EC of the European Parliament and of the Council of 30 November 2009 relating to appliances burning gaseous fuels[21] (Gas Appliance Directive, GAD) sets out essential requirements regarding the rational use of fuel (energy efficiency) and products of combustions (emissions) besides safety. These requirements are to be applied through harmonised standards. In practice this means where no specific ecodesign requirements are set, the standards harmonised under the Gas Appliance Directive may set specific requirements. Regarding certain warm air heaters specific requirements regarding efficiency have been established by harmonised standards. Sofar, these measures have not been adequate as significant savings potential remains illustrating a need for specific requirements applying to cooling products, high temperature process chillers or heat pumps.

Many air heating and cooling products in scope rely on the use of fluorinated gases to operate. The appliances need to comply with the provisions of Regulation 846/2006[22] on certain fluorinated gases (F-Gas Regulation) which has recently been reviewed. An agreed compromise proposal[23] has been achieved between the co-legislators (December 2013) and will, if confirmed by the EP plenary and the Council, regulate the maximum amount of virgin HFCs that can legally be placed on the market ("phase-down"), e.g. for filling or servicing equipment. This limitation of gas quantities available will affect all HFC-using equipment. The proposed revision includes prohibitions for placing on the market of certain types of new equipment using high GWP substances, including plug-in ("movable") room AC appliances from the year 2020 (GWP>150), and single split AC with less than 3kg of F-gases from 2025 (GWP>750). Obligations on reducing emissions during the use phase and end-of-life ("containment") have been largely maintained from Regulation 842/2006. The proposal however does not introduce a prohibition of sales of products or specific requirements for said equipment using these gases.In addition, it should be noted that several European countries have taken specific measures that are more restrictive than the current EU regulation on HFC refrigerants. By way of example, a ban on HFC for refrigeration (including air conditioning) products with a refrigerant charge above 10 kg has been in effect in Denmark since January 2007[24]. Austria has also banned the use of HFCs as refrigerants under specific conditions. Taxes on HFCs have been introduced in Denmark, and Slovakia, and are currently under discussion in Spain, France, Poland and Sweden. Fiscal incentives for climate-friendly alternatives exist in Austria, Belgium, Germany, the Netherlands, and the UK. Many Member States also have containment obligations such as certification schemes for personnel, recovery obligation, mandatory checks, record keeping etc. that in scope and requirments go beyond the EU level obligations. There are also voluntary programmes by industry, e.g. in voluntary take-back schemes at end of life (e.g. Greece, UK, Belgium).

Different alternative refrigerants with low GWP are appropriate depending on the type of equipment. In some cases there are use constraints due to flammability or toxicity that limit an

[21] OJ L 330, 16.12.2009, p. 10.
[22] OJ L 161, 14.6.2006, p. 1
[23] Brussels, 7.11.2012, COM(2012) 643 final
[24] See: http://www.hfc-fri.dk/_root/media/19348_HFC-bekendtg%F8relsen%20ENG.pdf

widespread use today, partly related also to specific safety standards in Member States. An example is France where the use of flammable or toxic or corrosive gases and liquids in public buildings is prohibited.[25] Stakeholders have also indicated Spain and Italy have similar regulations, although the precise references are not known from the studies.

Outside the EU there are minimum energy efficiency requirements applicable to various air heating products, cooling products or high temperature process chillers in the USA, Canada, Australia, China and Japan. In Annex 7 an analysis of the proposed requirements compared to third country requirements is made.

The above paragraphs show that a regulatory deficiency exists of rules covering air heating products, cooling products and high temperature process chillers, and that internal market related problems are being encountered due to regulatory fragmentation.

3.6. Baseline scenario: How will the issue evolve in absence of intervention?

The baseline assumes that current policy measures at Member State level will not change and no further action at EU level will be introduced. Thus, it assumes a continuation of existing trends regarding size, use, efficiency and specific emissions of appliances sold on the European market. To describe this development, "typical" product types and their properties have been defined in the preparatory study.

3.6.1. Scope of appliances covered

The scope of this Impact Assessment covers air heating products used for indoor space heating and cooling products used for space cooling and/or process cooling (there are products that combine both functions), using various heat sources and various heat generation or space cooling generation principles.

The generic types of products covered by this Impact Assessment are:

1) air heating products with a rated heat output up to 1 MW;

    a. electric heat pumps: split units, rooftop (packaged) units and VRF units;

    b. gas driven heat pumps;

    c. warm air heaters: fuel driven or electric;

2) cooling products with a rated cooling output up to 2 MW;

    a. electric air conditioners: split units, rooftop (packaged) units and VRF units;

    b. gas driven air conditioners;

    c. comfort chillers: water cooled and air cooled

3) high temperature process chillers.

[25] Arrêté du 25 juin 1980 portant approbation des dispositions générales du règlement de sécurité contre les risques d'incendie et de panique dans les établissements recevant du public. code de la construction et de l'habitation.

The types of air heating products to be covered are warm air heaters providing heat from a centralised or decentralised location in the building and heat pump air heaters outside the scope of Regulation 206/2012.

Cooling products covered by the proposed Regulation are comfort chillers and air conditioners outside the scope of Regulation 206/2012 and high-temperature chillers intended for industrial process cooling as these products may be similar to comfort chillers used for space cooling purposes.

Excluded from baseline and proposed scope

The scope of the proposed Regulation excludes air heating products providing heat to the room they are installed, as these are to be covered by measures developed for Local Space Heaters (LSH).

Heating products connected to a hydronic heat distribution are covered by other measures and initiatives such as Regulation 813/2013 for central heating boilers and proposals for regulations for solid fuel boilers and local space heaters.

3.6.2. Sales and stock

The sales and the resulting installed base (stock) are based on data from the preparatory studies. In some cases the consultation of stakeholders during the Impact Assessment study resulted in new information, in which case the sales and stock of products has been complemented or amended. This has been the case for gas engine driven heat pumps and for comfort and process chillers. Regarding the latter an extra segment for equipment with a capacity exceeding 400 kW has been added. More detailed information is provided in Annex 2.

Development of sales and stock assumed for this IA is shown in the following table.

Table 1: Development of sales and stock 1990 – 2030

	Units [No*1000/yr]				
	1990	**2000**	**2010**	**2020**	**2030**
Sales / units [No·1000/yr]					
Comfort chillers	26	73	105	127	152
comfort chiller, air cooled, <400 kW	21	60	88	107	129
comfort chiller, air cooled, ≥400 kW	2	5	6	7	7
comfort chiller, water cooled, < 400 kW	2	6	9	11	13
comfort chiller, water cooled, 400-1500 kW	1	1	2	2	2
comfort chiller, water cooled, ≥1500 kW	0	0	1	1	1
Electric Air conditioners & heat pumps (split, VRF and rooftop)	103	350	459	535	578
Gas Engine driven Air conditioners & heat pumps	0	0	0,75	1,2	1,7
High temp. process chillers	17	21	27	31	33
high temp. process chiller, air cooled, <350 kW	9	12	15	17	19
high temp. process chiller, air cooled, ≥350 kW	3	4	5	5	6
high temp. process chiller, water cooled <350 kW	2	3	4	4	5
high temp. process chiller, water cooled >350 -1000 kW	2	2	3	3	4
high temp. process chiller, water cooled ≥1000kW	0,1	0,2	0,2	0,3	0,3
Warm air heaters - Fuel (gas)	133	102	87	77	69
Warm air heaters - Electric	3	4	5	5	5

SALES/capacity [GW/yr]					
Comfort chillers	3	8	11	13	15
Air conditioners and heat pumps	2	8	11	12	13
High temp. process chillers	7	8	11	12	13
Warm Air Heaters	8	6	5	5	4
STOCK/units [No·1000]					
Comfort chillers	355	716	1468	2161	2616
Electric Air conditioners & heat pumps	1179	2828	5687	7312	8213
Gas Air conditioners & heat pumps	0	0	5	13	20
High temp. process chillers	192	266	340	421	473
Warm air heaters	1618	1919	1674	1407	1249
STOCK/capacity [GW]					
Comfort chillers	46	91	176	253	295
Air conditioners and heat pumps	26	63	130	171	188
High temp. process chillers	76	105	134	166	186
Warm Air Heaters	95	112	96	81	72

Sales of comfort chillers comprise both air- and water-cooled systems and are estimated to be some 105 thousand units in 2010, with an installed base of some 1.5 million products, although the installed capacity of 176 GW may be more accurate.

Sales of air conditioning and heat pumps are higher, at 459 thousand products in 2010, comprising packaged (rooftop) units, split units (ducted and unducted, mono and multiple split) and variable refrigerant flow (VRF) systems. The installed base is some 5.7 million units or 130 GW cooling capacity.

The sales share of cooling products is not evenly distributed over the EU as air conditioners (cooling of air) are more popular in southern countries and chillers (cooling of water) are more popular in mid-EU countries.

Gas engine driven heat pumps and air conditioners are relatively new on the EU market, with sales starting from approximately zero in year 2002. The market for these products is currently still very much a niche market with approximate annual sales in order of 750 units per year around 2010, leading to approximately 5000 units installed in Europe in 2012.

Sales of high-temperature process chillers (both air-cooled and water-cooled products) are estimated to be some 27000 units in 2010, and the installed base is assumed to be some 340 000 products or 134 GW cooling capacity.

The data shows that overall sales of cooling products exceeds 450 000 units annually and that of air heating products exceeds 300 000 units (air heating products include cooling products that are reversible and may also provide in space heating).

The total space cooling capacity placed on the market (including replacements) is some 33 GW roughly evenly split between chillers, air conditioners and high temperature process chillers.

3.6.3. Price and costs

Assumptions for product prices, installation and maintenance costs in the base year 2010 are derived from data collected in the preparatory studies. For this IA, it is assumed that the only price increase within the assessed timeframe is related to an increase in energy efficiency. The energy price assumptions of the analyses are presented in Annex 2.

Based on the preparatory studies and further data collected in the course of the impact assessment, the average composition of product price has been calculated (c.f. Annex 2). The combined turnover of retailers and installers, calculated on basis of purchase prices and the annual unit sales, is expected to be around 9000 million €/year for new equipment sold in 2010 (excluding VAT). The turnover from the manufacturers is 7000 to 8000 million €/year in 2010 depending on how much of wholesale revenue can be attributed to the manufacturers (as direct sales do take place). The combined turnover is some 23000 million €/year in 2010. The turnover of energy suppliers is roughly equal to that.

Employment in 2010 is estimated to be some 160 thousand jobs (not including energy suppliers), of which over 50% are related to installers/retailers.

The analysis shows that the sector of air heating products, cooling products and high temperature process chillers is economically significant in the European Union.

However, most of the air conditioner and heat pump products under the scope of the proposed measure are produced outside the EU, although a limited number of suppliers also have production facilities in the EU. For chillers (both comfort cooling and high temperature process) EU production is more relevant than for the air conditioner / heat pump products, although the major suppliers also import products. Warm air heaters are mainly produced within the EU.

The prices and costs at product level are presented in Annex 2.

3.6.4. Energy consumption and emissions

The calculation of the baseline energy consumption and emissions takes into account a development in heating and cooling demand, energy efficiency and specific emission values. All these values have been presented in Annex 2. The table below gives the main outcomes of the baseline projections for 2010 and 2030.

Table 2: Baseline: Seasonal efficiency, energy consumption and emissions in 2010 and 2030

	Efficiency [seasonal primary energy]		**Energy [PJ]**		**GHG [Mton $CO_{2\ eq}$]**	
	2010	**2030**	**2010**	**2030**	**2010**	**2030**
Cooling						
comfort chiller, air cooled, <400 kW	136%	163%	95	124	5	6
comfort chiller, air cooled, ≥400 kW	140%	177%	130	155	6	8
comfort chiller, water cooled, < 400 kW	186%	226%	10	12	1	1
comfort chiller, water cooled, 400-1500 kW	217%	289%	31	36	2	2
comfort chiller, water cooled, ≥1500 kW	217%	289%	19	21	1	1
split air conditioner	156%	173%	336	285	18	16
VRF air conditioner	165%	181%	101	313	6	20
rooftop air conditioner	120%	153%	188	91	11	5
gas engine driven air conditioner and heat pump	103%	113%	1	4	0	0
high temp. process chiller, air cooled, <350 kW	188%	213%	326	407	14	17
high temp. process chiller, air cooled, ≥350 kW	204%	235%	311	380	14	16
high temp. process chiller, water cooled <350 kW	292%	334%	69	85	3	4
high temp. process chiller, water cooled >350 -1000 kW	340%	382%	134	169	6	7
high temp. process chiller, water cooled ≥1000kW	344%	386%	27	35	1	2
Heating						
split heat pump	117%	132%	(included in 'cooling' values)			
VRF heat pump	130%	135%				
rooftop heat pump	124%	132%				
gas engine driven air conditioner and heat pump	129%	155%				
fuel (gas) fired warm air heater	60%	70%	672	404	35	21

electric warm air heater	30%	30%	25	12	1	1

Assuming no change in current policy measures, the 2030 consumption is assumed to be 2534 PJ/year. Although there is an improvement in efficiency to be expected the baseline development shows a slight increase in energy consumption for 2030 for the EU-27. The savings realised by more efficient products are offset by an increase of the stock.

The energy consumption calculated for 2010 corresponds to a total of 124 Mton $CO2_{eq}$ of greenhouse gas emissions, resulting from both 115 Mton indirect emissions (fuel and electricity related) of which 79 Mton is related to use of equipment using refrigerants and some 9 Mton $CO_{2\ eq}$ are direct emissions (refrigerant related). The refrigerant related emissions are estimated are thus 10% of the emissions by refrigerant-using equipment in 2010. This share is expected to increase to 15% because of increasing energy efficiency (whereby fugitive refrigerant related emissions increases and indirect emissions from electricity consumption decreases).

As regards emissions to air by fuel fired products the baseline shows a significant decline, from 36 kton $SO_{x\ eq}$ in 2010 to 22 kton $SO_{x\ eq}$ in 2030. This is mainly due to the expected decrease in sales and installed base of gas fired warm air heaters. Stakeholder consultations during the impact assessment phase however showed potential for further reduction of these emissions.

3.6.5. Other (non-energy related) impacts

The preparatory study included proposals for introduction of maximum noise levels and information requirements for most heating or cooling equipment including terminal equipment such as fan-coil units and heat rejection equipment such as cooling towers.

Noise is identified as a potentially relevant environmental impact, influencing the user satisfaction (and indirectly health). However, stakeholders indicated that for products used in non-domestic environments, the noise emitted by the product is of relatively low interest. For building regulations the noise emitted in occupied rooms (in this case coming from the heating or cooling emitter) is relevant and in many cases already regulated as many Member States have issued maximum noise levels within their building codes. Alternatively the noise from the unit can be attenuated by other measures than the source itself, outside the unit.

Stakeholders also mentioned a negative relationship between noise production and energy efficiency, i.e. higher energy efficiencies may be attained by increasing the air flow over the heat exchangers, thereby increasing noise.

As regards resource efficiency it is noted that the materials used in the equipment are predominantly metals with a high scrap value, which are likely to be recycled.

3.6.6. Improvement potential

The preparatory studies have investigated the options for improvement of energy efficiency and concluded a cost-effective savings potential exists, indicating that overall the societal costs can be reduced.

The technical design options that could bring about such savings were identified in the preparatory studies as follows (note: non-exhaustive):

- More efficient active components, such as compressors, burners (of fuels), drives and/or motors;

- More efficient static components such as larger heat exchangers etc.;
- Improved product control components to better adapt a (heating or cooling) output to a heating or cooling demand (more efficient part load operation).

Table 3: Baseline and Best Available Technology: Efficiency and emission typical values

	Efficiency [seasonal, primary energy]		Emission [mgNO_x/kWh input]	
	2010	BAT	2010	BAT
Cooling				
comfort chiller, air cooled, <400 kW	136%	186%		
comfort chiller, air cooled, ≥400 kW	140%	219%		
comfort chiller, water cooled, < 400 kW	186%	245%		
comfort chiller, water cooled, 400-1500 kW	217%	358%		
comfort chiller, water cooled, ≥1500 kW	217%	358%		
split air conditioner	156%	272%		
VRF air conditioner	165%	217%		
rooftop air conditioner[26]	120%	185%		
gas engine driven air conditioner and heat pump[27]	103%	175%	900	240[1)]
high temp. process chiller, air cooled, <350 kW	188%	290%		
high temp. process chiller, air cooled, ≥350 kW	204%	320%		
high temp. process chiller, water cooled <350 kW	292%	410%		
high temp. process chiller, water cooled >350 -1000 kW	340%	500%		
high temp. process chiller, water cooled ≥1000kW	344%	520%		
Heating				
split heat pump	126%	202%		
VRF heat pump	130%	164%		
rooftop heat pump	125%	158%		
gas engine driven air conditioner and heat pump	131%	175%	900	240[1)]
fuel (gas) fired warm air heater	60%	84%	275	70[1)]
electric warm air heater	30%	38%		

1) The maximum NO_x emission limits are based on Regulation 813/2013, but manufacturers of gas engine heat pumps explain that these values apply to fixed speed engines in cogeneration units, whereas gas engine heat pumps / air conditioners require engines operating at variable speeds which results in different typical emission values. Additionally, standard rating conditions for NO_x emission measurement of gas engine heat pumps / air conditioners have not yet been defined.

3.7. Should the EU act?

Whether the EU should act is governed by Article 15 of the Directive 2009/125/EC which states that in case a product represents a significant volume of sales, has a significant environmental impact within the Community, presents a significant potential for improvement (without entailing excessive costs), while taking into account an absence of other relevant Community legislation or failure of market forces to address the issue properly and with a wide disparity in environmental performance of products with equivalent functionality, the product can be covered by an implementing measure or by self-regulation.

The preceding sections show that the sales volume is large enough to be significant, as is the environmental impact from energy consumption and emissions. The current trend in sales and

26 The average and BAT efficiency of rooftop air conditioners / heat pumps is based upon data provided during the stakeholder consultation of the Impact Assessment study.

27 The average and BAT efficiency of gas engine air conditioners / heat pumps is based upon data provided during the stakeholder consultation of the Impact Assessment study.

characteristics of equipment placed on the EU market does not significantly reduce the overall energy consumption of these products.

The preparatory studies have established for the products within scope a significant potential for improvement (wide disparity in environmental performance) which can be achieved without excessive costs (improvement of average product results in lower life cycle costs).

Furthermore the studies showed that there is no relevant Community legislation addressing the problems related to this product group, nor adequate results from market forces addressing the issue properly.

Many stakeholders have expressed that the issue of energy consumption and emissions by these products needs to be addressed.

Hence, further measures by the EU are necessary to deal with this development. The Ecodesign Directive (Article 16 in particular) provides the legal basis for the European Commission to adopt implementing measures reducing energy consumption and emissions of air heating products and cooling products and high temperature process chillers.

Improved energy efficiency of air heating products and cooling products and high temperature process chillers, combined with low emissions of NO_x, through the introduction of ecodesign requirements, would contribute to reach the 20% energy savings potential by the year 2020, identified in the Energy Efficiency Action Plan[28]. Promotion of market take up of energy efficient air heating products and cooling products and high temperature process chillers complies with the Lisbon and renewed Sustainable Development Strategy[29] as it would encourage investment in R&D and provide for a level playing field for all market actors in the different EU Member States. In addition, it belongs to one of the key objectives defined in the Community Lisbon Programme for 2008-2010[30], i.e. 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[31].

4. POLICY OBJECTIVES

This impact assessment focuses on operational objectives since the general and specific objectives have already been set out in the impact assessments for the Ecodesign and Energy Labelling Directives.

4.1. General objectives

The preparatory studies have confirmed an existing and cost-effective potential to reduce energy consumption and emissions of products within scope. The current trend in sales and characteristics do not sufficiently realise this potential and the general objectives are therefore to develop a policy, which corrects the regulatory and market failures:

- Reduce fuel and electricity consumption and related emissions to air due to use of air heating products and cooling products following Community environmental priorities,

28 COM(2006)545.
29 OJ L 242, 10.9.2002, and Council document 109 17/06 of 26.6.2006
30 COM(2007)804
31 COM(2008)397.

such as those set out in Decision 1600/2002/EC[32] or in the Commissions European Climate Change Programme.

- Promote energy efficiency as contribution to the Community objective of saving 20% of the EU's energy consumption by 2020.

- Promote competitiveness of the air heating product and cooling product industry through the creation or expansion of the EU internal market for sustainable products.

These objectives should be achieved while maintaining a functioning internal market with a level playing field for producers and importers.

4.2. Specific and operational objectives

The specific objectives are:

- to increase the energy efficiency of the following product groups (definitions will be supplied in final measures):

  a) Comfort chillers
     i) Air-cooled <400 kW
     ii) Air cooled >400 kW
     iii) Water cooled <400 kW
     iv) Water cooled 400-1500 kW
     v) Water cooled >1500 kW
  b) Electric Air conditioners & heat pumps
  c) Gas Engine driven Air conditioners & heat pumps
  d) High temp. process chillers
     i) Air-cooled <400 kW
     ii) Air cooled >400 kW
     iii) Water cooled <400 kW
     iv) Water cooled 400-1000 kW
     v) Water cooled >1000 kW
  e) Warm air heaters - Gas
  f) Warm air heaters - Electric

- to reduce the emissions of nitrogen oxides and potent greenhouse gases of the products listed above (where relevant);

- to reduce the societal life cycle costs associated with production, use and disposal of the products listed above;

The necessary coherence with existing legislation and non-specific objectives leads to further operational objectives.

The **operational objectives** are:

  - to achieve the specific objectives listed above without having a significant negative impact on functionality, safety, affordability of the product, nor on the industry's

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[32] OJ L 242, 10.9.2002, p. 1.

competitiveness and the administrative burden imposed on it as provided in Art. 15 of the Directive;

- to introduce the requirements within a reasonable time frame, whereby a balance needs to be stricken between stringency of measures and timing of measure, as to allow the affected stakeholders to prepare for the introduction of the requirements.

- to maintain consistency with ecodesign requirements developed for other space heating or cooling products and process chillers;

These objectives should be achieved while maintaining a functioning internal market with a level playing field for producers and importers.

The monitoring of these objectives is described in Section 9.

5. POLICY OPTIONS

In order to address the issues identified in Section 3 and to meet the targets defined as policy objectives in Section 4, the following policy options are considered:

5.1. Option 1: No EU action (Baseline)

This option assumes continuation of current policy measures at Member State level, no further measures for air heating products, cooling products and high temperature process chillers at EU level and thus continuation of existing trends regarding size, use, energy efficiency and emissions of appliances. This option would have the following implications:

- The market and regulatory failure would persist:
  - Energy consumption and emissions of air heating products, cooling products and high temperature process chillers will remain at a level higher than the level that would realise the cost effective saving potential as established in the preparatory studies;
  - No harmonisation of energy and emission requirements would occur; Member States could develop their own national energy/emission limit values, hampering the internal market for these products;
- The specific mandate of the Legislator would not be respected. The product group is eligible for ecodesign measures under the stipulations of Article 15, a): It is economically and environmentally significant and there is a large saving potential that is not sufficiently addressed because of existing market and regulatory failures, and this saving potential can be achieved without excessive negative impacts.

This means that the problems described in chapter 3 would persist and therefore this option is discarded as policy option. This option is included in the impact assessment as baseline (“BAU” or Business-as-usual) and serves as reference in Section 6 for calculating savings of other policy options.

5.2. Option 2: Self regulation, "Voluntary agreement"

Self-regulation or voluntary agreements can have as benefits over legislative measures that the implementation may be much faster and at the same time offer more flexibility. For minimum standards, in order to be accepted as viable alternative to legislation, self-regulation initiatives have to comply with a stringent set of criteria defined by Annex VIII of Directive 2009/125/EC (openness for participation, added value, representativeness, quantified and staged objectives, involvement of civil society, monitoring and reporting, cost-effectiveness of administering a self-regulatory initiative, sustainability and incentive compatibility).

Self-regulation or voluntary agreements have not been tabled by the industry. This apparent lack of support for such an initiative makes meeting the requirements indicated before very unlikely. Further, a voluntary approach would not be consistent with the approach for other heating products.

For the above reasons, this option is discarded from further analysis.

5.3. Option 3: Ecodesign requirements only

This option considers the setting of ecodesign requirements on energy efficiency and emissions under the Ecodesign Directive without combining these with requirements under the Energy labelling Directive.

Introduction of ecodesign requirements under Directive 2009/125/EC would be partly coherent with the approach chosen for other space heating and cooling products, such as room air conditioners and central heating boilers (including heat pumps) for which ecodesign requirements have been introduced as well, but combined with energy labelling.

The option presented to stakeholders in the Consultation Forum meeting of 25 September 2013 covered only ecodesign requirements (sub-option A). See Annex 1 for a summary of that meeting.

Following the outcome of this meeting, this option has been further developed to take into account comments from stakeholders which have been reflected in the development of two other sub-options (B and C).

Table 4: Overview of evaluated sub-options

Sub-option	Description
A	This is the option presented at 25 Sep 2013. The ecodesign requirements are the most stringent of the options considered
B	This sub-option is based on comments from several industry organisations and introduces less stringent ecodesign requirements and also the removal of certain aspects from the regulation (such as noise) and a change in scope (regarding fan coils)
C	This sub-option introduces ecodesign requirements at a level in between sub-option A and B
BAU	This is the reference option, from which savings of the above sub-options are calculated (business-as-usual option or baseline)

All sub-options assume adoption of the measures by the end of 2014 (thus assuming the Regulation to be in place as of 1 January 2015 and, with requirements to apply as of 2017, allowing two years for preparation).

All options discussed below assume a method for measurement and calculation is applied, resulting in seasonal efficiencies for heating and/or cooling.

The sub-options assessed in the following sections differ in the level of efficiency requirements. An overview of the requirements per sub-option is given below.

Table 5: Energy efficiency (BAU: average efficiencies, Options: minimum requirements)

	BAU			Option A		Option B		Option C	
	2010	**2015**	**2020**	**2017**	**2019**	**2017**	**2021**	**2017**	**2020**
Cooling									
comfort chiller, air cooled, <400 kW	136%	141%	145%	157%	161%	137%	149%	149%	157%
comfort chiller, air cooled, ≥400 kW	140%	143%	153%	173%	185%	137%	157%	157%	173%
comfort chiller, water cooled, < 400 kW	186%	196%	200%	196%	200%	172%	188%	188%	196%
comfort chiller, water cooled, 400-1500 kW	217%	225%	245%	256%	272%	196%	236%	236%	256%
comfort chiller, water cooled, ≥1500 kW	217%	225%	245%	256%	272%	236%	256%	236%	256%
split air conditioner	156%	161%	165%	181%	189%	157%	169%	169%	181%
VRF air conditioner	165%	169%	173%	181%	189%	157%	169%	169%	181%
rooftop air conditioner	120%	128%	136%	181%	189%	117%	138%	117%	138%
gas engine driven air conditioner and heat pump	103%	102%	103%	167%	177%	157%	169%	157%	167%
high temp. process chiller, air cooled, <350 kW	188%	193%	196%	180%	200%	180%	200%	180%	200%
high temp. process chiller, air cooled, ≥350 kW	204%	213%	217%	200%	220%	200%	220%	200%	220%
high temp. process chiller, water cooled <350 kW	292%	303%	308%	260%	280%	260%	280%	260%	280%
high temp. process chiller, water cooled >350 -1000 kW	340%	342%	349%	300%	320%	300%	320%	300%	320%
high temp. process chiller, water cooled ≥1000kW	344%	343%	352%	320%	340%	320%	340%	320%	340%
Heating									
split heat pump	126%	128%	130%	141%	146%	115%	125%	133%	137%
VRF heat pump	130%	132%	134%	141%	146%	115%	125%	133%	137%
rooftop heat pump	99%	102%	103%	141%	146%	115%	125%	115%	125%
gas engine driven air conditioner and heat pump	131%	137%	146%	137%	142%	115%	125%	133%	137%
fuel (gas) fired warm air heater	63%	64%	66%	72%	78%	68%	74%	70%	74%
electric warm air heater	30%	30%	30%	30%	32%	30%	32%	30%	32%

Air conditioners and heat pumps that use sorption technology to provide cooling and or heating are excluded from proposed minimum energy efficiency requirements as it cannot be known when placed on the market which heat source will be applied (this could be waste heat). In order to increase transparency information requirements are proposed allowing performance assessment on the basis of known rating conditions.

The maximum emission values for nitrogen oxides for the different sub-options are presented in the following table. These requirements apply only to fuel fired products.

Table 6: Ecodesign maximum emission requirements

	BAU			Option A		Option B		Option C	
	2010	**2015**	**2020**	**2017**	**2019**	**2017**	**2021**	**2017**	**2020**
gas engine	900	900	900	240	240			350	350

driven air conditioner and heat pump									
fuel (gas) fired warm air heater	275	275	275	70	70	200	150	150	150

All options assume that the requirements would apply to products as they are placed on the market. Products that have already been placed on the market would not be affected by the proposed requirements.

The following sections describe the sub-options in more detail.

5.3.1. Sub option A (CF proposal)

This sub-option corresponds to ecodesign requirements presented in the working document discussed in the Consultation Forum meeting of 25 September 2013.

The scope of products is the widest of all, and so is the number of ecodesign requirements. The following table gives an overview of products and parameters covered by ecodesign requirements.

Table 7: Overview of parameters regulated per product type / sub-option A

Product type	**Product category**	**Parameter**				
		Min. energy efficiency for cooling	**Min. energy efficiency for heating**	**Max. NO_x emission limits**	**Max. noise limits**	**Information requirements**
warm air units	fuel fired		✓	✓		✓
	electric		✓			✓
vapour compression cycle electric motor driven	water cooled chiller	✓			✓	✓
	air cooled chiller	✓			✓	✓
	air-to-air air conditioner (for cooling)	✓			✓	✓
	air-to-air heat pump (for heating)		✓		✓	✓
	water/brine-to-air air conditioner					✓
	water/brine-to-air heat pump					✓
	condensing units					✓
	high temperature process chiller	✓(SEPR)				✓
vapour compression cycle fuel engine driven	air cooled chiller	✓		✓	✓	✓
	air-to-air air conditioner	✓		✓	✓	✓
	air-to-air heat pump		✓	✓	✓	✓
sorption cycle, gas driven,	chillers and heat pumps					✓
Terminal equipment	fan coil units				✓	

Energy efficiency and noise requirements were suggested to apply in two tiers (2017 and 2019). This separation in two tiers allows a longer transitional period for the industry. NOx limit values would apply in a single tier. For a detailed description of requirements, see Annex 3.

This sub-option was discussed in the Consultation Forum meeting of 25 September 2013 but especially industry stakeholders indicated that they could not accept this option. They stated that the energy efficiency and emissions requirements for especially cooling products were too stringent, especially given the combination with noise requirements. The requirements for heat pumps were considered to be much more stringent than for competing products covered by a different Regulation 813/2013.

Industry stakeholders responsible for placing on the market of gas-engine heat pumps (GEHP) stated the current equipment would not be able to meet the proposed requirements for energy efficiency (cooling efficiency) and NO_x emissions.

Furthermore the introduction of noise requirements for fan coils was contested, as this would not contribute to energy savings. As regards the timing of the measures, the two-year period between tiers was considered too short, in particular due to the stringency of measures proposed.

Other stakeholders, such as environmental and consumer NGOs welcomed the high level of stringency of the proposal.

5.3.2. Sub option B

Following the comments received during the Consultation Forum from some stakeholders (industry stakeholders in particular), this sub-option assesses the impacts of different, less stringent ecodesign requirements. The following table gives an overview of products and parameters considered.

Table 8: Overview of parameters regulated per product type / sub-option B

Product type	**Product category**	**Parameter**				
		Min. energy efficiency for cooling	**Min. energy efficiency for heating**	**Max. NO_x emission limits**	**Max. noise limits**	**Information requirements**
warm air units	fuel fired		✓	✓		✓
	electric		✓			✓
vapour compression cycle electric motor driven	water cooled chiller	✓			✓	✓
	air cooled chiller	✓			✓	✓
	air-to-air air conditioner (for cooling)	✓			✓	✓
	air-to-air heat pump (for heating)		✓		✓	✓
	water/brine-to-air air conditioner					✓
	water/brine-to-air heat pump					✓
	condensing units					✓
	high temperature process chiller	✓(SEPR)				✓
vapour compression cycle fuel engine driven	air cooled chiller					✓
	air-to-air air conditioner					✓
	air-to-air heat pump					✓
sorption cycle, gas driven,	chillers and heat pumps					✓
Terminal equipment	fan coil units	(product removed from scope)				

The main differences to sub-option A are:

1. No noise requirements for all equipment in scope (thus also removal of fan coils from scope);

2. Less stringent energy efficiency requirements for all products within scope, where applicable;

3. No requirements on energy efficiency, nor maximum NO_x emission levels for fuel (mainly gas) engine driven chillers, air conditioners and heat pumps (only information requirements);

4. The first tier is set at 2017 (two years after entry into force) and the second at 2021, giving a four year redesign period after the first tier, and six years after entry into force.

The specific energy efficiency and emission requirements are explained below. Further information is also shown in Annex 3.

Comfort chillers

The industry (EPEE, Eurovent, JBCE) commented that the option A requirements proposed for chillers are too severe, as they would affect a too large share of sales volume (according industry up to 93% of chiller sales would be affected by Tier 2).

Instead the industry proposed less stringent requirements that still remove from the market some 80% or more of the sales (compared to2010). The industry also asked for more time between the tiers as the capacity for redesign is limited, and the duration of redesign cycles exceeds two years.

Electric air conditioner and heat pumps

The efficiency levels for rooftop air conditioners have been revised as additional information regarding SEER performances (changing average and maximum seasonal efficiencies for cooling and subsequently heating) was made available, showing that none of the rooftop equipment would be able to meet the suboption A targets. The efficiencies are lower than expected, also due to changes in the measurement and calculation methods.

The energy efficiency requirements for heating mode of split type and VRF type air conditioners are aligned to 813/2013, levelling the playing field with other space heaters as regards heating efficiency. As regards cooling efficiency the requirements for split and VRF types of air conditioners in this suboption B are less strict compared to suboption A.

Fuel driven air conditioners and heat pumps

The requirements are at the same level as for electric air conditioners and heat pumps.

High temperature process chillers

No change in proposed energy efficiency requirements compared to suboption A or C.

Warm air heaters

Suboption B proposes requirements that are below the level suggested in the Working Document as this level would force the market into condensing technology only by Tier II. The relevant industries plead to reduce the levels to allow non-condensing technology to remain on the market, as phasing out non-condensing products would put pressure on manufacturers as the installed base would need to be retrofitted with condensate removal installations.

A detailed overview of actual seasonal efficiencies for all product groups is shown in Annex 3.

5.3.3. Sub option C

As certain stakeholders have indicated to prefer strict energy efficiency requirements this sub-option assesses the impacts of ecodesign requirements that are less strict than in sub-option A, but stricter than in sub-option B.

The scope of products to be covered by ecodesign requirements is identical to that of sub-option B, but the requirements on energy efficiency are stricter than in sub-option B.

Table 9: Overview of parameters regulated per product type / sub-option C

Product type	**Product category**	**Parameter**				
		Min. energy efficiency for cooling	**Min. energy efficiency for heating**	**Max. NO_x emission limits**	**Max. noise limits**	**Information requirements**
warm air units	fuel fired		✓	✓		✓
	electric		✓			✓
vapour compression cycle electric motor driven	water cooled chiller	✓			✓	✓
	air cooled chiller	✓			✓	✓
	air-to-air air conditioner (for cooling)	✓			✓	✓
	air-to-air heat pump (for heating)		✓		✓	✓
	water/brine-to-air air conditioner					✓
	water/brine-to-air heat pump					✓
	condensing units					✓
	high temperature process chiller	✓(SEPR)				✓
vapour compression cycle fuel engine driven	air cooled chiller					✓
	air-to-air air conditioner					✓
	air-to-air heat pump					✓
sorption cycle, gas driven,	chillers and heat pumps					✓
Terminal equipment	fan coil units	(product removed from scope)				

The main differences to sub-option A are that:

1. No noise requirements for all equipment in scope (thus also removal of fan coils from scope).

2. As in sub-option A this option has NO_x requirements, however at less stringent level.

3. No requirements on energy efficiency, nor NO_x for fuel (mainly gas) engine driven chillers, air conditioners and heat pumps (only information requirements).

The main difference to sub-option B is that suboption C has:

1. Ecodesign requirements regarding energy efficiency that are stricter than in suboption B.

2. NO_x requirements for (gas fired) warm air heaters (but less strict as in sub-option A).

3. The first tier is set at 2017 (two years after entry into force) and the second at 2020, giving a three year redesign period after the first tier, and five years after entry into force.

The specific energy efficiency and emission requirements are explained below.

Comfort chillers

As already stated under option B, the industry commented that the option A requirements proposed for comfort chillers are too severe, However, other stakeholders have argued against lowering the requirements. Therefore option C proposes a compromise in which requirements are more relaxed than in option A, but more severe than in option B. The minimum efficiency requirements for suboption C tier 1 are identical to that proposed as tier 2 in sub-option B and tier 2 requirements are identical to tier 1 of sub-option A.

This means that tier 2 is reduced in severity and comes into force at a later stage and more sales remain unaffected when compared to tier 1 of suboption A. The reason to not fully adopt the industries suggestions are the fact that the preparatory study indicated many sales to be decided on basis of first cost instead of least life cycle costs and that many products do not yet apply options to improve part load efficiency, such as using a VSD.

Furthermore this suboption assumes the requirement on noise is dropped, enlarging the options for energy efficiency improvement. The rationale is that noise problems related to use of this equipment (commercial and industrial, not household) are better tackled at local level (country or even site-specific) as abatement measures can be beyond the scope of the product itself and local noise requirements would apply to existing equipment as well (whereas ecodesign would only apply to equipment placed on the market and would not affect existing installations).

Electric air conditioners and heat pumps

As stated under suboption B, the efficiency levels for rooftop air conditioners have been revised. The proposed rooftop requirements are at the same level as suboption B.

The energy efficiency requirements for heating mode of **split and VRF type** air conditioners are not aligned to 813/2013 (as proposed under suboption B) as tighter requirements could be set. As regards cooling efficiency the requirements for split and VRF types of air conditioners in this suboption C are more strict compared to suboption B, as the preparatory study showed that tier 1 requirements are at LLCC levels and cost effective improvement would be possible.

Fuel driven air conditioners and heat pumps

The requirements are at the same level as for electric air conditioners and heat pumps.

High temperature process chillers

No change in proposed energy efficiency requirements compared to suboption A or B.

Warm air heaters

Suboption C proposes requirements that are slightly above the level suggested by the industry association. The tier II level is reduced to just allow non-condensing technology to remain on the market, as phasing out non-condensing would put pressure on manufacturers as the installed base would need to be retrofitted with condensate removal installations.

A detailed overview of actual seasonal efficiencies for all product groups is shown in Annex 3.

5.4. Option 4: Energy Labelling requirements only

This option provides in mandatory energy labelling (without ecodesign requirements). Introduction of a labelling scheme under Directive 2010/30/EC would be coherent with the approach chosen for other heating products, such as room air conditioners and central heating boilers using electricity (such as electric heat pumps), gas, liquid or solid fuels which also provide in space heating.

However, different to many other products such as domestic appliances and electronics, purchased mainly by lay-persons, in this case labelling alone is not expected to result in significant higher sales of more efficient products.

The effect of labelling depends on the market uptake of the label information. As most if not all of these products are rarely bought from a 'shop floor' (or through distance-selling) by lay-persons and instead mainly bought on specifications of trained personnel such as installers (for replacement sales, or new installations), specialist advisors (for new builds) and well-informed customers (in particular for the largest equipment that constitutes a major investment for these customers), access to and interpretation of information on the performance and energy efficiency is not a fundamental problem. A possible energy labelling scheme would not convey significantly more meaningful information than would be available in the technical information, possibly supplied in the form as required under possible ecodesign information requirements.

Of course the available information on these products can be improved, through introduction of more informative metrics for energy efficiency, but this could be handled through generic ecodesign (information) requirements, harmonising information requirements for products.

The market failure of the purchase price rather than total life cycle costs guiding the final purchase decision is not expected to change drastically through introduction of energy labelling.

No stakeholder has expressed support to this option. This option is therefore discarded from further analysis.

5.5. Option 5: Ecodesign requirements and energy labelling

This option considers the setting of Ecodesign requirements in combination with energy labelling as a combined market 'push and pull' effect.

As energy labelling is not considered a viable option, this option would not bring benefits compared to Option 3 on ecodesign requirements only.

This option is therefore discarded from further analysis.

5.6. Generic issues

Chiller efficiency metric

The minimum energy efficiency requirements are stated as seasonal efficiencies. For water cooled comfort chillers these efficiencies are based on performance assessment based on cooling towers as heat rejection method, following EN 14511-2:2011 'standard rating conditions' specifying a condensor (outdoor heat exchanger) inlet and outlet temperature of 30-35ºC.

Nowadays many water cooled comfort chillers are using dry coolers, which involves typically higher condensing temperatures (40-45ºC). It is possible to optimise water cooled compressor design for use with dry coolers. When a 'dry cooler optimised' compressor is used in a dry cooling system, some (limited) technical studies have shown that the performance is actually some 1-2 % higher than a 'cooling tower optimised' compressor could achieve.

Therefore, if the requirements and performance assessment continue to be based on use with cooling towers, then some 1-2% energy saving may not be achieved which is against the purpose of the proposed regulation.

It is proposed however to accept this loss of savings for the following reasons: The current standard method to rate compressors is mainly based on cooling tower condensing temperatures. The preparatory study assumes this in their proposed requirements, and the source for the study was also based on use of cooling towers. Changing to dry cooler performance assessment (based on higher condensing temperatures) would require re-assessment of chiller performances (the data of which data may not be available), re-opening of discussion with stakeholders as regards acceptable requirements (would be closer to air cooled chiller requirements) and would run a risk of being outdated in the near future as standards for assessing performance using evaporatively cooled equipment are being developed, which will lower the condensing temperatures again, bringing them closer to cooling towers.

Therefore, it is proposed to keep as basis for performance assessment heat rejection using cooling towers instead of dry coolers. The benefit, reaping at maximum 1-2% extra energy savings, is considered to be not sufficient to outweigh the disadvantages as explained above. Furthermore, the additional savings to be achieved by changing the basis for performance assessment are relatively insignificant compared to the differences between efficiency requirements according option A, B and C (much larger than 1-2%).

During the revision of the Regulation (expected five years after entry ito force, a review of preferred condensing temperatures is to be considered.

VRF testing

The requirements of the preparatory study set out for VRF units (belonging to air conditioners / heat pumps) assume a test with inclusion of indoor fans. Most VRF units however compete with comfort chillers, that are tested without indoor fans. In order to allow a more level playing field industry suggested to test VRF units without indoor fans. Other options are to fix the number of types of indoor units for the test, but as there are many possible configurations, the meaning of the tested value is greatly reduced. Another option is to correct for indoor fan consumption, but the first option gives the same effect with less burden.

The exclusion of indoor fans calls is reflected in the lower efficiency targets presented in suboption B and C which also include a correction on LLCC targets identified in the study.

Rooftop testing

During the time of writing of the preparatory study no actual part load performance data was available for rooftop air conditioners. Only since 2012 some part load data according EN 14825:2013 was made available and showed lower efficiencies than calculated in the preparatory study. Main reasons are underestimation of fan energy for transport of conditioned air and the inclusion of a fan power correction factor since EN 14825:2013. The use of VSD is not yet widespread, also leading to lower average efficiencies. The average product is therefore not as efficient as presented in the study.

6. ANALYSIS OF IMPACTS

6.1. Introduction

This Impact Assessment study is a proportionate analysis and only options that appear feasible have been assessed in more detail in the following section. They are assessed against the baseline scenario which describes the impacts in case no additional measures are taken.

The assessment is done with a view to the criteria set out in Article 15 (5) of the Ecodesign Directive. The aim is to identify options that achieve a balance between the quick realization of the objectives and the associated benefits for the environment and the user (due to reduction of life cycle costs) on the one hand, and potential burdens on manufacturers including SMEs on the other hand.

6.2. Economic impact

6.2.1. Energy saving and security of supply

The current analysis suggests an energy consumption of air heating products, cooling products and high temperature process chillers of 2477 PJ in 2010, which is expected to increase to 2534 PJ in 2030. The sub-options aim to reduce this energy consumption. The impacts on overall (primary) energy consumption of these options have been presented in the table below.

Table 10: Overall (combined) energy consumption for the different policy options [PJ][33]

Energy consumption	1990	2000	2010	2020	2030	change 2020	change 2020
BAU	1524	2060	2477	2655	2534		
A	1524	2060	2477	2562	2280	-92.8	-253.9
B	1524	2060	2477	2624	2421	-30.9	-113.1
C	1524	2060	2477	2600	2361	-55.5	-172.6

[33] The calculation is based on a changing primary-electricity conversion - see Annex 2

Stakeholders have argued that the target values for sub-option A are too severe in the given timeframe and would remove from the market too many models (see also the section on business impacts).

Sub-option B presents the savings on the basis of efficiencies the industry sees as acceptable. The missed savings compared to sub-option A are calculated to be some 2% 'missed' savings.

Sub-option C presents the savings of a compromise solution with targets set in-between sub-option A and B. Here the savings regarding sub-option A are 1 % 'missed' savings and the difference with sub-option B is just 1% extra savings.

Note that the above assessment does not include a consideration of the effects of possible noise requirements (as proposed under sub-option A). According industry stakeholders such requirements would hinder achieving ambitious energy efficiency targets.

6.2.2. Business impacts

The described measures will affect businesses involved in the placing on the market (and the services provided afterwards) in numerous ways.

A major impact will be the removal from the market of a certain sales volume that does not meet the requirements.

Sales removed from the market

In this assessment the affected sales or number of models to be removed from the market has been estimated on the basis of a normal distribution curve of the efficiency (based on a mean value and a standard deviation value, calculated as the difference between mean and BAT being 2 standard deviations). Note that the values for 'models removed' are therefore indicative only and cannot be compared to such values presented in the preparatory studies as these may be based on extensive database information. It was tried however to match the outcome of the parametric model with the values presented in preparatory studies as much as possible.

For GEHP and electric warm air heaters there was not sufficient generic data to allow an assessment of this aspect and data presented in this assessment is therefore indicative only.

The calculation of sales affected takes into account the expected increase in energy efficiency (according business-as-usual) which in itself could be expressed as a percentage of models removed (although actually no regulation requiring this was imposed). Using the same parametric approach as described above, the baseline is expected to have an effect comparable to phasing out models as indicated in the table below.

The difference between the percentage of models removed by the option and by the BAU is then the actual impact of the option and is shown below.

Table 11: Sales volume removed from the market, corrected for BAU improvement (based on parametric approach)

	BAU		Option A		Option B		Option C	
	tier 1	tier 2	tier 1	tier 2	tier 1	tier 2	tier 1	tier 2
AC<350kW	7%	9%	83%	84%	45%	69%	71%	80%
AC>350kW	17%	20%	72%	76%	28%	54%	57%	70%
WC<350 kW	4%	7%	65%	70%	19%	47%	50%	63%

WC>350kW	20%	23%	59%	65%	12%	42%	45%	56%
WC>1000kW	20%	23%	59%	65%	45%	56%	45%	56%
split AC	23%	26%	51%	55%	28%	37%	40%	48%
VRF	4%	7%	78%	85%	28%	53%	55%	75%
rooftop	16%	19%	84%	81%	29%	61%	29%	61%
GEHP								
HTPC-AC<350kW	16%	19%	25%	45%	25%	45%	25%	45%
HTPC-AC>350kW	17%	20%	29%	46%	29%	46%	29%	46%
HTPC-WC<350kW	9%	12%	12%	26%	12%	26%	12%	26%
HTPC-WC>350kW	13%	15%	10%	20%	10%	20%	10%	20%
HTPC-WC>1000kW	15%	17%	20%	30%	20%	30%	20%	30%
gasWAH	5%	7%	85%	91%	70%	87%	78%	87%
elecWAH								

The table shows that Option A tier 1 and especially tier 2 are very strict as they affect some 60% to maximum 84% in 2017 and 2019 (or >90% of the 2010 sales) of comfort chiller sales volume in 4 years. Sub-option B affects some 20% to 70% of sales volume (after correction for BAU improvement) and sub-option C affects some 45% to 80% of sales volume. These values do not consider the combined effects of possible noise requirements and/or NO_x requirements or change-over to other refrigerants following an F-gas regulation or other requirements where relevant.

The table does not present sales weighted information and should therefore not be regarded representative of the number of models that cannot be sold anymore. Such sales-weighted data does not exist in the public domain and is considered by manufacturers to be confidential. The values are therefore to be regarded as a general precursor or indicator of relative stringency of measures. When compared to the information presented in preparatory studies (ENTR Lot 6 more in particular) the sales volume affected is higher in the preparatory study. This can be explained that these are based on datasets where skewed presentation of models is possible (due to higher representation of certain models with certain efficiencies). This is not the case for a parametric exercise as shown in this section.

Regulations will not specifically affect larger or smaller manufacturers. In order to be present in the market of Member States where energy efficiency and low-emission requirements have already been implemented, some manufacturers have adapted their portfolio accordingly. The Regulation will support those manufacturers of air heating products, cooling products and high temperature process chillers that have already gained experiences with energy-efficient and low-emission technology.

It should be noted that Ecodesign regulations fall on the product, not on the producer. Therefore, it is not possible to reduce the impact of the regulations through exemptions or special regimes according to its size. Nevertheless, the impact on SMEs could be mitigated through several means, in particular a reasoned scheduling of the entry into force of the MEPS, as assessed in suboption B and C.

Regarding impact of noise requirements

Sound power requirements have been proposed in option A for comfort chillers, air conditioners and heat pumps using the compression principle, and fan coils. The requirements would apply in discrete steps of ranges in heating or cooling capacity.

The actual impact of the proposed measure could not be quantified, as no (or only very limited, illustrative) information could be retrieved showing the actual effects on the product group affected.

The relevant industries however did present information and a rationale where they indicate that increased sound power requirements would have negative impacts on the energy efficiency of the product.

One of the main reasons that higher efficiency conflicts with lower noise levels is that higher energy efficiency is achieved by higher air flows over the heat exchangers. This induces higher noise emissions. Indeed components can be changed to be as efficient with less volume flow, but this then affects the size (cost) and/or the capacity of the product.

Some stakeholders have argued that the proposed sound power requirements are more severe than those issued under Regulation 813/2013. The difference is greater in the higher capacity classes. Another difference is that Regulation 813/2013 mainly addresses residential products (typically heat pumps below 20 kW heat output), whereas the proposed measure is targeting typical commercial products (typically heat or cold output of above 20 kW). Industry understands the need for regulating sound power of products intended for residential applications but fails to see the need to regulate sound power of commercial products. They argue that commercial products are typically used in applications that are less noise sensitive, and fear that energy savings may be lost when stringent sound power requirements apply to products in environments that do not actually need stringent sound power requirements.

Another argument put forward by industries is that the standard rating conditions are different between Regulation 813/2013 and the proposed measure: Regulation 813/2013 requirements apply at standard rating conditions for heating which are part load operating conditions (typically 33% of ‘design’ load). The proposed measure however addresses also (or mainly) cooling products of which the standard rating conditions is the nominal or design load, requiring 100% load. Therefore noise levels will be higher for products declared for the proposed measure than declared under Regulation 813/2013. Industries have provided test data showing that if a typical product under the proposed measure were to be tested at part load conditions (50%), the typical sound power would be reduced by some 10 dBA.

As argued above, the scope of products covered by the proposed measure consists of predominantly commercial and industrial products. The industries argue that for commercial and industrial areas usually different, more relaxed, sound power requirements exist than for residential areas, issued by authorities at national, regional or local level. For the outdoor units in particular, several methods for noise abatement exists besides reducing the noise emission of the product itself, such as cladding the product in sound absorbing shrouds.

Partly for these reasons the sub-options B and C have been introduced to assess the effects of more lenient energy efficiency measures. The options however do not allow a quantitative assessment of what combination of minimum energy efficiency and maximum noise level would be feasible.

Specific impacts on VRF units

Stakeholders have raised the issue that the measurement and calculation method for VRF units also has an impact on indicated efficiency requirements. Unlike other 'split' type products for air conditioning or heating, heating or cooling efficiency of VRF units is declared without consideration of the energy consumption of the indoor units. This is current market practice, as there are a multitude of possible configurations (one outdoor unit can be combined with up to 60 indoor units, and the total possible configurations are 10^{42}). This approach is also applied for chillers, where the energy required for distribution of indoor heating or cooling (the energy consumption of the fan and electronic controls of the fan coil units) is not included. As VRFs and chillers are competing for similar applications in the market place, the exclusion of indoor energy allows for a more level playing field. Clients however are presented an efficiency of the combined outdoor and indoor units, using software to identify the preferred configuration and make the correct calculations.

The preparatory study has calculated the energy efficiency, savings and costs of VRFs on the basis of presence of 10 indoor units. As this calculation formed the basis of the measure, it was assumed that the requirements relate to efficiency values including indoor units. This procedure would require manufacturers to modify sales brochures and software and would create an uneven playing field with respect to chillers.

If therefore the approach of declaring efficiency of VRF without indoor units is followed, then the efficiencies of VRFs will increase relative to the study outcomes (as indoor energy is not included in the calculation) which would need to be reflected in the requirements.

However, industry stakeholders have also pointed out a counter-balancing effect, as the efficiency of the VRFs at LLCC point was overestimated in the preparatory study. Further calculation of the improvement options following the preparatory study have resulted in slightly higher SEER values and significantly lower SCOP values at LLCC point.

Both effects (on excluding indoor units and correcting for overestimation of efficiencies at LLCC point) lead to a correction of 1.01 for SEER values and 0.95 for SCOP values, which should be reflected in proposed minimum energy efficiency requirements.

Partly for these reasons sub-options B and C have been introduced to assess the effects of more lenient energy efficiency measures, here in particular for VRF units. Sub-option B shows a 33 PJ higher energy consumption in 2030 for VRF only than in suboption A, and sub-option C shows 17 PJ higher energy consumption in 2030 for VRF only than for suboption A.

Specific impacts on gas engine heat pumps

Gas engine heat pumps are relatively new to the EU market and their performance has not been subject to extensive analysis before. The relevant industry states that the products cannot meet the requirements for sub-option A. The proposed levels would phase out most, if not all products from the (emerging) market.

The principle of GEHP is similar to that of VRF units, however here the electric motor is replaced by a gas engine.

Manufacturers indicate that neither the proposed NO_x limits nor energy efficiency under option A can be met. As comparison they have indicated that the NO_x limits set by the Japanese Ministry of Environment for GEHP are 600 ppm. When converting ppm to mg/kWh, the NO_x limit for GEHP in Japan is around 1050 mg/kWh. The current average product is likely to have a peak emission (nominal capacity) of around 800～1000 mg/kWh.

Proposed NO_x requirements could be attainable if the following conditions are met:

- The maximum emission limit is raised to 500 mg/kWh, to be tightened to 350 mg/kWh;
- The emissions take into account part load operation and not just nominal operation;
- The emission is not expressed on basis of a unit of energy input, but on basis of heat (or cold) output.

In order to meet minimum energy efficiency requirements, the calculated seasonal efficiency for cooling is to take into consideration the useful heat output.

Industry has proposed to implement a testing method that takes into account the specific characteristics of GEHP and includes part load operation.

Turnover by market actor

The following table indicates the distribution of total turnover of market activities related to manufacturing and distribution of air heating products, cooling products and high temperature process chillers and use by market actors for the different policy options in the assessed timeframe.

Table 12: Distribution of total turnover (billion EUR) by market actor in the different policy options in 2030

2030	Retailer/installer, incl. maintenance	Wholesale[34]	Manufacturer	Energy provider	Total
BAU	15.8	13.7	11.9	28.2	69.6
A	17.1	14.9	13.0	25.3	70.2
B	16.3	14.2	12.3	26.9	69.6
C	16.7	14.6	12.7	26.2	70.2

The figure above shows the high (35%) share of the energy provider (suppliers of fuels and electricity) in the total turnover. Installation and maintenance is responsible for 19% of the total in 2030 in the BAU option.

All sub-options have in 2030 almost the same total turnover, which is some 130% of turnover realised in 2010, the difference caused by an increase in the turnover of the manufacturer, related to an increase of sales and the purchase price of the product. The turnover of the wholesaler/retailer will also increase due to the increase in sales and relative higher product costs. The turnover of the energy provided will remain relatively constant for all analysed options between 25 to 28 billion € in 2030.

Administrative burden

The form of the legislation is a Regulation which is directly applicable in all Member States. This ensures no costs for national administrations for transposition of the implementing legislation into national legislation.

The Impact Assessment on the recast of the Energy Labelling Directive[35] calculates the administrative burden of introducing a new implementing Directive, similar to the proposed ecodesign implementing measure, in accordance with the EU Standard Cost Model.

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[34] "Wholesale" can cover either sales organisations between manufacturer and final retailer and/or manufacturer related sales organisations.

It estimates the administrative cost of implementing measures in the form of a Directive at € 4.7 million of which € 720.000 for administrative work on the amendment/development of the new Directive and €4 million for transposition by Member States. It follows that the administrative cost of an implementing Regulation – as is currently proposed - would reduce transposition costs by avoiding certain transposition costs.

Administrative costs of enforcing the Regulation are difficult to estimate. Enforcement could involve random spot-checks by the authorities of Member States, but from experience with other regulations of this type most spot-checks are not random but follow indications of competitors or third parties (e.g. industry or specific complaints of buyers). In those cases, the probability of not only recuperating testing costs and legal costs, but also of collecting fines is high. As these products were not regulated before on ecodesign parameters, the total number of products to be followed by market surveillance is increased.

Third country standards/requirements.

In Annex 7 an overview is presented of the requirements in other countries (at MS level and third countries). A direct 'head-to-head' analysis cannot be provided as the proposal are based on a calculation method which differs from that of other countries. The comparison is therefore based on the EER values identified for certain SEER or SCOP levels.

Timing of proposed measures

In general the industry responded that the timing of two years between the two tiers is too short. They state there is a relation between timing of tiers and their stringency (the more stringent, the more time is needed between tiers) as not all products can be redesigned at the same time, ao. due to finite research and development capacity.

They suggest a timing between tiers of at least 4 years as this coincides with average product redesign time, assuming that only a partial redesign of the product portfolio would be necessary.

The difference in timing of measures is reflected in the timing of tiers in the different suboptions: Suboption A is based on tiers in 2017 and 2019, suboption B on tiers in 2017 and 2021 (4 years in between) and suboption C is based on tiers in 2017 and 2020.

6.2.3. Compliance cost and timing

As appliance efficiency increases, purchase costs are expected to increase as well as costs for testing due to the introduction of seasonal efficiency values testing (more operating conditions to be tested). In general, the impact of the need to test appliances due to any kind of regulation could be significant on manufacturers, especially SMEs who develop products and would then be required to pay testing facilities for (possibly several) tests to characterise their product. Testing requirements should therefore be a compromise between thoroughness of product performance evaluation and cost effectiveness.

Manufacturers need time to make the necessary investments in order to ensure that appliances comply with the legal requirements. According to stakeholder consultation, the design cycle to develop a completely new appliance, which is able to deal with the strictest requirements, is between 3 to 5 years. Manufacturers already have their products tested in the context of

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[35] SEC(2008) 2862

several European standards (safety) or as a consequence of voluntary participation in a certification scheme.

Having said this, test capacity (laboratory time) may be a limiting factor, meaning that a very quick introduction (< 1 year) of requirements is not feasible. Industry and other stakeholders have also indicated that a 2 / 2 year period to prepare Tier 1 and Tier 2 requirements would be extremely demanding. In general it can be stated that the more demanding the requirements are, the more time needs to be reserved for design (as more products need to be improved, given limited capacity for designing) and for testing (given limited capacity of testing laboratories).

Costs of redesign of products

Products covered by the proposed measure have a typical design cycle of 2.5 to 3 years, or up to 5 years for products of high performance that need to cope with various other requirements / operating conditions. The (re)design will eventually lead to performance tests to be carried out to verify the designed performance. And for certain products or product ranges a (re)design may mean that production facilities have to be adapted or established, which requires long term planning and high investment, especially if a change related to use of refrigerants is intended (e.g. flammable refrigerants require a different set-up for production facilities). Given the limited design, testing capacity and adaptation of production facilities this means that only a certain percentage of products are undergoing redesign every year.

The actual additional costs for (re)designing products and production facilities to meet proposed requirements is not known. Of course a modest requirement will require less costs, than a very stringent one. Costs may be assumed to be passed on to final customers, but do force a manufacturer to make upfront costs, which are only recuperated over the total design life cycle. A very ambitious set of requirements will drive up design and development costs and may affect European manufacturers' competitiveness on the world market.

Testing costs and laboratory capacity

Capacity

There is a limited number of laboratories that can perform performance testing (energy efficiency, capacity, etc.) of chillers, air conditioners and heat pumps and cooling products. There is in particular a lack of laboratory capacity for testing of very large equipment and of very complicated equipment. For example an estimated maximum of 10 laboratories exist in Europe that can perform VRF testing and the largest of these (currently assigned to do Eurovent Certification testing) can only test for seasonal efficiency up to max 20 kW. High capacity testing is problematic as the heating tests require climatization (cooling) of large testing rooms up to minus 20 degrees where required. Equipment of higher capacities are rated according modelling exercises based on tests of smaller units.

Of course many manufacturers may have their own facilities to do testing, but these are not to be used for market surveillance, so the problem mainly exists for verification and certification.

Costs

The test costs depend on the number and type of test to be performed: Testing at standard rating conditions is less costly than testing at different operating temperatures (which is required for establishing seasonal efficiencies). Indicatively a test for both establishing SEER and SCOP may be between 30 to 40 000 euro. If sound (noise) testing is included costs rise by 5 000 euro.

For total test costs the following calculation is set up:

- manufacturers have a number of product families to declare performance for (could be >30 for larger manufacturers and <5 for smaller manufacturers). For chillers it is assumed to be one family as the number of models is known;

- each family has a number product variants, an average of 20 variants is assumed and indicated;

- testing is required for 20% tot 50% of models within each family, with the remainder covered through extrapolation or calculation from the tested results;

- testing is required every 3 years (average design cycle), resulting in testing of 33% of the total number of models each year, except for high temperature process chillers where testing is assumed to be required every 5 years, in conformity with the information given for medium and low temperature process chillers;

- the test cost per manufacturer are multiplied by the number of manufacturers, whereby a number of smaller manufacturers has been added, with 50% of test costs.

The above calculation results in some 40 million € euro of annual test costs, which represents 0.1% of total annual expenditure. These costs do not vary significantly across the options considered.

There is however a relation to the proposed measurement and calculation method, as the tests for chillers could be classed under two product categories (comfort chiller and high temperature process chiller) with differing requirements and calculation methods. Integrating the measurement and calculation methods could reduce the required number of eight test points.

Compliance costs are expected to increase significantly as more elaborate testing will be required compared to a business-as-usual scenario. Costs will be borne by manufacturers, in particular by those who do not own an internal testing facility and instead depend on use of third party testing laboratories, and will be passed on to final consumers. There is no quantitative data available on the number and size of companies with and without internal testing facilities. The other actors in the value chain (importers, wholesale, retail, installers) are expected to remain relatively unaffected.

Assuming that for most products testing at only standard rating conditions is required, this would reduce test costs on average to 1/3, resulting in total 14 million € of test costs for the business-as-usual scenario.

Impact of forthcoming F-Gas revision

Refrigerants are currently regulated through the so-called F-gas Regulation 842/2006, which has recently been reviewed.

The prohibition from 2025 onwards of HFCs with a $GWP_{100\ years}$ of more than 750 for split AC systems containing a maximum 3 kg of those gases, will phase out the use of high GWP HFCs for the smaller units (indicatively below 20 kW). The phase-out (prohibition) of the use of high GWP HFCs in some categories (in particular in refrigeration) will liberate HFCs for the use in other equipment where no specific prohibitions have been introduced, such as chillers or larger air conditioners. The overall phase-down of gas consumption and the fact that in some product categories the use is phase out altogether will however send a strong signal to the end user on the need to invest into lower GWP technologies.

6.2.4. Competitiveness and internal market

International trade

The process for establishing ecodesign requirements has been fully transparent, and before adoption of the measures a notification under WTO-TBT will be issued.

The majority of air conditioner and heat pump products covered under the scope of the proposed measure are produced outside the EU, although a limited number of suppliers also have production facilities in the EU.

For chiller products EU production is more relevant than for the air conditioner / heat pump products, although the major suppliers also import products.

6.2.5. Territorial impact

Territorial impact assessment (TIA) is one of the possible elements of the impact assessments. According the Impact Assessment guidelines issued 2009[36], TIA is only required when the policy explicitly targets a (type) of region and/or the policy targets some regions or areas more than others. In this case, these conditions do not apply and thus the TIA is not required.

6.3. Environmental impact

6.3.1. Greenhouse gas emission reduction

Greenhouse gas (GHG) emissions are based on the fuel or electricity consumption and the specific GHG emission of a fuel or unit of electricity. The specific emission values of electricity is based on the MEErP 2011 study.

Overall GHG emissions in the baseline are expected to reduce from 115 Mt CO_{2eq} in 2010 to some 110 Mt CO_{2eq} in 2030 as a combined effect of changes in sales and energy efficiency. The policy options reduce overall GHG emissions compared to baseline from 110 to 99 to 105 Mt in 2030, a reduction of 5-10%. Part of the savings are also attributable to an increase in electricity generation efficiency (conversion according MEErP 2011).

Table 13: Overall GHG emissions [Mton $CO_{2\,eq}$ / year]

	2010	**2020**	**2030**
BAU	115	120	110
Suboption A	115	115	99
Suboption B	115	118	105
Suboption C	115	117	103

[36] European Commission, Impact Assessment Guidelines, SEC(2009)92

The share of direct (refrigerant related) GHG emissions compared to the indirect (electricity consumption related) emissions of only the equipment using compressors (thus excluding warm air heaters) increases from 10% in 2010 to 12% in 2020 and 15% in 2030 according BAU or 17-19% in 2030 according option A to C (whereby total indirect emissions exclude GHG emissions by warm air heaters).

Per main product category the direct emissions as share of total emissions per main product category are as shown in the table below.

Table 14: Overall GHG emissions [Mton $CO_{2\,eq}$ / year]

		Share direct as % of total direct+indirect emissions per product group		
		2010	**2020**	**2030**
Comfort chillers	BAU	13%	14%	15%
	Suboption A		14%	16%
	Suboption B		14%	15%
	Suboption C		14%	15%
elec HP / AC	BAU	18%	19%	21%
	Suboption A		20%	24%
	Suboption B		19%	22%
	Suboption C		19%	22%
HTPC	BAU	1.2%	1.2%	1.3%
	Suboption A		1.3%	1.4%
	Suboption B		1.2%	1.3%
	Suboption C		1.2%	1.4%

6.3.2. Use of Low GWP refrigerants

CO_2 emissions of products covered by the proposed measure can be indirect, i.e. linked to the use of energy by the appliance or direct, i.e. linked to the fluorinated refrigerant used.

The use of a 'bonus' in the form of lower, less stringent energy efficiency requirements would allow for investments in energy efficiency to be diverted towards investments in using low-GWP refrigerants. This approach has already been taken in Regulation 206/2012 with regard to ecodesign requirements for air conditioners and comfort fans[37] where a less stringent efficiency requirements is set for products using refrigerants with a GWP below 150. The use of such bonus was proposed on the Working Document discussed 25 September 2013 in the Ecodesign Consultation Forum.

The analysis needs to take into account that the products covered by the proposed Regulation are different in what refers their usage patterns (for instance, number of hours used per year) and in the technologies they use, in consequence, the share of direct / indirect emissions differs per product resulting in different optimum values for any tentative bonus that might be applied.

Table 15 Overview of direct and indirect emissions by main product categories (vapour compression cycle only) and ecodesign options

	Direct emissions	Indirect emissions

[37] OJ L 72, 10.3.2012, p. 7.

Year		2010	2015	2020	2025	2030	2010	2015	2020	2025	2030
Comfort chillers	BAU	1.9	2.3	2.6	2.9	3.2	12.5	14.4	15.4	15.3	14.5
	Suboption A	1.9	2.3	2.8	3.1	3.5	12.5	14.3	14.9	14.4	13.3
	Suboption B	1.9	2.3	2.7	3.0	3.2	12.5	14.3	15.3	15.2	14.3
	Suboption C	1.9	2.3	2.7	3.1	3.4	12.5	14.3	15.1	14.7	13.7
AC's	BAU	6.4	7.6	9.0	10.2	11.6	12.5	14.4	15.4	15.3	14.5
	Suboption A	6.4	7.7	9.6	11.6	14.0	29.0	31.7	31.2	28.5	25.2
	Suboption B	6.4	7.7	9.1	10.6	12.4	29.0	31.9	32.7	31.2	28.7
	Suboption C	6.4	7.7	9.3	11.1	13.2	29.0	31.9	32.3	30.3	27.3
HTPCs	BAU	0.5	0.5	0.6	0.6	0.7	38.0	41.0	43.4	44.5	44.7
	Suboption A	0.5	0.5	0.6	0.7	0.8	38.0	40.9	42.4	42.6	42.1
	Suboption B	0.5	0.5	0.6	0.6	0.7	38.0	40.9	42.6	42.9	42.5
	Suboption C	0.5	0.5	0.6	0.7	0.8	38.0	40.9	42.6	42.7	42.3

This impact assessment has calculated the level at which the effect of the bonus in terms of a reduction of direct CO_2 emissions stops being positive due to an increase on the indirect emissions due to a relatively lower energy efficiency of the products covered by the implementing measure.

Only the effect on total CO_2 emissions is discussed. As the proposed Regulation will address the minimum energy efficiency of the equipment placed on the market but not the refrigerant used further considerations regarding the applicability of different refrigerants to different uses are not considered or impacts on life cycle costs of the product are not considered, in this respect, the 'bonus' is to be considered as an additional feature as consumers / manufacturers will have the option of opting for a product complying with the conventional energy efficiency requirements.

The analysis has been done taking as basis the data collected in the relevant preparatory studies regarding leakage rates, refrigerant charges, etc. The results of this analysis show the following effect of the use of a bonus on the total CO_2 emissions for the different product groups covered by the Regulation.

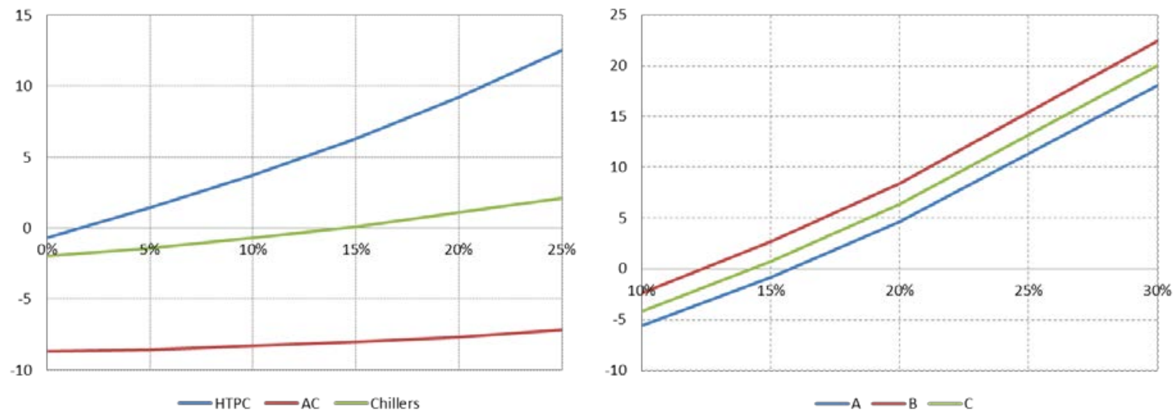
- For comfort chillers, a bonus of 14% results in a neutral effect in terms of CO_2 emissions.

- For air conditioners, the share of direct emissions is the greater among the products covered by the Regulation, these results in a general positive effect of a bonus in terms of total CO_2 emissions. Nevertheless, it is to be noted that a bonus above 15% results in efficiencies below the business as usual scenario.

- For high temperature process chillers, a relatively small bonus (around 2%) results in an increase of the total emissions of these products.

- Regarding the effect of a bonus applied to all products within the scope of the proposed Regulation it can be noted that suboption A is the one where the value of the bonus can be higher without having a negative effect on the total CO_2 emissions (around 16%). In the case of option B a 13% bonus can already result in increased total CO_2 emissions. Option C is in the middle of the two before mentioned cases.

Figure 1: Effect of bonus on total CO_2 emissions for different product groups and policy options [Mton/year]



Different refrigerants have been modelled as substitutes for different products, in general for chillers R-32 has been assumed as substitute for air conditioners while HFO1234yf/ze has been modelled as substitute for comfort chillers and HTPC.

The use of refrigerants assumed for the BAU option for all sub-options has been kept identical to that of the preparatory studies (DG ENTR Lot 6 in particular), the same applies to leakage rates of refrigerants and usage patterns of appliances.

In consequence fixing a bonus at an adequate level for chillers and air conditioners equipment using refrigerants with GWP below 150 would be positive from a total CO_2 emission point of view.

6.3.3. Reduction of emissions of nitrogen oxides

As explained before, reducing NO_x emissions is also an objective of policies and measures aiming at reducing emissions to air of polluting substances. All policy options analysed in this IA will contribute to this.

The current trend shows a reduction of acidifying emissions from 39 kton SOx $_{eq.}$/yr in 2010 to 22 kton/year in 2030.

Regarding the requirements proposed in sub-option A, the relevant industries (of GEHP and fuel fired WAH) have responded that these requirements cannot be achieved and would result in a complete phase out of these products. The impact assessment must therefore conclude that the savings for sub-option A cannot be achieved, unless a major phase out of models is accepted.

Sub-option B does not introduce NO_x requirements for GEHP and more attainable levels for WAH. This leads to savings by 2030 of around 1.7 kton compared to baseline (BAU).

Sub-option C is more stringent for GEHP as certain industry actors assume the targets to be attainable. For WAH the requirements are identical to sub-option B resulting in savings of 2.2 kton by 2030.

Table 16: Overall NO_x emissions [kton $SO_{x\,eq}$ / year]

	1990	2000	2010	2020	2030

BAU	39.0	44.6	36.2	28.9	22.3
A	39.0	44.6	36.2	27.8	19.1
B	39.0	44.6	36.2	28.5	20.5
C	39.0	44.6	36.2	28.2	20.1

6.4. Social impact

6.4.1. Employment, training and certification of market actors

Exact data on employment in the sector is not available. The best estimate of current employment, based on information in annual reports and anecdotal data in the public domain, is used for the following assessment.

The number of jobs then follows from the division of a specific revenue by the average revenue per employee. For example, if the industry revenue doubles then also the employment doubles. Following MEErP 2011[38] , the average revenue per employee for the various market actors is used as a parameter to calculate the employment effects. (around 160-170 000 euros per employee in the HVAC industry and 100 000 euros per employee for installers).

Table 17: Jobs for year 2030 [No·1000]

	Retail/installer	Wholesale	Manufacturer	Energy provider	Total
BAU	158	49	72	36	315
A	171	53	79	32	336
B	163	51	75	34	323
C	167	52	77	34	330

Following MEErP 2011, indirect employment effects outside the sector are not taken into account. This means that no Input/Output analysis or other type of analysis was employed to estimate e.g. the indirect jobs in the local economy where the workers spend their income. Also the indirect employment effect of the tax income generated by the sector is not taken into account. The employment analysis is strictly limited to the air heating products, cooling products and high temperature process chiller industry, their OEMS (i.e. compressors), the AC/H system industry (refrigerants, piping, terminal units, installation materials), wholesalers and retailers/installers (installing and maintaining products and the system they operate in).

It should be noted that there are large uncertainties in future projections. Especially the crisis in the construction industry since 2008 will have effect on primarily new built applications, but possibly also on decisions for maintaining or investing in refurbishment of equipment. The AC/H industry has suffered from the crisis, but exact figures cannot be given. Also it is not certain if Member States are willing to invest substantially in promoting, through subsidies and regulations, energy efficiency in buildings, in general.

The increase in the jobs, e.g. for installers, in the various policy scenarios may seem optimistic, but it should be taken that the total number of jobs in the EU27 building installation sector is around 3.4 million (Eurostat 2010). In that light 0.09 million jobs (value for 2010) are only 3% of the total.

As many products in this scope rely on use of refrigerants only properly trained and certified technicians should be charged with sizing and installing a heating or cooling system for safety

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[38] Methodology for Ecodesign of Energy-related Products (MEErP 2011) Final Report Part 1: Methods VHK 28/11/2011 for COWI Belgium sprl

reasons as well as for optimising the system performance. Further training of installers is needed in order to cope with the increasing degree of complexity to adjust the appliances. The "F-Gas" Regulation 842/2006 prescribes training and certification of personnel handling fluorinated gases such as HFCs. For other refrigerants, such as CO2, hydrocarbons or ammonia, other legislation is relevant, such as the pressurised equipment Directive (97/23/EC).

Employment impacts outside the EU are primarily indirect ones. The analysis does not calculate net employment impacts, which would require applying complex economic modelling. This would have to take into account (among other aspects) direct and indirect impacts of substituting other heating or cooling systems.

All policy options have a positive impact on employment, creating around 7-20 thousand jobs in the EU in year 2030; most of these jobs are to be created in the retailer/installer sector.

6.4.2. Consumer economics and affordability

The costs referenced in this chapter are purchase costs, energy costs and life cycle costs which includes the former and costs for installation and maintenance.

Purchase costs or acquisition costs will increase compared to the baseline (note that values are expressed in 2010 prices, and are not corrected for inflation etc.)

Total purchase costs will amount to 20 billion in 2030 according the baseline scenario, or 21 billion according the most stringent sub-option. Differences between options are minor.

Table 18: Acquisition costs per option [billion € / year]

Acquisition costs	**1990**	**2000**	**2010**	**2020**	**2030**
BAU	3	6	11	15	20
A	3	6	11	16	21
B	3	6	11	15	20
C	3	6	11	16	21

Energy costs however are expected to decrease through the introduction of measures as energy efficiencies increases.

Table 19: Energy costs per option [billion € / year]

Energy costs	**1990**	**2000**	**2010**	**2020**	**2030**
BAU	20	26	30	30	28
A	20	26	30	29	25
B	20	26	30	30	27
C	20	26	30	30	26

Overall expenditure, which covers above costs for purchase and energy, and costs for installation of new products and maintenance of existing products, to society for products within scope is calculated to be some 57 billion in 2030. The sub-options reduce this value by 1-2% in 2030.

Table 20: Overall expenditure per option billion € / year]

Total expenditure	**1990**	**2000**	**2010**	**2020**	**2030**
BAU	24	35	45	52	57
A	24	35	45	52	56

B	24	35	45	52	56
C	24	35	45	52	56

6.4.3. Health and safety aspects

Health

For health it should be noted that certain products in scope emit significant levels of noise, by both indoor and outdoor units. Whether or not noise requirements are set is discussed in chapter 6.

Although products can be made less noisy, this often counteracts measures to improve energy efficiency (e.g. a higher air flow over heat exchangers) or leads to bigger and/or more costly products.

There are measures at national level that aim to limit indoor noise and/or outdoor noise. The solutions to limit noise emissions are not limited to modifications of the product only. Limitation of indoor and outdoor noise could also be tackled through various retrofit solutions, or may be superfluous due to other sources of noise (equipment used in industrial areas, ambient noise). Therefore, in order not to compromise energy savings and to allow a certain subsidiarity, sub-option B and C do not impose noise emission limit levels.

The sound power levels as proposed under sub-option A were considered to be too strict by certain stakeholders as they did not consider the difference in rating conditions between heating and cooling modes. At the same time, some of the equipment covered by the proposed measure is already subject to sound power levels set by other existing regulations.

Therefore, this section attempts to describe an alternative scenario for sound power levels, taking into account the maximum sound power levels imposed by other regulations such as 813/2013 and 206/2012 while reducing the severity of the levels.

Regulation 206/2012 on ecodesign requirements for room air conditioners lays down maximum indoor and outdoor sound power levels for air-to-air air conditioners or heat pumps of maximum 12 kW cooling or heating capacity (except single duct or double duct units, for which a maximum indoor sound power of 65 dB(A) is set). The sound power is to be established at the standard rating conditions (see further below).

Regulation 813/2013 for ecodesign of space heaters and combination heaters lays down maximum sound power levels for heat pump (combination) heaters also to be established at standard rating conditions, but this time only for equipment connected to a water-based heating system.

The standard rating conditions in Regulation 206/2012 assume the product to be operating at 100% load conditions when cooling or at part load conditions when heating (standard rating conditions for cooling are equal to reference design conditions, with indoor temperature at 27ºC and outdoor at 35ºC). The standard rating conditions in Regulation 206/2012 and 813/2013 for heating assume the product to be operating at part load conditions as the standard rating conditions relate to an indoor air temperature of 20ºC and outdoor air temperature of 7ºC (the reference design conditions for an average heating season define -10º as outdoor air temperature).

The above leads to the conclusion that for equipment $\leq$ 12 kW in principle regulation 206/2012 for sound power when cooling is more strict as 813/2013 as the same sound power values apply to a (cooling) condition which is under heavier loads. There are currently no sound power levels identified for cooling products other than (reversible) air-to-air conditioners / heat pumps, and/or of a capacity beyond 12 kW.

Therefore it can be concluded that for equipment providing heating up to 70 kW the sound power levels of regulation 813/2013 can be applied, in order not to create an uneven playing field between competing technologies. The indoor noise requirements however must consider both categories of ducted and non-ducted units, as this element did not apply to products covered by 813/2013. These can be based on values identified in the preparatory studies.

For equipment providing cooling up to 12 kW the sound power levels of 206/2012 can be applied (are identical to equipment providing heating up to 12 kW). For equipment with a cooling capacity exceeding 12 kW new requirements should be set, up to a capacity of maximum 70 kW, in analogy with 813/2013.

In the below table these are based on the sound power levels identified in the preparatory studies (DG ENTR Lot 6 in particular). As the values for heating and cooling are equal it can be concluded that the values for cooling mode will be the limiting (stricter) values. This is considered acceptable as the DG ENTR Lot 6 study applies to cooling products in particular and an assessment of impacts is performed. However, the progressive stringency in three tiers is not adopted, in order to stay in line with existing regulations, that have applied only a single tier.

Table 21: Suboption A maximum sound power levels.

<table>
<tr><th colspan="12">Maximum sound power level (L_{WA}) in dB, for equipment with a</th></tr>
<tr><td colspan="3">rated heating output ≤ 6 kW</td><td colspan="3">rated heating output > 6 kW and ≤ 12 kW</td><td colspan="3">rated heating output > 12 kW and ≤ 30 kW</td><td colspan="3">rated heating output > 30 kW and ≤ 70 kW</td></tr>
<tr><td>indoors, non-ducted</td><td>indoors, ducted</td><td>outdoors</td><td>indoors, non-ducted</td><td>indoors, ducted</td><td>outdoors</td><td>indoors, non-ducted</td><td>indoors, ducted</td><td>outdoors</td><td>indoors, non-ducted</td><td>indoors, ducted</td><td>outdoors</td></tr>
<tr><td>60*</td><td>60***</td><td>65*</td><td>65*</td><td>65***</td><td>70*</td><td>70*</td><td>70/80***</td><td>78*</td><td>80*</td><td>85***</td><td>88*</td></tr>
<tr><td colspan="3">rated cooling output ≤ 6 kW</td><td colspan="3">rated cooling output > 6 kW and ≤ 12 kW</td><td colspan="3">rated cooling output > 12 kW and ≤ 30 kW</td><td colspan="3">rated cooling output > 30 kW and ≤ 70 kW</td></tr>
<tr><td colspan="2">indoors</td><td>outdoors</td><td colspan="2">indoors</td><td>outdoors</td><td colspan="2">indoors</td><td>outdoors</td><td colspan="2">indoors</td><td>outdoors</td></tr>
<tr><td>indoors, non-ducted</td><td>indoors, ducted</td><td>outdoors</td><td>indoors, non-ducted</td><td>indoors, ducted</td><td>outdoors</td><td>indoors, non-ducted</td><td>indoors, ducted</td><td>outdoors 1)</td><td>indoors, non-ducted</td><td>indoors, ducted</td><td>outdoors</td></tr>
<tr><td>60**</td><td>60</td><td>65**</td><td>65**</td><td>65</td><td>70**</td><td>70***</td><td>70_B / 80_B ***</td><td>75 / 80_A ***</td><td>80***</td><td>85</td><td>85***</td></tr>
<tr><td colspan="12">* Sound power level based on 813/2013
** Sound power level based on 206/2012
*** Sound power level based on first tier in table 7-19 of Task 7 of DG ENTR Lot 6 preparatory study (p. 61). The values for heating and cooling are similar for outdoor and non-ducted units, which means that for cooling the levels are quite strict. The analysis of Task 7 is however based on the cooling performance and identified for most products (except for VRF for which no data was available) that these requirements would be attainable at LLCC levels (not BAT levels).
A) for packaged products only (the outdoor sound power level can be 5 dB higher than for other equipment)
B) for ducted indoor sound power of units of 12-17.5 kW, the lower value applies, for units between 17.5-30 kW the higher value applies.</td></tr>
</table>

Safety

The products in scope are covered by existing legislation regarding safety such as the Low Voltage Directive, the Gas Appliance Directive, the Pressurised Equipment Directive and the Machinery Directive. For products using fluorinated refrigerants the F-Gas Regulations is relevant.

6.5. Conclusion on economic, social and environmental impacts

The tables below give a comparative overview of the main impacts of the analysed policy options versus the objectives of Ecodesign measures following the criteria mentioned in Art.

15 of 2009/125/EC and an overview of fulfilment of boundary conditions according to sub 5 of this article. The complete summary table can be found in Annex 6.

Table 22: Overview of approximate impacts of the different policy options for 2030

	Scenarios 2030			
	BAU	**A**	**B**	**C**
Environment				
Energy [PJ / year]	2534	2279	2420	2361
GHG [Mton $CO_{2\ eq}$ / year]	110	99	105	103
Acidification [kton SO_x / year]	22	19	21	20
Consumer [billion € / year]				
expenditure	57	56	56	56
purchase costs	20	21	20	21
energy costs	28	25	27	26
Business (turnover) [billion € / year]				
manufacturer	11.9	13.0	12.3	12.7
wholesale	13.7	14.9	14.2	14.6
retail/ installer	15.8	17.1	16.3	16.7
Employment [jobs · 1000]				
Retail/installer	157.8	171.3	162.9	167.4
Wholesale	49.2	53.4	50.8	52.2
Manufacturer	72.3	78.5	74.6	76.7
of which within EU	34	42	42	42
of which OEM	4	4	4	4
Energy providers	36	32	34	34

7. MARKET SURVEILLANCE OF VERY LARGE EQUIPMENT

The proposal for ecodesign requirements for power transformers describes a procedure for checking compliance similar to that of many (all) other ecodesign requirements, however has added a paragraph specifically for larger equipment or equipment placed on the market in low quantities. This paragraph states: "*Given the weight and size limitations in the transportation of medium and large power transformers, Member States authorities may decide to undertake the verification procedure at the premises of manufacturers, before they are put into service in their final destination.*"

A similar procedure may apply to equipment (very large chillers, up to 2 MW cooling capacity) covered by the proposed measure.

This requires the existence of generally recognised state of the art measurement methods, including methods set out in documents the reference numbers of which have been published for that purpose in the Official Journal of the European Union, that could be used for 'in situ' measurement or measurement before 'putting into service'. A mandate for the establishment for such measures to the relevant European Standardisation Organisations could be issued. The timing of the requirements should take into account the time needed to develop such methods, or the existence of transitory methods.

7.1. Conformity Assessment

The New Approach entailed refining conformity assessment in such a way as to allow the Community legislator to evaluate the consequences of the utilisation of different conformity assessment mechanisms. The Global Approach introduced a modular approach, which subdivided conformity assessment into a number of operations (modules).

These modules differ according to the stage of development of the product (for example design, prototype, full production), the type of assessment involved (for example documentary checks, type approval, quality assurance), and the person carrying out the assessment (the manufacturer or a third party).

The Global Approach was completed by Council Decision 90/683/EEC, which was replaced and brought up to date by Decision 93/465/EEC, which was repealed by Decision No 768/2008/EC. These decisions lay down general guidelines and detailed procedures for conformity assessment that are to be used in New Approach directives. Thus, conformity assessment is based on:

- manufacturers' internal design and production control activities ('self declaration');
- third party type examination combined with manufacturers' internal production control activities;
- third party type or design examination combined with third party approval of product or production quality assurance systems, or third party product verification (5);
- third party unit verification of design and production; or
- third party approval of full quality assurance systems.

In addition to laying down guidelines for the use of conformity assessment procedures in technical harmonisation directives, Decision No 768/2008/EC (repealing Decision 93/465/EEC) harmonises the rules for the affixing and use of the CE marking.

In Directive 2009/125/EC, Article 8 Conformity assessment, item 2) it is stated: "The conformity assessment procedures shall be specified by the implementing measures and shall leave to manufacturers the choice between the internal design control set out in Annex IV to this Directive and the management system set out in Annex V to this Directive. Where duly justified and proportionate to the risk, the conformity assessment procedure shall be specified among relevant modules as described in Annex II to Decision No 768/2008/EC ("Conformity assessment procedures"), these are as shown below.

- Module A, Internal production control
- Module A1 Internal production control plus supervised product testing
- Module A2 Internal production control plus supervised product checks at random intervals
- Module B EC-type examination
- Module C Conformity to type based on internal production control

- Module C1 Conformity to type based on internal production control plus supervised product testing
- Module C2 Conformity to type based on internal production control plus supervised product checks at random intervals
- Module D Conformity to type based on quality assurance of the production process
- Module D1 Quality assurance of the production process
- Module E Conformity to type based on product quality assurance
- Module E1 Quality assurance of final product inspection and testing
- Module F Conformity to type based on product verification
- Module F1 Conformity based on product verification
- Module G Conformity based on unit verification
- Module H Conformity based on full quality assurance
- Module H1 Conformity based on full quality assurance plus design examination

No such risk has been proven in the supporting analysis (preparatory study or impact assessment) or raised by stakeholders.

In related Regulations (for example 813/2013 on space heaters) the chosen conformity assessment is based on self-declaration: The internal design control set out in Annex IV of Directive 2009/125/EC or the management system set out in Annex V to that Directive.

This annex does not specify in detail how equipment of which the declared performance is not based on an actual test carried out should be declared. In the proposed measure for ventilation products, it is stated that in case the information included in the technical documentation for a particular product has been obtained by calculation on the basis of design, or extrapolation from other equivalent products, or both, the technical documentation shall include the following information:

a) details of such calculations or extrapolations, or both;

b) details of tests undertaken by manufacturers to verify the accuracy of the calculations and extrapolations;

c) a list of any other products where the information included in the technical documentation was obtained on the same basis.

Such a clause could apply to air heating and cooling products, including high temperature process chillers as well.

8. COMPARISON OF POLICY OPTIONS

The table below shows the options compared on fulfilling boundary conditions for requirements according Article 15 of Directive 2009/125/EC.

Table 23: Evaluation of policy options in terms of their impacts compared to the base line

	Sub-options			Comment
	A	B	C	
Promote energy efficiency hence contribute to security of supply	+++	+	++	Option A saves most energy and reduces emissions most
Reduce energy consumption and related CO_2 missions	+++	+	++	
Reduce GHG and NOx emissions	+++	+	++	
No significant negative impacts on the functionality of the product from the perspective of the user	---	0	-	negative for A as certain products are completely removed from the market (GEHP and WAH) and others experience extensive affected sales volumes. Neutral for B, and slightly negative for C as some sales volume is affected
Health, safety and the environment shall not be adversely affected	++	0	0	Option A addresses noise, option B/C do not.
No significant negative impact on consumers in particular as regards affordability and life-cycle costs	---	0	-	Option A will prohibit sales of certain products, prices least affected with option B. Life cycle costs are very much varying accross options and products.
No significant negative impacts on industry's competitiveness	--	0	-	most negative for A as this options would introduce the highest strains on design/engineering and ability for SMEs to follow
Setting of an ecodesign requirement shall not have the consequence of imposing proprietary technology on manufacturers	--	0	-	
Impose no excessive administrative burden on manufacturers	0	0	0	Neutral for all as all options require similar administrative burden (although slightly less for option B and C as fan coils are not within scope)

Legend:
++: very positive impact
+: small positive impact;
0: neutral impact
-: small negative impact
--: large negative impact

Table 24: Comparison of the Policy Options in terms of their effectiveness, efficiency and coherence of responding to the specific objectives

	Sub-options		
	A	B	C
Reduce fuel and electricity consumption and related emissions to air due to use of air heating products and cooling products following Community environmental priorities, such as those set out in Decision 1600/2002/EC or in the Commissions European Climate Change Programme.	+++	+	++

Promote energy efficiency as contribution to security of supply in the framework of the Community objective of saving 20% of the EU's energy consumption by 2020.	+++	+	++
Promote competitiveness of the air heating product and cooling product industry through the creation or expansion of the EU internal market for sustainable products.	+++	+++	+++
Promote market take-up of energy-efficient air heating products and cooling products with low NOx emissions (where relevant);	+++	+	++
Drive investments in R&D towards environmentally friendly products;	++	+	++
Make sustainable products more affordable through mass production;	+	+	+
Not having a significant negative impact on functionality, safety, affordability of the product, nor on the industry's competitiveness and the administrative burden imposed on it as provided in Art. 15 of the Directive;	-	+	+
To maintain consistency with ecodesign requirements developed for other space heating or cooling products;	+	+	+
Impose no excessive administrative burden on manufacturers	0	0	0

Legend:
++: very positive impact
+: small positive impact;
0: neutral impact
-: small negative impact
--: large negative impact

The above assessment shows that although sub-option A is the most advantageous for the environment, the impacts on businesses are considerable, and in certain categories lead to complete phase out of sales volume. This leaves sub-option B and C as viable alternatives, where a balance needs to be struck between somewhat lesser environmental impacts (sub-option C) or somewhat lesser business impacts (sub-option B).

As the removal of noise requirements reduces the strain on achieving the energy efficiency targets, option C is considered to strike the right balance between protecting the environment while respecting the industries competitiveness.

The use of a bonus (e.g. in the order of 10%) for equipment using refrigerants with a GWP below 150 would be positive from a global emissions point of view for comfort chillers and air conditioners.

9. MONITORING AND EVALUATION

The main monitoring element will be the tests carried out to verify correctness of declared energy efficiency, emissions or other required product information. The monitoring of the impacts should be done by market surveillance carried out by Member State authorities ensuring that requirements are met.

An effective market shift towards higher energy efficiencies and lower emissions will be the main indicator of progress towards market take-up of more efficient air heating products, cooling products or high temperature process chillers, i.e. the effectiveness of the measures will be monitored by assessing how the efficiencies and emissions change over time. This information is available from the product fiche.

The main monitoring parameters are: the type of product, the seasonal efficiencies, the type of refrigerant, the heating and or cooling capacities as reported on the product fiches.

There is also a monitoring task for the Commission with a view to the review of this specific regulation. The appropriateness of scope, definitions, concept and possible trade-offs will be monitored through an on-going dialogue with stakeholders and Member States. The main issues for a possible revision of the proposed ecodesign requirements are:

- Possible adverse impacts not foreseen at the time of conclusion of the Regulation;

- Necessity to revise the ecodesign requirements.

Revision and adaptation to technical progress (e.g. market take up of alternative, low GWP refrigerants, etc.) could be implemented through Comitology.

Taking into account the time necessary for collecting and analysing the data and experiences related to the implementation of ecodesign requirements as well as assessing technological progress, a review of the main elements of the framework could be presented 5 years after implementing the regulation.

ANNEX 1: CONSULTATION

DRAFT MINUTES

Meeting of the Consultation Forum under Article 18 of Directive 2009/125/EC on energy-related products

Air heating products, cooling products and high temperature process chillers (Lot 21)

Brussels, 25 September 2013 (10.00 – 15:45)

EC Participants: Ismo GRONROOS-SAIKKALA (Chairman), Marcos GONZALEZ ALVAREZ (ENER), Nina PICKL (ENER), Davide POLVERINI (ENTR)

1. WELCOME AND PRESENTATION

The **Chair** welcomed the participants and indicated that the purpose of the meeting was to discuss the proposed draft Regulation on air heating products, cooling products and high temperature process chillers.

The **Chair** provided an update on the Regulatory Committees and Energy Labelling expert meetings held on 23 and 24 September:

Energy labelling of solid fuel boilers (lot 15): Member States experts agreed that the same label as for other space heaters should apply. Member States requested the Commission to review the Biomass Labelling Factor (BLF) so biomass boilers can achieve a higher energy class. The Commission will proceed with the adoption of the Regulation on the basis of the content of the discussion.

Energy labelling of local space heaters (lot 20): the majority of Member States experts agreed that electric products should be out of the scope and that the approach for biomass products should be coherent with the approach to be taken for biomass boilers. The Commission would proceed with adoption of the regulation on the basis of the content of the discussion after the meeting on ecodesign of local space heaters foreseen for 9-10 October.

Ecodesign regulatory committee on **solid fuel boilers (lot 15)**: It was not possible to find an agreement in the Regulatory Committee. On emission requirements neither the proposal from the Commission, nor alternatives from different Member States allowed reaching an appropriate solution.

2. WORKING DOCUMENTS

After a presentation of the proposed Regulation from **Commission** services the documents were discussed by Member States and stakeholders.

2.1. Scope

INFORSE asked why the proposal sees no need for labelling. **EVIA** indicated that fan coils should be excluded from the scope of the Regulation, this comments was supported by **JRAIA**. **SE** supported the inclusion of fan coils in the scope of the Regulation. **EVIA** asked if solar heating air devices where covered by the proposal. **FI** asked whether district heating and cooling are within the scope of the Regulation.

The **Commission services** replied that the products under the lot were intended to be specified and installed by professionals and thus labelling was not necessary. They replied that noise had been identified as a relevant environmental impact of fan coils during the preparatory studies. They indicated that solar air heating devices and district heating and cooling are not covered by the proposal.

2.2. Relationship with F-Gas Regulation and bonus depending on GWP of refrigerant

UK raised the question whether we should wait for the final outcome of the F-gas Regulation review. This comment was supported by **DK** who added that a wrong signal would be given that low refrigerants with low GWP are less efficient if a bonus is used. They indicated that there is no need for such bonus. **EPEE** supported **UK** and **DK** and indicated that the bonus used for comfort chillers using an F-Gas with a GWP below 675 should be deleted. **EEB** stated that the proposed bonus does not contradict the F-gas Regulation but instead it will give an extra incentive for industry. **EPEE** expressed its concerns indicating that CO_2 emissions are not the only problem and other aspects such as security of supply should be analysed before granting a bonus. **DE** indicated that if a bonus is to be used it should be in line with the Regulations on air conditioners, where the value used for the threshold has been 150.

The **Commission services** stated that the use of the bonus and its specific level would be readdressed during the Impact Assessment phase and that current proposals are based on the findings of the preparatory study. They invited participants to provide written comments including technical data on the topic. They indicated that the final result of the review process of the F-gas Regulation will be taken into account during the rest of the process.

2.3. Seasonal Space Heating efficiency

EPEE appreciated the conversion to seasonal energy efficiency and indicated that the requirements are too stringent. **EUROAIR** indicated that the requirements for warm air heaters are too stringent. **CETIAT** asked for coherent dates of entry into force of requirements, aligning them with Lot 1. **DE** and **INFORCE** argued that the energy efficiency requirements are comparatively low and that they could be higher as the preparatory study shows. **CLIMAGAS** suggested waiting until the final calculation methods are ready before setting minimum requirements. This comment was supported by **ASERCOM** and **MARCOGAZ. DK** asked for a faster coming into force of requirements. **EPEE** said that in their opinion the time given in the documents is too short since a number of product ranges need to be redesigned and between 2 and 3 years are needed to redesign each product range. **CETIAT** mentions that requirements for water to air units are missing.

The **Commission services** pointed out that sometimes measurement methods used in the preparatory studies have been fine-tuned, the small difference in numbers come from different calculation methodologies and added that legislation and standardisation often need to run in parallel. They indicated that in the Impact Assessment different scenarios for the coming into force of requirements and its level of stringency will be analysed. They replied to **CETIAT** that no requirements are proposed for water to air heating products as sales are not significant enough. If industry wants to include them it is possible if relevant data will be provided on those products.

2.4. Seasonal Space Cooling Efficiency

EPEE stated that the proposed efficiency values are too stringent and would ban 90% of the products from the market. They also indicated that the time given for redesigning such complex products is also too short. They added that there is little margin for improvement on this products. **NL** asked for clarification about the meaning in terms of additional cost to adapt current products to the future requirements. **EEB** indicated that the requirements should be ambitious and take the learning curve into account. This comment was supported by **NL**.

The **Commission services** pointed out that the proposals are based on what the preparatory studies had identified as feasible and with least life cycle costs. Other impacts of the Regulation will be analysed in the Impact Assessment.

2.5. Seasonal Energy Performance Ratio. High temperature Process chillers (HTPC)

CLASP pointed out that the draft definition does not sufficiently distinguish HTPC from comfort chillers. They added that the temperature used in the definition should be changed from 6ºC to 7ºC in order to be in line with the proposals on professional refrigeration. **INFORSE** states that the identified potentials are relatively low. They have found higher potentials and will come back with further comments.

The **Commission services** indicated that the definition of HTPC would be considered based on comments received from stakeholders.

2.6. NO_x emissions

EUROAIR indicated that the proposed limits are too stringent and proposed to send a proposal after the meeting suggesting new thresholds. **DE** indicated that the limit values should be in line with Lot 1. **EUROAIR** mentioned that the combustion temperatures of products under this lot are higher than for products under Lot 1 and in consequence the emission limit values should be higher. **PANASONIC** mentioned that the proposed NO_x requirements are not reachable for heat pumps using combustion engines and proposed to set limits based on energy output instead of fuel input and to consider emission for a seasonal average point of view. This comment was supported by **MARCOGAZ** that asked to establish a proper NO_x measurement method for combustion engine heat pumps. **CLASP** asked about the reasons for setting maximum NO_x emission values for high temperature process chillers.

The **Commission services** indicated that the proposed values should be coherent with Lot 1. Regarding the measurement methods for combustion engine heat pumps it should be developed under the Mandate in preparation on space and water heaters and replied to **CLASP** that although gas engine high temperature process chillers have not been identified, the requirements, in line with those for process chillers have been included to avoid loopholes.

2.7. Noise requirements

EVIA indicated that noise requirements should not be set to these products and that low noise and high efficiency are sometimes not possible at the same time. In addition, noise is not part of the core aspects to be covered under the Ecodesing Directive. This comment was supported by **EPEE** who also indicated that the working temperatures are different than those used for space heaters and in consequence the noise emissions are different. **FGK** also supported the comments and added that the experts designing the systems should be able to make the right choices. **FI** mentioned that maximum noise emissions are usually covered by national legislation. **CZ** considered that the sound power requirements are in direct contradiction to the energy efficiency requirements. They added that the main cause of the sound power is the fan and the compressor and explained that in order to decrease noise, the fan speed needs to be reduced or fans need to be enlarged. They recommend setting limits for residential application only. **FI** supported the comment from **CZ**. **NL** admitted that the importance of noise depends on the surrounding but the proposed Regulation is a way of tackling the problem at its source. **SE** supported the setting of minimum noise requirements.

The **Commission services** replied that noise has been regulated already in other implementing measures. Noise has been identified as a relevant environmental impact of these products. They invited stakeholders and Member States to provide technical evidence regarding the relationship between noise emissions and efficiency and on the corresponding appropriate levels of noise requirements.

2.8. Verification procedure

DK pointed out that some product ranges are so big and complex, third party certification (TPC) should be considered. **NL** supported the comment and asked the **Commission services** to analyse the implications of TPC during the next steps of the process before taking a final decision. **IT** indicated that TPC would not substitute market surveillance and would add an additional extra burden and cause confusion. **BE** supported the comments from **DK** and **NL** and indicated that TPC is already working well for other products. **LV** urged the **Commission services** to take into account the cost imposed on Member States when analysing the different options for the verification procedure and take into account the cost and availability of laboratories in their analysis.

The **Commission services** indicated that a close look to the different options for verification procedure would be carried out during the legislative process, including issues such as cost or availability of laboratories.

3. AOB

The **Chair** informed that some stakeholders had considered the savings projected by the figures in the Ecodesign and Energy Labelling Regulations very high in relation to the 2020 objective. The scenarios developed under the preparatory studies are based on 'bottom-up' engineering models without the intention of taking into account the impacts at the level of the economy, such as the different rebound effects (studies discount up to 50% of the savings due to the rebound effect). On the other hand, the economic modelling, PRIMES, used by the Commission services does not address product policy measures in sufficient detail. To address the matter, JRC (Sevilla) was contracted to develop a new economic model (currently called 'POTENCIA'), which is meant to replace PRIMES. The new model will better integrate the bottom-up product policy impacts into the top-down macroeconomic modelling of impacts of product policy measures. In addition, a contract has been launched in order to consolidate the saving estimates made in the different preparatory studies and impact assessments in the past and prepare them for input to the POTENCIA model. It is expected that the new model will be running a year from now.

SE welcomed the initiative and is looking forward to having this new tool.

A document with information on the schedule for upcoming meetings was handed out.

The **Chair** ended the discussion and welcomed any further feedback and data from stakeholders, in particular during the coming month.

Attendance list

Commission Services	Ismo GRONROOS-SAIKKALA Marcos GONZÁLEZ ÁLVAREZ Davide POLVERINI Nina PICKL
Austria	Franz KESNER
Belgium	Bram SOENEN Guibert CREVECOEUR
Bulgaria	Bontcho BONTCHEV
Czech Republic	David SCHREIB
Germany	Floris AKKERMAN Anja BEHNKE Miriam HÄFELE Arne KÜPER Jens SCHUBERTH
Denmark	Bjarke HANSEN Per Henrik PEDERSEN
Estonia	Urmas RAUDSAAR
Finland	Pekka KALLIOMAKI Mikko NYMAN
France	Evelyne BISSON
Hungary	Domagoj VALIDZIC
Ireland	Mark SWEENEY
Italy	Simonetta FUMAGALLI Milena PRESUTTO Paolo ZANGHERI
Lithuania	Ilona GOLOVACIOVA
Latvia	Reinis BERZINS
The Netherlands	Hans-Paul SIDERIUS
Norway	Hans T. HAUKAS Kjell THORSEN
Poland	Ewa KOSSAK
Sweden	Carls LOPES
Slovenia	Andreja BELAVIC BENEDIK
The United Kingdom	Edward Michael RIMMER
ASERCOM	Hermann RENZ
Bureau of Energy Efficiency India	Ashish SARASWAT
CEN	Andrea CETRONE
CETIAT	Michele MONDOT
CLASP	Marie BATON Jeremy TAIT
CLIMAGAS	Sergio ZALLOCCO
ECEEE	Nils BORG
ECOS	Stamatis SIVITOS
EEB	Stephane ARDITI
EHI	Fanny Rateau
EHPA	Dina KOEPKE Pieter-Jan CLUYSE
EPEE	Denis BONVILLAIN Els BAERT Veerle BEELAERTS Pierre CREVAT Paul de LARMINAT Mihai SCUMPIERU

	Andrea VOIGT
EUROAIR	Bert STAVENGA Ian VAUGHAN
EUROVENT	Sylvain COURTEY Felix VAN EYKEN
EVIA	Claus HAENDEL
FGK	Stefan THIE
GDFSUEZ	Rodolphe DESBOIS
GEA	Franz-Josef HOFFMANN
GrDF	Thierry ROCQUE
INFORSE	Gunnar Boye OLESEN
JRAIA	Osami KATAOKA
MARCOGAZ	Francisco SICHAR
ORGALIME	Anne Claire RASSELET Nina LETH-ESPENSEN
PANASONIC	Sebastian MERINO HAMAMURA
VHK	Martijn VAN ELBURG

ANNEX 2: BASELINE DATA

The following data and values have been used for the baseline calculations.

1. SALES, PRODUCT LIFE AND STOCK

Throughout this report products are referred to in an abbreviated form. The table below shows how these align with more elaborate product description.

Comfort chillers	
Air-cooled <400 kW	AC<350kW
Air cooled >400 kW	AC>350kW
Water cooled <400 kW	WC<350 kW
Water cooled 400-1500 kW	WC>350kW
Water cooled >1500 kW	WC>1000kW
Electric Air conditioners & heat pumps	split AC
	VRF
	rooftop
Gas Engine driven Air conditioners & heat pumps	GEHP
High temp. process chillers	
Air-cooled <400 kW	HTPC-AC<350kW
Air cooled >400 kW	HTPC-AC>350kW
Water cooled <400 kW	HTPC-WC<350kW
Water cooled 400-1000 kW	HTPC-WC>350kW
Water cooled >1000 kW	HTPC-WC>1000kW
Warm air heaters - Gas	gasWAH
Warm air heaters - Electric	elecWAH

Table A2-1: Sales per year

	1990	2000	2010	2020	2030
Sales [No·1000 / year]					
Comfort chillers	26	73	105	127	152
Air-cooled <400 kW	21	60	88	107	129
Air cooled >400 kW	2	5	6	7	7
Water cooled <400 kW	2	6	9	11	13
Water cooled 400-1500 kW	1	1	2	2	2
Water cooled >1500 kW	0	0	1	1	1
Electric Air conditioners & heat pumps	103	350	459	535	578
Gas Engine driven Air conditioners & heat pumps	0	0	0.75	1.2	1.7
High temp. process chillers	17	21	27	31	33
Air-cooled <400 kW	9	12	15	17	19
Air cooled >400 kW	3	4	5	5	6
Water cooled <400 kW	2	3	4	4	5
Water cooled 400-1000 kW	2	2	3	3	4
Water cooled >1000 kW	0.1	0.2	0.2	0.3	0.3
Warm air heaters - Gas	133	102	87	77	69
Warm air heaters - Electric	3	4	5	5	5

The sales have been based on market data as presented for the year 2010 in the preparatory studies. The sales for the historical years (before 2010) and projections (beyond 2010) are also based on information provided in these studies. It must be noted that as the Impact Assessment is based on parametric modelling and the preparatory studies only provided values "as is" the total of sales can be different.

Contrary to some products groups covered by the preparatory study, this Impact Assessment did not keep sales constant for certain product groups. Instead a gradual increase or decline for certain models was introduced to arrive at more plausible outcomes, also in relation to market trends identified in the same preparatory studies (where available).

As this Impact Assessment also covers products not analysed as base case in the preparatory studies (but which were needed in the Impact Assessment as requirements may or may not apply to these products) another difference to the data presented in the preparatory studies is introduced.

The results of the analysis are very sensitive to the assumptions made for high temperature process chillers. The underlying analysis assumes a modest increase in sales, of close to 2% increase in 2015, but levelling off to 0.5% in 2030. Furthermore, did the underlying assumption introduce an extra category of high-temperature process chillers of above 1000 kW following proposals for requirements for such category. This has changed the average of power attributed to high temperature process chillers categories and thus also the energy requirement for each category. For the other products in scope the assumptions have remained largely the same.

The link of sales to stock (installed base) is governed by the product life of products. These are based on information provided in preparatory studies.

Table A2-2: Product life [years]

AC<350kW	20
AC>350kW	25
WC<350 kW	20
WC>350kW	25
WC>1000kW	25
split AC	15
VRF	15
rooftop	15
GEHP	15
HTPC-AC<350kW	15
HTPC-AC>350kW	15
HTPC-WC<350kW	15
HTPC-WC>350kW	15
HTPC-WC>1000kW	20
gasWAH	15.9
elecWAH	10

The resulting stock has been calculated as shown below.

Table A2-3: Stock [No·1000]

	1990	2000	2010	2020	2030
Comfort chillers	355	716	1468	2161	2616

Electric Air conditioners & heat pumps	1054	2437	4484	5062	4935
Gas Air conditioners & heat pumps	125	280	499	535	305
HT process chillers	192	266	340	421	473
Warm air heaters	1618	1919	1674	1407	1249

There has been considerable debate during the preparatory studies and afterwards, during the preparation of this Impact Assessment as regards the actual number of sales and stock of these products. The above sales and stock have been re-assessed during the impact assessment study, to take into account stakeholder comments, e.g related to gas engine heat pumps, warm air heaters, comfort chillers (where extra categories have been added).

2. ENERGY EFFICIENCY

As energy efficiency is a ratio between useful output (a heat demand) and energy input (fuel/electricity consumption) this section first describes the heat demand applicable to the various products. This heat demand is calculated as the heating capacity of the products (based on information from preparatory studies) multiplied by 'equivalent full load hours'. The outcome is the applicable heat demand. For most products the equivalent full load hours were calculated such that the resulting heat demand matched the values used in the preparatory studies. As this Impact Assessment must take into account existing legislation in its baseline assumptions, the equivalent full load hours change throughout time to account for on-going improvement of building stock resulting in less overall heat demand (effect of EPBD and various national measures relating to building energy use). This effect has been estimated to be 1% of reduction of full load hours per year. This effect however has not been applied to products for which the ambiance function is more prominent than its heating function, such as open fires (solid fuel and gas, including flue less products).

The heat demand as used in the model is shown below.

Table A2-4: Base heating or cooling demand for calculation

	Nominal capacity [kW]	COOL eq.full load [hrs/yr]	COOL output [kWh/yr]	HEAT eq.full load [hrs/yr]	HEAT output [kWh/y]r	Share reversible
AC<350kW	44	600	26,400	0	0	0%
AC>350kW	714	600	428,400	0	0	0%
WC<350 kW	61	600	36600	0	0	0%
WC>350kW	894	600	536400	0	0	0%
WC>1000kW	1600	600	960000	0	0	0%
split AC	17	600	10,020	1400	23380	69%
VRF	28	600	16800	1400	39200	88%
rooftop	70	600	63924	1400	98000	62%
GEHP	40	600	24720	1400	56000	100%
HTPC-AC<350kW	145	5,964	864800	0	0	0%
HTPC-AC>350kW	1000	2,825	2825400	0	0	0%
HTPC-WC<350kW	250	4,418	1104556	0	0	0%
HTPC-WC>350kW	750	4,375	3281289	0	0	0%
HTPC-WC>1000kW	1600	4,031	6450000	0	0	0%
gasWAH	59	0	0	1200	71079	100%

elecWAH	20	0	0	1200	24000	100%

The energy efficiency of products is based on values identified in the preparatory studies:

- Efficiency of chillers and air conditioners, expressed as SEER {or SPER(cooling)}, was converted to seasonal efficiencies on primary energy basis by dividing by 2.5 and subtracting 3% for control losses and 5% if the outdoor heat exchanger is water cooled.

- Efficiencies of heat pumps, expressed as SCOP or SPER (gas fired), was converted to seasonal efficiencies on primary energy basis by dividing by 2.5 and subtracting 3% for control losses.

- Efficiencies of high temperature chillers, expressed as SEPR, was converted to seasonal efficiencies on primary energy basis by dividing by 2.5.

- Efficiencies of warm air heaters were calculated on the basis of their thermal (useful) efficiency, emission efficiency, control losses, auxiliary energy consumption, ignition losses and vent losses.

Stakeholders largely agreed with the unit for energy efficiency as indicated.

It is assumed that some incremental improvement of energy efficiency takes place (due to innovation, market transformation, etc.). For electric chillers, air conditioning and heat pumps the efficiency trend as depicted in the preparatory studies slightly reduced, to better account for the learning curve effect (incremental improvements are gradually harder to realise, as ‘easier’ savings have been realised). For high temperature chillers a trend similar to that of comfort chillers was assumed. For gas driven heat pumps and warm air heaters no trend information was available and values have been assumed on the basis of best available information.

Table A2-5: Typical efficiencies (BAU)

	2010	2015	2020
Cooling			
AC<350kW	141%	145%	141%
AC>350kW	143%	153%	143%
WC<350 kW	196%	200%	196%
WC>350kW	225%	245%	225%
WC>1000kW	225%	245%	225%
split AC	161%	165%	161%
VRF	169%	173%	169%
rooftop	128%	136%	128%
GEHP	102%	103%	102%
HTPC-AC<350kW	193%	196%	193%
HTPC-AC>350kW	213%	217%	213%
HTPC-WC<350kW	303%	308%	303%
HTPC-WC>350kW	342%	349%	342%
HTPC-WC>1000kW	341%	349%	341%
Heating			
split AC	128%	130%	128%

VRF	132%	134%	132%
rooftop	102%	103%	102%
GEHP	137%	146%	137%
gasWAH	64%	66%	64%
elecWAH	30%	30%	30%

The average efficiencies of products in stock is calculated by summing the sales for each year, with their respective efficiencies and dividing this by the stock.

The above calculations assume that the overall (seasonal) efficiency of new products placed on the market will develop as shown below (shown are efficiencies for year 2010, BAU only, and 2030, all options).

TableA2-6: Development of energy efficiency for the different policy options[39]

		BAU 2010	BAU 2030	A	B	C
Cooling	AC<350kW	136%	163%	174%	161%	169%
	AC>350kW	140%	177%	207%	179%	194%
	WC<350 kW	186%	226%	221%	210%	216%
	WC>350kW	217%	289%	326%	295%	311%
	WC>1000kW	217%	289%	326%	307%	311%
	split AC	156%	173%	228%	208%	219%
	VRF	165%	181%	204%	186%	196%
	rooftop	120%	153%	185%	153%	155%
	GEHP	103%	110%	190%	188%	189%
	HTPC-AC<350kW	188%	208%	226%	224%	225%
	HTPC-AC>350kW	204%	230%	252%	250%	251%
	HTPC-WC<350kW	292%	328%	335%	333%	334%
	HTPC-WC>350kW	340%	377%	383%	380%	381%
	HTPC-WC>1000kW	340%	378%	397%	394%	396%
Heating	split AC	126%	132%	168%	150%	160%
	VRF	130%	135%	155%	137%	145%
	rooftop	99%	106%	158%	138%	139%
	GEHP	131%	155%	154%	141%	149%
	gasWAH	63%	69%	84%	79%	79%
	elecWAH	30%	30%	34%	34%	34%

Note that these are not the same values as the energy efficiency target values, as the modelling assumes that the average of the remaining products on the market will be higher than the target value itself.

The actual energy consumption by each product category is then calculated as the efficiency of the stock appliance and the heat demand for that base year. The energy consumption per unit is presented below.

Table A2-7: Energy consumption per unit [kWh/yr primary energy]

[39] The calculation is based on a changing primary-electricity conversion - see Annex 2

		2010	2020	2030
Cooling	AC<350kW	19,383	16,361	12,965
	AC>350kW	305,563	252,619	193,299
	WC<350 kW	19,679	16,471	12,949
	WC>350kW	246,734	196,944	148,536
	WC>1000kW	441,582	352,473	265,836
	split AC	6,431	5,465	4,634
	VRF	10,182	8,740	7,425
	rooftop	42,000	33,292	26,439
	GEHP	24,000	21,511	18,024
	HTPC-AC<350kW	460,000	441,617	415,933
	HTPC-AC>350kW	,385,000	1,304,923	1,229,402
	HTPC-WC<350kW	378,273	358,151	336,489
	HTPC-WC>350kW	965,085	939,340	870,659
	HTPC-WC>1000kW	1,875,000	1,826,078	1,688,037
Heating	split AC	13,792	11,203	9,831
	VRF	26,576	23,249	18,634
	rooftop	61,525	52,941	41,846
	GEHP	43,404	34,580	28,924
	gasWAH	112,117	97,255	82,283
	elecWAH	80,000	72,000	64,000

Table A2-8: Energy consumption of total stock [BAU]

			2010	2020	2030
Energy	Comfort chillers	PJ/yr	285	360	348
		TWh_electric	32	40	39
	AC (cooling)	PJ/yr	627	733	692
		TWh_electric	70	81	77
	HP (heating)	PJ/yr	93	220	349
		TWh_electric	10	24	39
	Warm Air Heaters	gas fired PJ/yr	697	544	416
		elec TWh_electric	10	5	5
	HT chillers	PJ/yr	867	1018	1076
		TWh_electric	96	113	120
	Total	PJ/yr	2477	2655	2534
		Mtoe/yr	59	64	61

3. GREENOUSE GAS EMISSIONS

Greenhouse gas (GHG) emissions have been calculated on the basis of both the energy consumption of the stock (indirect GHG emissions) and from fugitive emissions of refrigerants (direct GHG emissions).

As inputs the Impact Assessment calculation assumed the following specific emission factors for solid fuels, gas and electricity. Liquid fuels have not been assessed as no data existed to identify the number of liquid fuel fired local space heaters in the sales or stock.

Table A2-9: GHG emissions [Mton $CO_{2\,eq}$ in year 2010]

	2010	2015	2020	2025	2030
Indirect emissions					
Comfort chillers	12.5	14.4	15.4	15.3	14.5
AC's	29.0	31.9	32.9	31.8	29.7
High temperature process chillers	37.98	41.02	43.44	44.46	44.73
Warm air heaters	35.8	31.7	28.0	24.6	21.4
Direct emissions					
Comfort chillers	1.9	2.3	2.6	2.9	3.2
AC's	6.4	7.6	9.0	10.2	11.6
High temperature process chillers	0.5	0.51	0.57	0.62	0.69

For electric products a time-dependent specific emission was applied:

Table A2-10: Specific GHG emissions per year

Specific GHG emissions	1990	2000	2010	2020	2030
kg CO_2/kWh$_{elec}$	0.500	0.430	0.394	0.384	0.374
kgCO_2/GJ primary energy	56	48	44	43	42

4. ACIDIFYING EMISSIONS (NOX)

Acidifying emissions have been calculated on the basis of the emissions of only the fuel fired products (GEHP and gas fired Warm Air Heaters).

Table A2-11: NO_x emissions of total stock [kton $NO_{x\,eq}$]

	2010	2015	2020	2025	2030
GEHP	0.3	0.6	0.7	0.9	0.9
gasWAH	51.3	45.5	40.5	35.5	30.9
Total in kton NO_x	51.7	46.1	41.3	36.4	31.8
Total in kton$SO_{x\,eq.}$	36.2	32.3	28.9	25.5	22.3

5. PURCHASE COSTS AND OTHER ECONOMIC INPUTS

The increase of product purchase price through increase of energy efficiency or other environmental improvements have been calculated in the preparatory studies, together with other costs such as installation and maintenance. These studies described the effects on purchase price option by option.

This impact assessment study applies a parametric modelling of effects of increase of energy efficiency on purchase cost through introduction of price elasticity factors. This parametric approach is chosen as the Commission can only steer on the basis of performance parameters and not on presence of actual design options. Therefore the calculation of cost impacts and sales impacts as performed in preparatory studies could not be followed. Furthermore this has the added benefit that the total handling of data could be greatly reduced as this impact assessment covers products that have been subject of (in total) four[40] different preparatory studies.

The parameters for the exponential function of price per unit of efficiency improvement have been tuned to result in purchase prices that match those of the preparatory studies for base case products and improved products as close as possible. Note: this approach is an acceptable way of dealing with incremental changes in efficiency and product price but do not necessarily result in outcomes identical to those in the preparatory studies.

In addition, an annual price decrease has also been applied as a result of on-going reductions in purchase prices due to improved efficiency of production, lower manufacturing costs (for instance through moving production to low wage countries), etc. This effect has been set at 1% per year.

The purchase costs inputs are shown below. The values in bold correspond to base case purchase prices. The costs include installation costs.

The generic formula used is an exponential curve, as shown below:

$$Purchase\ price = a \cdot b^{kW} \cdot 1000$$

Table A2-12: Price parameters

	kW	a	b
AC<350kW	44	13.714	0.1709
AC>350kW	714	31.822	0.2001
WC<350 kW	61	11.01	0.1284
WC>350kW	894	43.286	0.1628
WC>1000kW	1600	77.5	0.1628
split AC	17	2.4429	0.1897
VRF	28	26.665	0.0868
rooftop	70	18.216	0.0439
GEHP	40	10000	0.4
HTPC-AC<350kW	145	13.714	0.1709
HTPC-AC>350kW	1000	31.822	0.2001
HTPC-WC<350kW	250	11.01	0.1284
HTPC-WC>350kW	750	43.286	0.1628
HTPC-WC>1000kW	1600	92.3	0.1628
gasWAH	59	2000	1.5
elecWAH	20	500	0

Table A2-13: Purchase costs [€]. Parametric calculations purchase price by primary seasonal efficiency

	a'	b'	30%	60%	80%	150%	200%	250%	300%	350%	400%

[40] These are: ENER Lot 20 – Local Room Heating Products; ENER Lot 21 – Central heating products that use hot air to distribute heat; ENTR Lot 1 - Refrigerating and freezing equipment; ENTR Lot 6 - Air-conditioning and ventilation systems

AC<350kW	13.714	0.1709	14,435	15,195	15,723	17,721	19,302	21,024	22,900	24,942	27,167
AC>350kW	31.822	0.2001	33,791	35,881	37,346	42,962	47,482	52,479	58,001	64,104	70,849
WC<350 kW	11.01	0.1284	11,442	11,892	12,201	13,348	14,234	15,177	16,184	17,257	18,401
WC>350kW	43.286	0.1628	45,453	47,728	49,307	55,259	59,945	65,029	70,543	76,526	83,016
WC>1000kW	77	0.1628	81,347	85,418	88,245	98,897	107,284	116,383	126,252	136,959	148,574
split AC	2.4429	0.1897	2,586	2,737	2,843	3,247	3,570	3,925	4,316	4,745	5,217
VRF	26.665	0.0868	27,368	28,091	28,582	30,373	31,720	33,127	34,596	36,131	37,734
rooftop	18.216	0.0439	18,457	18,702	18,867	19,456	19,888	20,329	20,780	21,241	21,713
GEHP	10000	0.4	11,275	12,712	13,771	18,221	22,255	27,183	33,201	40,552	49,530
HTPC-AC<350kW	13.714	0.1709	14,435	15,195	15,723	17,721	19,302	21,024	22,900	24,942	27,167
HTPC-AC>350kW	31.822	0.2001	33,791	35,881	37,346	42,962	47,482	52,479	58,001	64,104	70,849
HTPC-WC<350kW	11.01	0.1284	11,442	11,892	12,201	13,348	14,234	15,177	16,184	17,257	18,401
HTPC-WC>350kW	43.286	0.1628	45,453	47,728	49,307	55,259	59,945	65,029	70,543	76,526	83,016
HTPC-WC>1000kW	92	0.1628	96,965	101,819	105,189	117,886	127,883	138,728	150,493	163,255	177,100
gasWAH	2000	1.5	3,137	4,919	6,640						
elecWAH	500	0	500	500	500						

Energy costs have been assessed following fuel/electricity costs as shown below. Note that the energy price increase is compensated by the discount factor in which case there is no need to increase the energy prices for future years.

Table A2-14: Energy costs [€/year]

	Energy form	**Energy price [€/kWh final energy]**	**Energy price [€/kWh primary energy]**
AC<350kW	electricity	0.09	0.036
AC>350kW	electricity	0.09	0.036
WC<350 kW	electricity	0.09	0.036
WC>350kW	electricity	0.09	0.036
WC>1000kW	electricity	0.09	0.036
split AC	electricity	0.09	0.036
VRF	electricity	0.09	0.036
rooftop	electricity	0.09	0.036
GEHP	gas	0.061	0.061
HTPC-AC<350kW	electricity	0.09	0.036
HTPC-AC>350kW	electricity	0.09	0.036
HTPC-WC<350kW	electricity	0.09	0.036
HTPC-WC>350kW	electricity	0.09	0.036
HTPC-WC>1000kW	electricity	0.09	0.036
gasWAH	gas	0.061	0.061
elecWAH	electricity	0.09	0.036

Total expenditure is also determined by additional costs for installation and maintenance. These values are copied without modification from the preparatory studies.

Table A2-15: Maintenance costs [€]

AC<350kW	15100

AC>350kW	46600
WC<350 kW	12600
WC>350kW	73400
WC>1000kW	110100
split AC	3200
VRF	21600
rooftop	12900
GEHP	43200
HTPC-AC<350kW	15100
HTPC-AC>350kW	46600
HTPC-WC<350kW	12600
HTPC-WC>350kW	73400
HTPC-WC>1000kW	110100
gasWAH	1000
elecWAH	200

6. ECONOMICS

The turnover and number of jobs associated with each sector are determined by the values shown below.

Table A2-16: Data for calculation of market actor turnover

			2010	**2020**	**2030**
Market actor turnover [Million €·1000]					
VAT	20%	VAT	2.2	3.0	3.9
Retail turnover excl.VAT (purchase prices)	115%	retail mark-up	8.8	12.1	15.7
Wholesale turnover	115%	wholesale mark-up	7.7	10.5	13.7
Manufacturer turnover			6.7	9.1	11.9
Energy turnover			28.3	29.5	28.8
related to installation/maintenance			4.4	6.8	8.9
Jobs ('000)					
Installers	0.1	retail turnover per employee	88.0	121.2	157.8
Wholesale	0.279	wholesale Turnover per employee (million/employee)	27.4	37.8	49.2
Manufacturer jobs	0.165	manuf.turnover per employee (million/employee)	40.3	55.5	72.3
within EU jobs	50%	manufacturing within EU	20.2	27.8	36.2
which are OEM jobs	10%	OEM share of manuf	4.0	5.6	7.2
Energy Jobs	0.782	Energy turnover/employee (million/employee)	37.7	38.8	36.1
Total			193.5	253.3	315.3

Table A2-17: Test costs

	families	**models**	**% of range tested**	**% tested per**	**test costs (avg)**	**avg. costs/yr per**	**for SMEs (avg.**	**# of large manuf.**	**# of SME**	**total costs for all**

				year		**manufacturer**	**50%)**			
AC<350kW	1	140	20%	33%	30000	277200	138.600	12	24	6652800
AC>350kW										
WC<350 kW										
WC>350kW										
WC>1000kW										
split AC	5	40	20%	33%	30000	396000	198000	12	24	9504000
VRF	5	40	20%	33%	30000	396000	198000	12	24	9504000
rooftop	5	40	20%	33%	30000	396000	198000	12	24	9504000
GEHP	3	5	50%	33%	30000	74250	37125	12	24	1782000
HTPC-AC<350kW	12	30	20%	20%	15000	216000	108000	20	0	4320000
HTPC-AC>350kW										
HTPC-WC<350kW										
HTPC-WC>350kW										
HTPC-WC>1000kW										
gasWAH	5	20	20%	33%	10000	66000	33000	12	24	1584000
elecWAH	1	10	20%	33%	5000	3300	1650	12	24	79200

ANNEX 3: ECODESIGN REQUIREMENTS OF THE OPTIONS CONSIDERED

1. ECODESIGN MINIMUM ENERGY EFFICIENCY REQUIREMENTS

The minimum energy efficiency requirements for the different sub-options are presented in the following tables.

Table A3-1: Ecodesign requirements for sub-option A, B and C

		BAU			option A		option B		option C	
		2010	**2015**	**2020**	**2017**	**2019**	**2017**	**2021**	**2017**	**2020**
Cooling	AC<350kW	136%	141%	145%	157%	161%	137%	149%	149%	157%
	AC>350kW	140%	143%	153%	173%	185%	137%	157%	157%	173%
	WC<350 kW	186%	196%	200%	196%	200%	172%	188%	188%	196%
	WC>350kW	217%	225%	245%	256%	272%	196%	236%	236%	256%
	WC>1000kW	217%	225%	245%	256%	272%	236%	256%	236%	256%
	split AC	156%	161%	165%	181%	189%	157%	169%	169%	181%
	VRF	165%	169%	173%	181%	189%	157%	169%	169%	181%
	rooftop	120%	128%	136%	181%	189%	117%	138%	117%	138%
	GEHP	103%	102%	103%	167%	177%	157%	169%	157%	167%
	HTPC-AC<350kW	188%	193%	196%	180%	200%	180%	200%	180%	200%
	HTPC-AC>350kW	204%	213%	217%	200%	220%	200%	220%	200%	220%
	HTPC-WC<350kW	292%	303%	308%	260%	280%	260%	280%	260%	280%
	HTPC-WC>350kW	340%	342%	349%	300%	320%	300%	320%	300%	320%
	HTPC-WC>1000kW	340%	341%	349%	320%	340%	320%	340%	320%	340%
Heating	split AC	128%	130%	128%	141%	146%	115%	125%	133%	137%
	VRF	132%	134%	132%	141%	146%	115%	125%	133%	137%
	rooftop	102%	103%	102%	141%	146%	115%	125%	133%	137%
	GEHP	137%	146%	137%	137%	142%	115%	125%	133%	137%
	gasWAH	64%	66%	64%	72%	78%	68%	74%	70%	74%
	elecWAH	30%	30%	30%	30%	32%	30%	32%	30%	32%

2. ECODESIGN MAXIMUM EMISSION VALUES

The maximum emission values for the different sub-options are presented in the following table.

Table A3-2: Ecodesign maximum emission requirements

	BAU			Option A		Option B		Option C	
	2010	**2015**	**2020**	**2017**	**2019**	**2017**	**2019**	**2017**	**2019**
rooftop	900	900	900	240	240			350	350
GEHP	900	900	900	240	240			350	350
gasWAH	275	275	275	70	70	200	150	200	150

3. SOUND POWER REQUIREMENTS

The requirements for the maximum sound power level of comfort chillers, air-to-air air conditioners, air-to-air heat pumps and fan coil units as proposed under option A only, apply in two tiers and are stated below:

a) From 1 January 2017 the sound power level of comfort chillers, air-to-air air conditioners, air-to-air heat pumps and fan coil units shall not exceed the values in Table below:

First tier maximum sound power levels, expressed in dB

(1) Product by rated cooling or heating output	(2) Outdoor side
rated output < 6 kW	64
rated output > 6 kW and < 12 kW	69
rated output ≥ 12 kW and < 30 kW	74 / 79*
rated output ≥ 30 kW and < 70 kW	84
	Non-ducted Indoor side**
rated output < 6 kW	59
rated output > 6 kW and < 12 kW	64
rated output ≥ 12 kW and < 30 kW	69
rated output ≥ 30 kW and < 70 kW	79
	Ducted Indoor side **
rated output < 6 kW	59
rated output ≥ 6 kW and < 12 kW	64
rated output ≥ 12 kW and < 17.5 kW	69
rated output ≥ 17.5 kW and < 40 kW	79
rated output ≥ 40 kW and < 70 kW	84

* for packaged products the value is increased by 5 dB

** indoor noise requirements shall not apply to comfort chillers

b) From 1 January 2019 the sound power level of cooling only comfort chillers, air-to-air air conditioners, air-to-air heat pumps and fan coil units shall not exceed the values in Table below:

Second tier maximum sound power levels, expressed in dB

Product by rated cooling or heating output	Outdoor side
rated output < 6 kW	63
rated output > 6 kW and < 12 kW	68*
rated output ≥ 12 kW and < 30 kW	73 / 78*
rated output ≥ 30 kW and < 70 kW	83
	Non-ducted indoor side**
rated output < 6 kW	58
rated output > 6 kW and < 12 kW	63
rated output ≥ 12 kW and < 30 kW	68
rated output ≥ 30 kW and < 70 kW	78
	Ducted indoor side**
rated output < 6 kW	58
rated output ≥ 6 kW and < 12 kW	63
rated output ≥ 12 kW and < 17.5 kW	68
rated output ≥ 17.5 kW and < 40 kW	78
rated output ≥ 40 kW and < 70 kW	83

* for packaged products the value is increased by 5 dB

** indoor noise requirements shall not apply to chillers

ANNEX 4: RELATED MEASURES

This annex aims to provide clarity to thepolicy context by explaining how this initiative complements existing measures for related equipment such as the ecodesign requirements for space heating and cooling products (air conditioners and heating boilers, including heating pumps- regulations 813/2013; 206/2012) and requirements relating to the emissions of refrigerants (F gases regulation).

This initiative complements existing measures for similar or related space heating and cooling equipment in the following manner:

Regulation 813/2013[41] applies to space heaters and combination heaters with a rated heat output ≤ 400 kW. These heaters are defined as supplying heat to a water based heating system for space heating purposes.

The current initiative supplements the above regulation by defining a scope of heating products that do not suplly heat to water based heating systems but to air based heating systems. In doing so, an overlap of measures is avoided.

The above approach has as consequence that the heating function of reversible chillers 9that supply heat or cold to a water based system) is outside the scope of the initiative as it is already covered by Regulation 813/2013. This does not mean that reversible chillers must be kept outside the scope as the Blue Guide[42] states that two or more 'measures' can cover the same product or hazard. The general principle of simultaneous application still applies where the essential requirements of the directives are complementary to each other.

Regulation 206/2012 applies to air conditioners of less than 12 kW cooling capacity (or heating if supplying heat only) [43]. The current initiative supplements the above regulation by specifically excluding products covered by 206/2012.

The initiative thus covers equipment with higher cooling capacities (or heating if supplying heat only), but also equipment that uses other heat sources than air, such as brine and water (206/2012 applies to air source air conditioners only).

As regards warm air heaters and high temperature process chillers the initiative would not need to complement existing measures. The forthcoming measure for medium and low temperature chillers would complement the initiative, but a clear separation in scope is sought to avoid overlap.

As the products covered by the initiative are primarily intended for space heating and cooling they may be affected by flanking measures such as the EPBD and EED.

Directive 2012/27/EU[44] of the European Parliament and of the Council of 25 October 2012 on energy efficiency (EED) provides energy saving targets for Member States and creates the

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[41] COMMISSION REGULATION (EU) No 813/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for space heaters and combination heaters

[42] Guide to the implementation of directives based on the New Approach and the Global Approach, European Commission. Available from http://ec.europa.eu/enterprise/policies/single-market-goods/files/blue-guide/guidepublic_en.pdf. Section 2.2 Simultaneous application of directives, p16.

[43] COMMISSION REGULATION (EU) No 206/2012 of 6 March 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for air conditioners and comfort fans

conditions for the development and promotion of the market for energy services, including measures improving the energy efficiency of air heating products, cooling products and high temperature process chillers. However, it is up to the Member States to select the concrete measures to achieve the energy savings targets, and no harmonised measures specifically improving the environmental performance of these products are provided.

Directive 2010/31/EU[45] of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (EPBD) requires Member States, amongst others, to apply minimum requirements to the energy performance of new and existing buildings (when undergoing major renovations). Article 8 of the Directive indicates that Member States shall set system requirements in respect of the overall energy performance, the proper installation, and the appropriate dimensioning, adjustment and control of the technical building systems which are installed in existing buildings. Nevertheless, the specific requirements to be set to the system are to be decided by Member States and no harmonised values are set at European level under this Directive.

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[44] OJ L 315, 14.11.2012, p. 1.

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

ANNEX 5: ECODESIGN REQUIREMENTS FOR SOUND POWER IN RELATED REGULATIONS

Table 5 in Regulation 206/2012 on ecodesign requirements for room air conditioners lays down maximum sound power levels of indoor and outdoor sound power for air-to-air air conditioners or heat pumps of maximum 12 kW cooling or heating capacity (except single duct or double duct units, for which a maximum indoor sound power of 65 dB(A) is set). The sound power is to be established at the standard rating conditions.

Table 5

Requirements for maximum sound power level

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

Table 3 in Regulation 813/2013 for ecodesign of space heaters and combination heaters lays down maximum sound power levels for heat pump (combination) heaters

3. REQUIREMENTS FOR SOUND POWER LEVEL

From 26 September 2015 the sound power level of heat pump space heaters and heat pump combination heaters shall not exceed the following values:

Rated heat output ≤ 6 kW		Rated heat output > 6 kW and ≤ 12 kW		Rated heat output > 12 kW and ≤ 30 kW		Rated heat output > 30 kW and ≤ 70 kW	
Sound power level (L_{WA}), indoors	Sound power level (L_{WA}), outdoors	Sound power level (L_{WA}), indoors	Sound power level (L_{WA}), outdoors	Sound power level (L_{WA}), indoors	Sound power level (L_{WA}), outdoors	Sound power level (L_{WA}), indoors	Sound power level (L_{WA}), outdoors
60 dB	65 dB	65 dB	70 dB	70 dB	78 dB	80 dB	88 dB

The standard rating conditions in Regulation 206/2012 for cooling assume the product to be operating at 100% load conditions (standard rating conditions is equal to reference design condition, with indoor temperature at 27ºC and outdoor at 35ºC).

Table 2

Standard rating conditions, temperatures in 'dry bulb' air temperature

('wet bulb' indicated in brackets)

Appliance	Function	Indoor air temperature (°C)	Outdoor air temperature (°C)
air conditioners, excluding single duct air conditioners	cooling	27 (19)	35 (24)
	heating	20 (max. 15)	7(6)
single duct air conditioner	cooling	35 (24)	35 (24) (*)
	heating	20 (12)	20 (12) (*)

(*) In case of single duct air conditioners the condenser (evaporator) when cooling (heating) is not supplied with outdoor air, but indoor air.

The standard rating conditions for Regulation 813/2013 establish conditions for heat pumps that supply heat to water-based heating systems only (not air-to-air systems):

Table 3

Standard rating conditions for heat pump space heaters and heat pump combination heaters

<table>
<tr><th rowspan="3">Heat source</th><th>Outdoor heat exchanger</th><th colspan="4">Indoor heat exchanger</th></tr>
<tr><th rowspan="2">Inlet dry bulb (wet bulb) temperature</th><th colspan="2">Heat pump space heaters and heat pump combination heaters, except low-temperature heat pumps</th><th colspan="2">Low-temperature heat pumps</th></tr>
<tr><th>Inlet temperature</th><th>Outlet temperature</th><th>Inlet temperature</th><th>Outlet temperature</th></tr>
<tr><td>Outdoor air</td><td>+ 7 °C (+ 6 °C)</td><td rowspan="5">+ 47 °C</td><td rowspan="5">+ 55 °C</td><td rowspan="5">+ 30 °C</td><td rowspan="5">+ 35 °C</td></tr>
<tr><td>Exhaust air</td><td>+ 20 °C (+ 12 °C)</td></tr>
<tr><td></td><td>Inlet/outlet temperature</td></tr>
<tr><td>Water</td><td>+ 10 °C/+ 7 °C</td></tr>
<tr><td>Brine</td><td>0 °C/– 3 °C</td></tr>
</table>

ANNEX 5: NON-EXHAUSTIVE LIST OF RELEVANT COMPANIES

The relevant preparatory studies identified the following manufacturers.

Table A10-1. Main manufacturers

<table>
<tr><th colspan="2">Product category</th><th>Manufacturer's name</th></tr>
<tr><td colspan="2">Comfort chillers</td><td>There are at least 34 suppliers of chillers, partnering in the Eurovent certification program,, some of whom offer very extensive ranges of product types and sizes, while others are more specialised.
The major suppliers are Toshiba-Carrier, Climaveneta, Trane and JCI (York). Much of the production is within Europe though the major suppliers also import some products.
Chillers and larger air conditioners are complex products requiring significant resources to develop, test and service.</td></tr>
<tr><td rowspan="4">Air conditioning / heat pumps</td><td>Split units</td><td>Daikin, Toshiba-Carrier, Mitsubishi Electric, Fujitsu and LG. Most products are manufactured outside Europe, although several of the major suppliers also manufacture in Europe. at least 13 significant suppliers</td></tr>
<tr><td>packaged</td><td>Toshiba-Carrier, Trane, Lennox and York. CIATESA, HITECSA, This reflects the greater importance of rooftop units in North America, though production for the European market is divided between European and overseas manufacture. approximately 12 manufacturers</td></tr>
<tr><td>VRF</td><td>Daikin, Mitsubishi Electric and Hitachi. Products are predominantly manufactured outside Europe. approximately 12 suppliers</td></tr>
<tr><td>GEHP</td><td>Aisin</td></tr>
<tr><td colspan="2">High temperature chillers</td><td>Toshiba-Carrier, Climaveneta, Trane and JCI (York)</td></tr>
<tr><td rowspan="2">Warm air heaters</td><td>Gas fired</td><td>Winterwarm, Ambirad, Mark, Reznor</td></tr>
<tr><td>Electric</td><td>Systemair, Johnson & Starley, Dimplex, Stiebel Eltron, Flakt-Woods, Durexheaters, IHP, ABCO, Frico</td></tr>
</table>

For chillers as for air conditioners, the market is competitive in the sense that a number of larger companies manufacture products targeted at the same market, and none of them has a dominant market share. (However, the chillers with the highest seasonal efficiencies appear to use the same proprietary technology under license).

ANNEX 6: LIST OF ABBREVIATIONS USED

AC<350kW	Comfort chiller, air cooled, with capacity less than 350 kW
AC>350kW	Comfort chiller, air cooled, with capacity of 350 kW or more
WC<350 kW	Comfort chiller, water cooled, with capacity less than 350 kW
WC>350kW	Comfort chiller, water cooled, with capacity of 350 kW or more, but less than 1000 kW
WC>1000kW	Comfort chiller, air cooled, with capacity of 1000 kW or more
split AC	Electric air conditioner or heat pump (water/brine/air-to-air) of a split design (separate indoor and outdoor heat exchangers, connected by refrigerant carrying piping)
VRF	Electric air conditioner or heat pump (water/brine/air-to-air) of a split design (separate indoor and outdoor heat exchangers, connected by refrigerant carrying piping) of which the total refrigerant volume flow can be regulated by the unit
rooftop	Electric air conditioner or heat pump (water/brine/air-to-air) of a packaged design (indoor and outdoor heat exchangers, combined in a single package, usually placed on top of the roof)
GEHP	Gas engine driven air conditioner or heat pump (water/brine/air-to-air) usually of a split design (separate indoor and outdoor heat exchangers) but not limited to that type.
HTPC-AC<350kW	High temperature process chiller, air cooled, with capacity less than 350 kW
HTPC-AC>350kW	High temperature process chiller, air cooled, with capacity of 350 kW or more
HTPC-WC<350kW	High temperature process chiller, water cooled, with capacity less than 350 kW
HTPC-WC>350kW	High temperature process chiller, water cooled, with capacity of 350 kW or more, but less than 1000 kW
HTPC-WC>1000kW	High temperature process chiller, air cooled, with capacity of 1000 kW or more
gasWAH	Fuel fired warm air heater (usually natural gas fired)
elecWAH	Electric warm air heater

ANNEX 7: COMPARISON OF PROPOSAL VERSUS REQUIREMENTS IN VARIOUS OTHER COUNTRIES.

Introduction[46]

Certain EU member states (e.g. United Kingdom and France) as well as third countries have introduced requirements for cooling and heating products.

In Europe, the requirements may be based on EER/COP values, established according the EN 14511 or 'seasonal' efficiencies, such as SEER/SCOP established according EN14825 (most recent version is from 2013)

It appears that more economies are moving to seasonal performance indexes; For larger capacity products, USA and Japan use the HSPF, which is based on the same principle but for different climatic conditions and testing points. In the USA, the ISO 13256 standard is used. Australia included low power modes in the AEER and ACOP, which combines a full load metrics and consumption of low power modes.

Both the USA and Japan, while moving to seasonal performance requirements for these products, keep the full load requirements or even strengthen both full load and part load requirements at the same time (USA situation).

It should be added that verification tolerances vary in the different countries and according to the type of operation, heating or cooling. Information received from manufacturers shows that the full load EER and COP should lie between 85 % and 95 % of the declared values for all countries, with most countries requiring at least 90 % of the declared values.

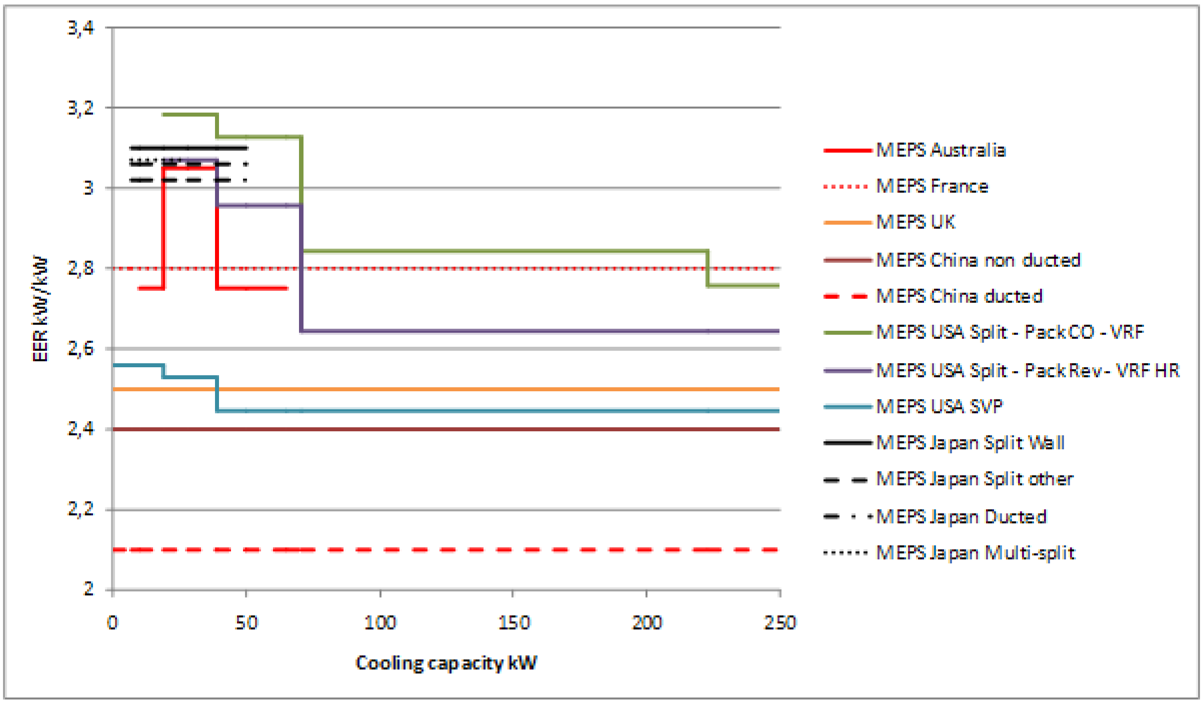
Details are given below on the values of the minimum performance required by product type.

Air cooled air conditioners

Full load EER is regulated in a number of countries. The reference testing conditions, full load, 35 °C outdoor, 27 °C db / 19 °C wb, are the same, except for small differences in the USA standard.

From preparatory study Task 1, section 3.4: Figure 1 - 42 . MEPS air conditioners, Air-cooled, Full load EER (kW/kW)

[46] This text is an excerpt from DG ENTR preparatory study Lot 6, Task 1, section 3.4

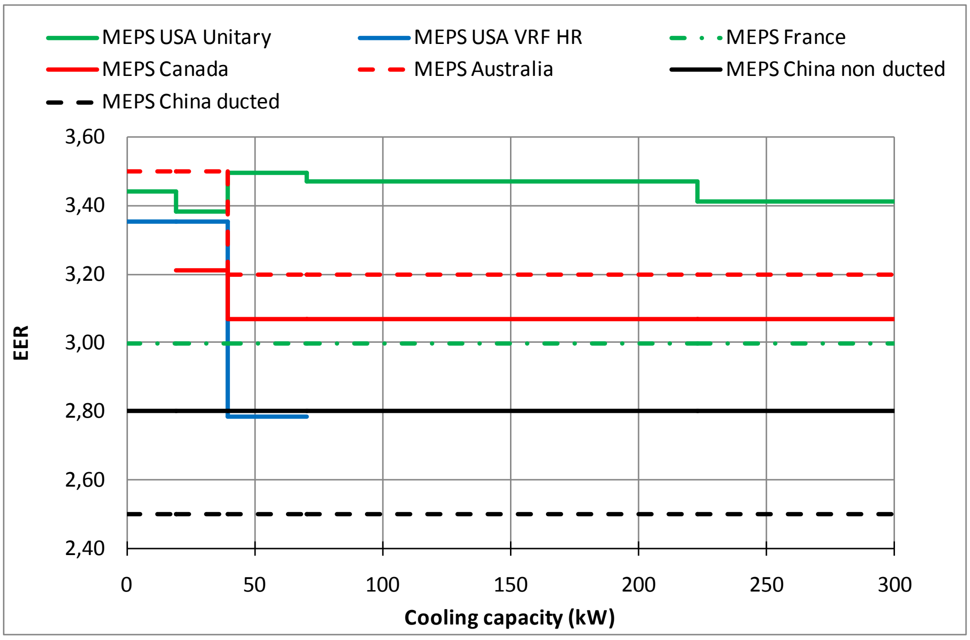


The proposed requirements would allow air conditioners with EER values between 2.5 (lowest ambition, SEER 4.0 to 4.3) to 2.8 (highest ambition, SEER 4.5 to 4.8).

The EU proposals are most likely more strict than US SVP requirements (single vertical package) and Chinese ducted and non-ducted requirements. The more ambitious EU requirement would probably be more strict that USA VRF requirements (reversible units).

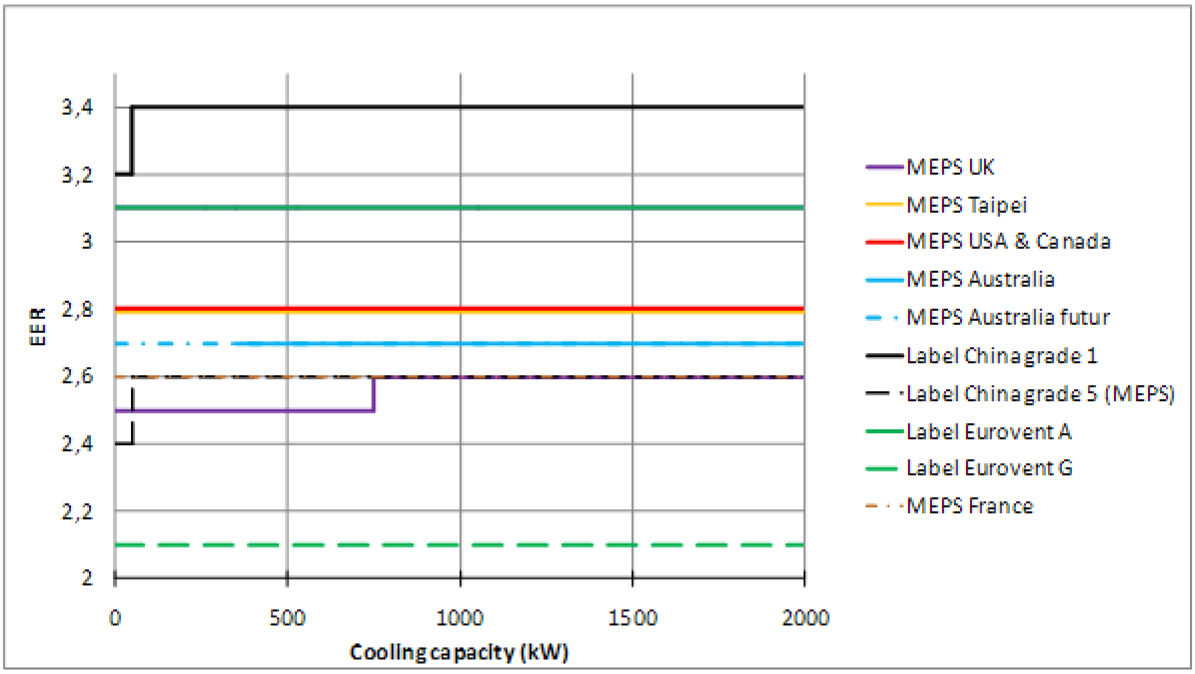
The proposal establishes no requirements for water cooled air conditioners. Some countries do have requirements for such equipment.

From preparatory study Task 1, section 3.4: Figure 1 - 44 . MEPS air conditioners, Water-cooled, Full load EER (kW/kW)



Air cooled chillers:

From preparatory study Task 1, section 3.4: Figure 1 - 46 . MEPS chillers, Air cooled, Full load EER (kW/kW)

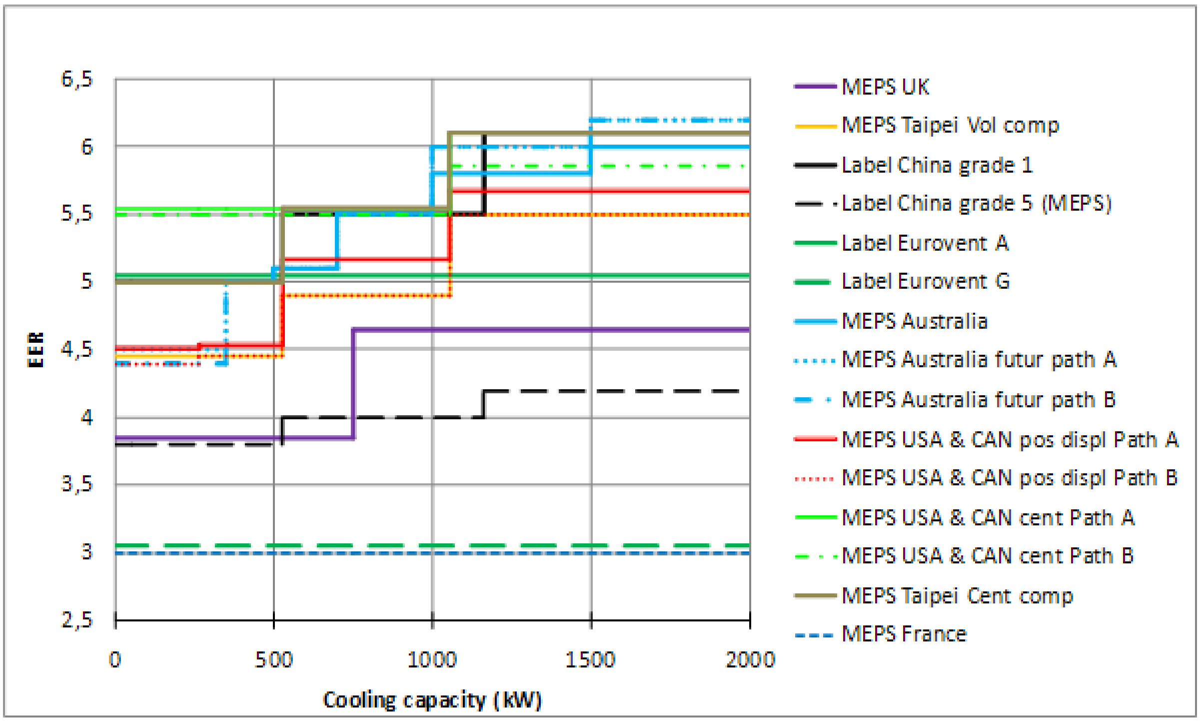


The proposed EU requirements would allow air cooled chillers with EER values between 2.6 (lowest ambition, SEER 3.6 to 4.3) to 2.8 (highest ambition, SEER 4.1 to 4.7).

The least ambitious EU proposals are most likely more strict than UK requirements, Chinese grade 5 requirements and likely slightly above to the level set by Australia, and below the level set by US SVP requirements (single vertical package) and Chinese ducted and non-ducted requirements. The more ambitious EU requirement would probably be as strict as USA and Canadian requirements, but likely below China grade 1 requirements.

Water cooled chillers

From preparatory study Task 1, section 3.4: Figure 1 - 48 . MEPS chillers, Water cooled, Full load EER (kW/kW)



The proposed EU requirements would allow water cooled chillers of < 400 kW with EER values between 3.9 (lowest ambition, SEER 4.5 to 5.1) to 4.4 (highest ambition, SEER 5.2).

The proposed EU requirements would allow water cooled chillers of > 400 kW with EER values between 4.4 (lowest ambition, SEER 5.1 to 6.6) to 4.9 (highest ambition, SEER 6.6 to 7.0).

The least ambitious EU proposals are most likely more strict than US path B and probably close to the level of Chinese grade 5 and below the level set by most other regions. The more ambitious EU requirement would probably be as strict as levels set by USA and Canada requirements.

High temperature process chillers

No requirements (neither within the EU or in third countries) have been identified in the documents consulted [47] [48].

Warm air heaters

[47] COMMISSION STAFF WORKING DOCUMENT DRAFT IMPACT ASSESSMENT Accompanying document to the Draft Commission Regulation implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for Industrial Process Chillers and Condensing Units.{C(20XX) yyy final}{SEC(20XX) yyy}

[48] Ecodesign performance requirements for high temperature process chillers and further consultation on walk in cold rooms, Jeremy Tait, Tait Consulting Limited, Philippe Rivière, ARMINES Paris On behalf of CLASP Europe for the European Commission DG ENTR12 June 2013

Requirements on minimum energy efficiency are set by standards EN 621:2009, EN 778:2009, prEN 1020:2007, EN 1319:2009, EN 13842:2004 (min. 84% NCV) and EN 1196:2011 (min. 90% NCV).

As these standards are harmonised (under Gas Appliance Directive 90/396/EEC, and Construction Products Directive 89/106/EEC, etc.) they currently apply to these products.

Standards may apply to warm air heaters in the UK, but the actual level is not described in the preparatory study [49]. The same study mentions standards in the US the efficiency levels of which appear to be lower than required in the EU by the harmonised standards. The Canadian requirements may be stricter for one type of furnace.

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No significant differences between the proposals and similar standards have been identified, reducing the risk of regulatory barriers to international trade.

[49] Preparatory Studies for Ecodesign Requirements of EuPs (III), ENER Lot 21 – Central heating products that use hot air to distribute heat, Task 1: Definition, Report to the European Commission, DG ENER, 09 July 2012