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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 professional refrigerated storage cabinets, blast cabinets, condensing units and process chillers

{C(2015) 2881 final}
{SWD(2015) 96 final}

Acronym List

AEC	Annual Energy Consumption
ASERCOM	Association of European Refrigeration Component Manufacturers
CECED*	Conseil Européen de la Construction d'appareils Domestiques (European Committee of Domestic Equipment Manufacturers)
CEN	Comité Européen de Normalisation (European Committee for Standardization)
CEN TC44 WG2	CEN Technical Committee 44 Working Group 2
CU	Condensing Unit
COP	Coefficient Of Performance
EFCEM	European Federation of Catering Equipment Manufacturers
EEI	Energy Efficiency Index
EEN	Enterprise Europe Network
EPEE	European Partnership for Energy and the Environment
GWP	Global Warming Potential
HC	Hydro Carbons
HFC	Hydro Fluoro Carbons
JIEG	Joint Industry Expert Group
MEPS	Minimum Energy Performance Standards
MS	Member State
SAEC	Standard Annual Energy Consumption
SEPR	Seasonal Energy Performance Ratio
SME	Small and Medium-sized Enterprise
TWh	Terawatt hour
TEWI	Total Equivalent Warming Impact

* The current name does correspond anymore to the initials which formed the acronym in the past

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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.

Lead DG: ENTR

Associated DG: ENER

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

Agenda planning or WP reference: 2012/ENTR/025

1. POLICY CONTEXT

The Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the Commission to set ecodesign requirements for energy-related products[1] (hereafter referred to as the Ecodesign Directive) is to be implemented by the European Commission through regulations dealing with the products groups identified by the Ecodesign Working Plans. The Ecodesign Working Plan for 2009-2011[2] identified "refrigerating and freezing equipment" as one of the ten priority product groups. DG Enterprise explores, within this group, the appropriateness of setting Ecodesign requirement on the category of professional refrigeration, which includes five products: professional storage cabinets, blast cabinets, condensing units, industrial process chillers and walk-in cold rooms. Following the usual practice in Ecodesign regulations, also the possibility of introducing a labelling system under Directive 2010/30/EU of the European Parliament and of the Council has been explored.

The impact of the regulation that might cover the five products belonging to the professional refrigeration group have been analysed in three reports. These reports are consistent, having been developed in parallel, and can therefore be read as a single one; they are kept separate mainly for readability. Two reports cover two products: professional storage cabinets and blast cabinets in one case, condensing units and industrial process chillers in the other. The reason behind their merging is to be found in the strong similarities in terms of user profile, technology, and market conditions. The fifth product, walk-in cold rooms, has been kept separate because of its unique characteristics within the group.

This reports covers condensing units (from now on sometimes referred to as CU) and industrial process chillers (from now often referred to simply as chillers). A condensing unit is a product that provides cooling to at least one refrigeration appliance or system, such as for

1 OJ L 285, 31.10.2009.
2 COM (2008) 660

instance a walk-in cold room; on its own, it cannot reproduce the full refrigeration cycle[3], since it is usually made of just a compressor and a condenser. A chiller is a machine that removes heat from a liquid, mostly via a vapor-compression cycle; the cooled liquid is then used for multiple industrial purposes, for instance to cool an equipment, or materials for further processing. The materials can be as diverse as food and plastics.

2. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

2.1. Organisation and timing

No ecodesign requirements within the framework of the Ecodesign Directive have so far been set on this product group.

A background preparatory study was carried out from December 2008 to November 2010 in order to give input to this impact assessment[4]. The preparatory study provided the European Commission with technical background supporting the design of eco-design requirements following the methodology defined in Annexes I and II of the Ecodesign Directive.

The impact assessment was launched in February 2012 and supported by an Interservice Steering Group including CLIMA, COMP, ECFIN, ENTR, ENV, INFSO, LS, MARKT, RTD, SANCO, SG and TRADE. The ISG met on February the 23, July the 5th, December the 12th and assisted during all key steps of the impact assessment.

An impact assessment study for each of the five products groups falling in the category of professional refrigeration was carried out from March 2012 to October 2012 to provide the European Commission with technical background and data collection and analysis supporting the setting of eco-design requirements.

2.2. Impact Assessment Board

[*Section to be completed further to the IAB meeting*].

2.3. Transparency of the consultation process

The opinions of stakeholders were gathered throughout the process through the Consultation Forum created in compliance with Article 18 of the Ecodesign Directive and through numerous bilateral meetings. The preparatory study consulted manufacturers in three stakeholder meetings and registered stakeholders were granted access to the documents publicly available on the project website http://ecofreezercom.org

- The Ecodesign Consultation Forum was consulted on 19 January 2012 with the participation of Member States, consumer organisations, environmental NGOs and the manufacturers represented by CECED (Conseil Européen de la Construction d'appareils Domestiques). The working document presenting the policy options was sent one month in

[3] A full refrigeration cycle requires, in addition to a compressor and a condenser, also an expansion valve and an evaporator. It is based on the fact that when a liquid evaporates into a gas, it subtracts heat from the surrounding environment; in order to exploit this process repeatedly, it is necessary to compress the gas to liquefy the gas again. Clearly, the process requires energy because it aims at removing heat from a colder environment and adding it to a warmer one, thereby going against the natural behaviour of heat.

[4] Preparatory Study for Eco-design Requirements of EuPs, Lot 1 Refrigerating and freezing equipment. Available on: http://ecofreezercom.org

advance of the meeting. All replies to the working document are available on the CIRCA website. The minutes of the Consultation Forum are also available in Annex I.

- The IA contractor attended two meetings hosted by the industrial association EPEE (European Partnership for Energy and the Environment) on 8 February and 21 March 2012 (morning). The meetings were the occasion to discuss the collaboration with the JIEG (Joint Industry Expert Group) detailed in Section 2.4.
- A consultation meeting open to all parties interested in the chillers and condensing units regulations was held in Bruxelles on 21 March 2012 (afternoon).
- A formal SME consultation through a questionnaire[5] translated in 7 languages was launched via the Commission's Enterprise Europe Network on 30th of March 2012 with a deadline of 21st of May.
- A general stakeholder consultation through a similar but slightly more comprehensive questionnaire was sent on 4th April directly to 211 registered stakeholders from at least 17 EU countries which included national industry associations and other dissemination nodes, with a deadline of 10th May.

The following table summarizes the consultation events and their results.

Table 1. Consultation events and numbers of participants / respondents

Consultation event	No. of manufacturer and industry participants / respondents (Chillers)	No. of manufacturer and industry participants / respondents (Cond. Units)	No. of government, NGO or other participants / respondents	Comments
Consultation forum 19 January 2012	6	6	c. 45	Open meeting for all 5 professional refrigeration product groups
JIEG meeting 8 Feb 2012	9	9	0	Closed meeting hosted by EPEE (JIEG only)
JIEG meeting 21 Mar 2012	11	11	0	Closed meeting hosted by EPEE (JIEG only)
Informal consultation meeting 21 Mar 2012	c. 14	14	c. 35	Open meeting on chillers and condensing units

[5] The SME questionnaire is very similar, if somewhat shorter, to the stakeholder questionnaire available at http://www.taitconsulting.co.uk/Ecodesign_Consultation.html . Both questionnaires aimed at collecting feedback on the proposed regulation, its modifications following the Consultation Forum and its impacts.

SME consultation (EEN, April/May 2012)	6	6	0	To EEN registrants in 7 languages, replies via portal
Stakeholder consultation questionnaire (April/May 2012)	5	7	5	Questionnaire sent direct to all stakeholders (English only), and disseminated further by several national industry associations

The Commission's minimum standards on public consultation can thus be considered to be fully met.

2.4. Outcome of the consultation process

Member States agreed with the introduction of regulatory measures for condensing units, with a few (UK and Sweden in particular) favouring the introduction of ambitious requirements. The need for the development of an appropriate and widely shared metric was generally recognised, with a few countries worrying about the effect that the development of a (more appropriate) new standard on measurement of seasonal efficiency could have on the timing of the regulation. In the case of chillers, a significant numbers of MSs found that the data presented in the Consultation Forum was not sufficient to substantiate the proposed Ecodesign requirements, and it was also stressed how information requirements are costly for manufacturers and are justified only if sufficiently significant energy savings can be achieved through combined information and performance requirements. For both products, a few countries encouraged the Commission to look into the possibility of favouring the adoption of climate friendly, low GWP (Global Warming Potential) gases, and wished that also noise requirements could be considered.

Environmental NGOs were decisively in favour of the introduction of regulatory measures, wishing that they could cover also noise emissions and incentivize the use of low GWP refrigerants. They also worried about the lack of data regarding chillers, since in their opinion this could lead to too lax requirements being set.
The consultation with the **industry** has been an important part of the development of the considered regulation. The industry found that the preparatory study, while being trustworthy in regard to the technological analysis performed, did not report reliable data about the average performance of the products on the market; therefore, it made new, more reliable data for the regulation. More about this topic is reported in Section 3.1. The feedback from the industry was also important to estimate the impact of the possible regulation, its effect on the

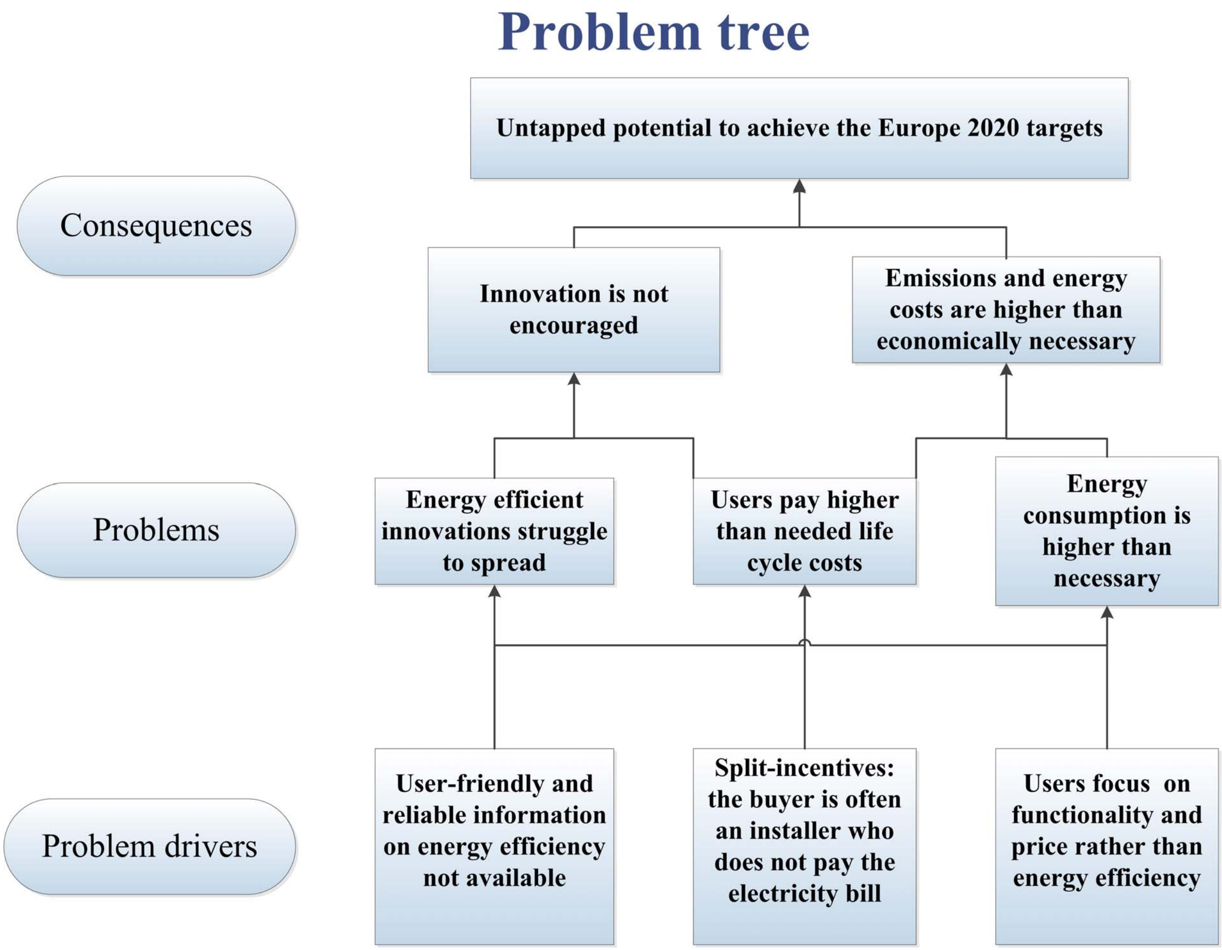
market, the relative stringency of the thresholds and the testing methodologies. Smaller producers and those having a high number of customized products were particularly worried about the testing and administrative burden and proposed, or commented on, methods to reduce it. The industry generally supports the introduction of minimum requirements, but with different positions about their level and timing; there is also significant support for a labelling scheme once the data necessary to underpin it will be available.

3. PROBLEM DEFINITION

The market for both condensing units and chillers is driven primarily by purchase price; this fact has been confirmed by all stakeholders. This happens despite the fact that cost-effective energy-saving technologies are available and that both 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. This is indeed the case for a minority of buyers, generally large companies and/or companies that operate in sectors where energy costs are a high share of total costs; but the vast majority focuses on price alone. There are multiple reasons behind this situation. First of all, often (particularly in the case of condensing units) the purchase is not performed by the final user, but rather by an installer; the latter does not pay the electricity costs and has to operate in a very competitive market, and consequently tends to reduce costs to a minimum by including the cheapest products in his offer. The existence of such split incentives is commonly referred to in the economic literature as the principal-agent problem. Second, for many users the electricity bill represents a small percentage[6] of their total costs, so that they have little incentive to focus on them. Third, it would cost them a great deal of time and effort to acquire the information necessary to compare the energy performance of different products, since there is no easy instrument such as a label or other easily usable performance information to do so, and the declared energy performance is expressed in a measure, the COP, that covers only full load performance and so does not reflect performance in real use with varying ambient temperatures and loading patterns. Consequently, buyers continue to focus on purchase price; readily available technological solutions that improve energy performance struggle to find their way to the marketplace and the potential for improvement lies largely unexploited, as has been confirmed throughout the consultation process. The following diagram represents these mostly demand-driven problems graphically.

Diagram 1: Problem Tree

[6] For example, this is the case of retailers with a low proportion of perishable food/drink in their overall range, of metal fabricators using chillers for a couple of machines in large workshop, and of processors of high value foods.



Grounds for an implementing measure

According to Article 15(1) of the Ecodesign Directive, a product shall be covered by an implementing measure or self-regulation if the criteria listed in Article 15(2) are met, namely:

(a) the energy using product shall "represent a significant volume of sales and trade, indicatively more than 200 000 units a year";

(b) it shall "have a significant environmental impact within the EU";

(c) it shall "present significant potential for improvement in terms of its environmental impact without entailing excessive costs, taking into account in particular:

  (i) the absence of other relevant EU legislation or failure of market forces to address the issue properly;

  (ii) a wide disparity in the environmental performance of energy using products available on the market with equivalent functionality."

The following paragraphs will verify if and how the criteria listed above are met.

3.1. Baseline scenario

As explained in Section 2.4, new data was provided after the Consultation Forum to underpin the regulation. The preparatory study data, while being reliable from a technological point of view, was deemed to be less trustworthy about the average energy performance. This situation was due to a limited dataset, the reliance on data covering only commercial and not also industrial condensing units, the use of data covering only a small percentage of the market in the case of chillers, and for both products the use of an improper way of measuring the performance, the COP (Coefficient of Performance). The COP is a measure of an amount of cooling achieved with an amount of electrical energy used. It is an appropriate metric for smaller appliances, but not for larger ones, since it is calculated at full load rather than with a method that reflects the real usage of the product. Consequently, the industry categorically refused to accept the requirements envisaged in the preparatory study and decided to contribute to the regulatory process through an industry group consisting of at least 7 of the biggest EU manufacturers. This group (called the Joint Industry Expert Group, JIEG) covers both condensing units and process chillers; its key members had previously set up an industry voluntary certification scheme for compressors under the auspices of ASERCOM, a platform of leading component manufacturers within the European Heating, Ventilation, Air Conditioning and Refrigeration Industry. The JIEG provided the evidence that underpin the current regulatory proposals, and contributed to their development by the IA contractor and the Commission. There is therefore an undeniable reliance on data provided by the industry associations in these proposals, which otherwise would not have been solid or even possible in the case of chillers. However, the data and the proposals based on them have been cross-examined and found sound by the Commission IA study contractor and by an independent industry consultant[7]. Furthermore, the data has not been disputed by the respondents to the consultations, including SMEs. Importantly, the data provided by the industry were based, in the case of larger appliances, not on the COP but on the SEPR (Seasonal Energy Performance Ratio), which is derived from a calculation based on the COPs of the product at different ambient temperatures and cooling loads, and therefore better reflects its real usage. The SEPR was well received in the consultation, and its calculation has not been found to be challenging, also thanks to a spread sheet tool attached to the consultation questionnaire (see Chapter 5 for further details on the SEPR metric).

3.1.1. Sales and stock (Article 15(2)(a))

Condensing Units

The baseline scenario is developed on the base of the following definition:

"A condensing unit is a piece of refrigeration equipment including at least one compressor and one condenser placed on the EU market as a package and intended to provide cooling to at least one refrigeration appliance or system.“

The proposed regulation includes medium and low temperature condensing units[8], which operate respectively at evaporating temperatures of -10˚C and -35˚C; this will result into two broad categories, which present different technical characteristic and therefore have to be treated separately. High temperature CUs, often referred to as 'outdoor units', that operate at evaporating temperatures of +10˚C are used for air conditioning systems and are consequently covered by planned or existing air conditioning regulations[9].

[7] Director of Cool Concerns Limited, technical advisor to Defra since 1993 and former President of the UK Institute of Refrigeration with over a decade track record of advising UK Government on energy efficiency of commercial and industrial refrigeration equipment.

[8] Condensing units are used as components of other products or installations; however, only when they are sold as such they will be subject to the regulations. CUs used by their producer as components of another product will not fall under the regulation.

[9] In order to avoid confusion, it is better to state already here the existence of Ecodesign regulation No 206/2012 covering small air conditioners, which is freely available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:072:0007:0027:EN:PDF; this is the one referred to as

The following table reports the condensing units sales, stock and energy consumption in 2012, while the following figures report the evolution of the stock up to 2030. All data are the result of the modeling performed by the IA contractor on the basis of the preparatory study data (The data provided by the JIEG regarded only the efficiency profile of the products existing on the market, not the market itself).

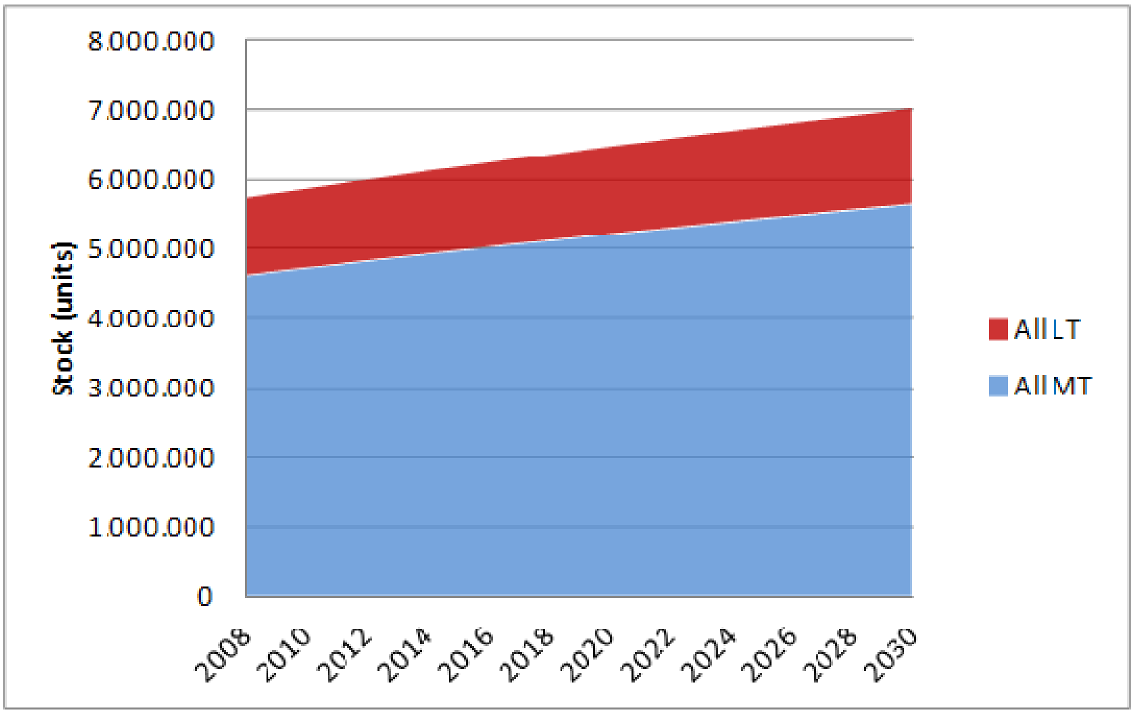
Table 2. Summary of condensing units stock, sales and energy consumption at 2012.

	Stock at 2012 (units)	Stock as %	Annual sales at 2012 (units)	Sales as %	Stock Annual Energy consumption at 2012 (TWh)	% of annual stock energy consumption
Medium temperature	4,822,000	81%	504,000	81%	54.1	79%
Low temperature	1,157,000	19%	121,000	19%	14.6	21%
Total	5,978,000	100%	625,000	100%	68.7	100%

Source: preparatory study about stock and sales, elaboration of the IA contractor on the basis of JIEG data about energy consumption. Please note that all tables and figures in this IA share these sources, unless stated otherwise.

the air conditioners regulation. Furthermore, as described in Section 3.3.1, the Commission is working on the possibility to regulate air conditioning chillers, which are used in larger air conditioner systems. The latter cannot be directly regulated, since they are not a product but a system built on site.

Figure 1. Projected development of stock of condensing units broken down into medium (MT) and low temperature (LT) applications.



Chillers

The baseline scenario is based on the following definition:

"a process chiller is a factory-built piece of refrigeration equipment which is primarily intended to cool down and maintain the temperature of a liquid through a vapour compression cycle within a refrigeration process, including at least a compressor and an evaporator within a "package".

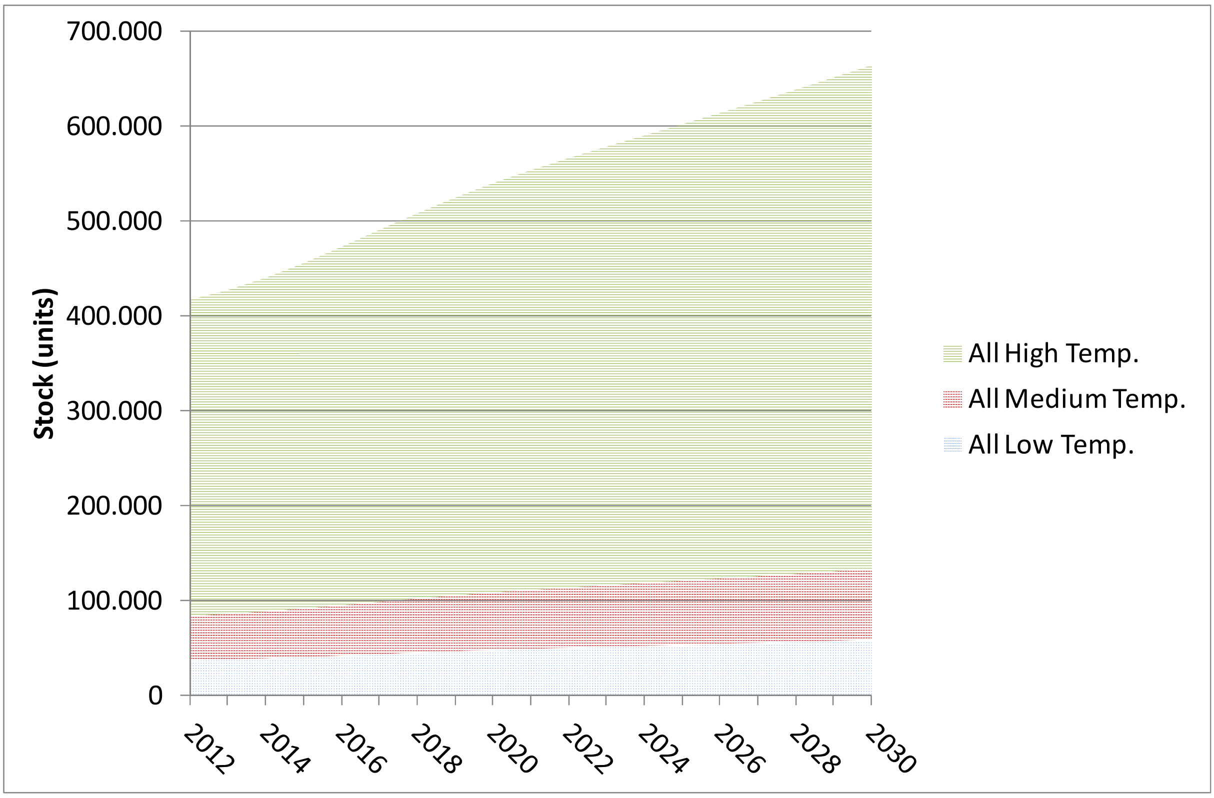
Chillers of all cooling capacities intended for use with air-cooled or water-cooled condensing and chillers intended for use at high, medium or low[10] 'target' temperature are included in the scope of the regulation, while chillers assembled on site, chillers with evaporative condensing and those using absorption technology are excluded. High temperature chillers, while falling within the scope of the regulation, present peculiar issues that are analysed in Sections 6.5 and 6.7. They are initially not considered as the object of possible requirements, but their inclusion into them will be considered as an option later on.

Table 3. Summary of chillers stock, sales and energy consumption at 2012.

[10] 'Low operating temperature' means that the chillers is intended to function at an operating temperature between -25°C and -8°C, with the reference point at -25°C
'Medium operating temperature' means that the chillers is intended to function at an operating temperature between -12°C and +3°C, with the reference point at -8°C
'High operating temperature' means that the chillers is intended to function at an operating temperature between +2°C and +15°C, with the reference point at +6°C

	Stock at 2012 (units)	Stock as %	Annual sales at 2012 (units)	Sales as %	Stock Annual Energy consumption at 2012 (TWh)	% of annual stock energy consumption
High temperature	333,400	80%	27,700	81%	89.5	70%
Medium temperature	46,900	11%	4,000	11%	15.5	12%
Low temperature	36,500	9%	3,100	9%	23.4	18%
Total	416,800	100%	34,800	100%	128.4	100%

Figure 2. Stock of industrial process chillers broken down into high, medium and low temperature applications.



Concluding, the criteria set by Article 15(2) (a) of the Ecodesign Directive are clearly met in the case of condensing units, since the sales numbers are visibly above the threshold. In the case of chillers, they are clearly below the indicative figure of 200,000 units; nevertheless, the criteria are to be considered met because of the very high energy consumption, intensive usage, and long average life of this product. In fact, the average consumption of a chiller is comparable to the annual consumption of about 1,400 household dishwashers and double of that of all condensing units.

3.1.2. Environmental impacts (Article 15(2)(b))

The analysis focuses on the use phase of the products because other life cycle phases fall out of the scope of the proposed regulation. For instance, the end-of-life phase is generally addressed in the Waste of electrical and Electronic Equipment Directive 2002/96/CE (WEEE Directive). During the use phase, the main environmental impact of both products consists in their contribution to global warming caused by the leakage of refrigerant gases and above all the emissions caused by the production of the electricity used.

The energy consumption has been foreseen to develop as shown in Figure 3 for condensing units and in Figure 5 for chillers. The baseline scenario is built on the assumption that without additional policies, efficiency levels will remain constant despite the availability of better products. This has indeed been the case in the last years for the EU market as a whole, with energy-efficient improvements struggling to be introduced because competition focuses mostly on prices, as confirmed by the industry. The result is a noticeable increase in energy consumption, which is set to reach almost 300 TWh[11] in 2030 for the two products combined.

The contribution of the energy use to global warming is depicted in Figure 4 for condensing units and Figure 6 for chillers, where energy consumption is converted into TEWI (Total Equivalent Warming Impact), expressed in million tonnes CO2 equivalent. The electricity conversion factors are those used for all Ecodesign regulations according to the MEErP methodology, as explained in Annex II. The assumptions made about refrigerant charges, leakage rates and typical refrigerants to estimate the direct (i.e. caused by the refrigerant gases instead of the energy use) global warming impacts are detailed in Section 6.6. Clearly, the direct impact of the refrigerant gases are superior (around 20%) in the case of CUs than for chillers. This is due to the widespread use of ammonia (GWP equal to zero) in chillers, and above all to the much lower leakage rates: chillers tend to be much better attended, both during usage and at end of life, by their producers.

Lastly, the possibility of regulating noise emissions, whose consideration had been suggested by NGOs and some MSs in the Consultation Forum, has not been investigated in depth because a consensus emerged during the consultations that since these products are used in a noisy professional setting, the gains achievable are disproportionate to the related costs.

Figure 3. Energy consumption (TWh per year) of condensing units broken down into medium (MT) and low temperature (LT) applications.

[11] As a term of comparison, this amounts to the energy production of about 30 nuclear power stations currently in use over one year, which average an energy output of about 10 TWh.

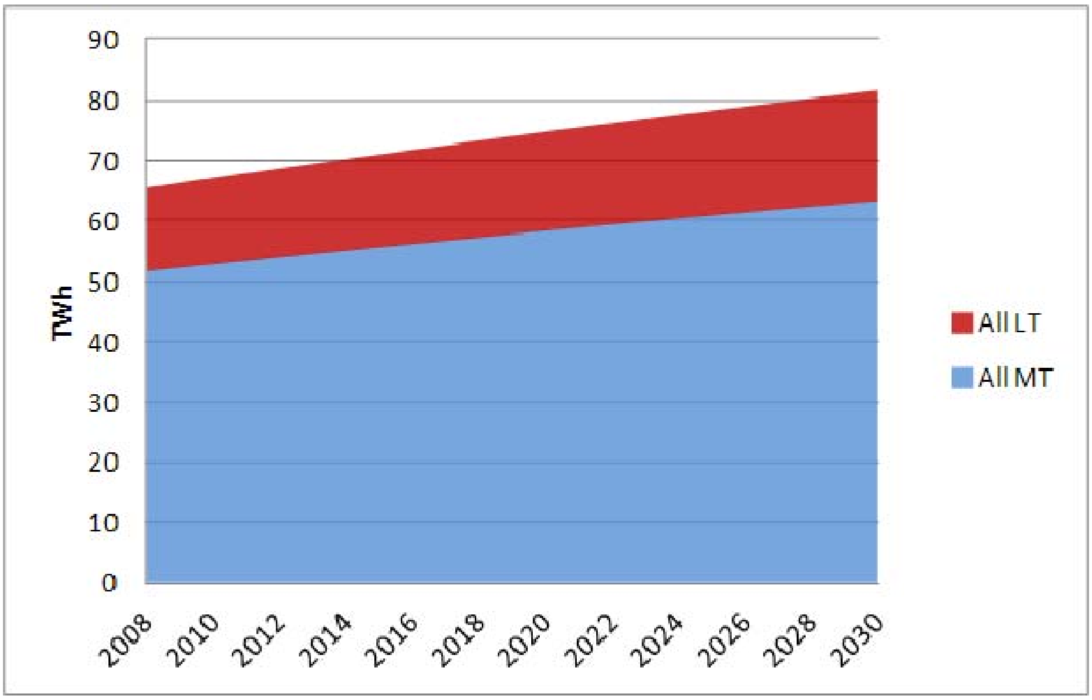


Figure 4. Global warming impact of Condensing Units: indirect from energy consumption and direct from refrigerant leakage

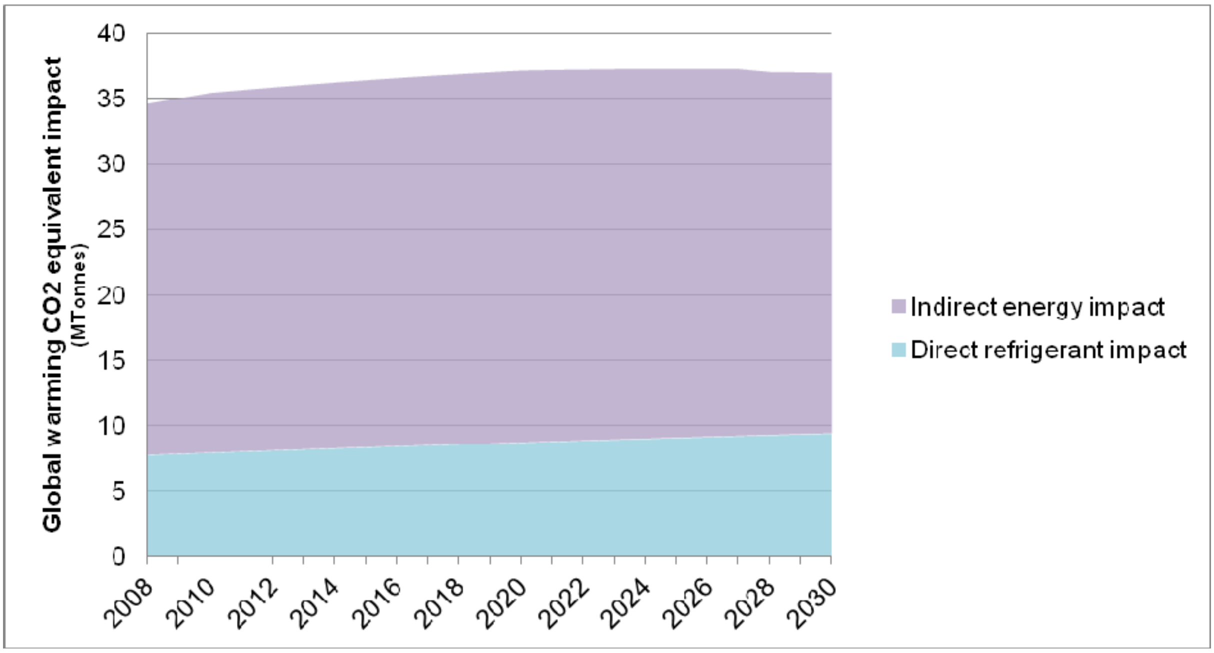


Figure 5. Energy consumption (TWh per year) of industrial process chillers by temperature applications.

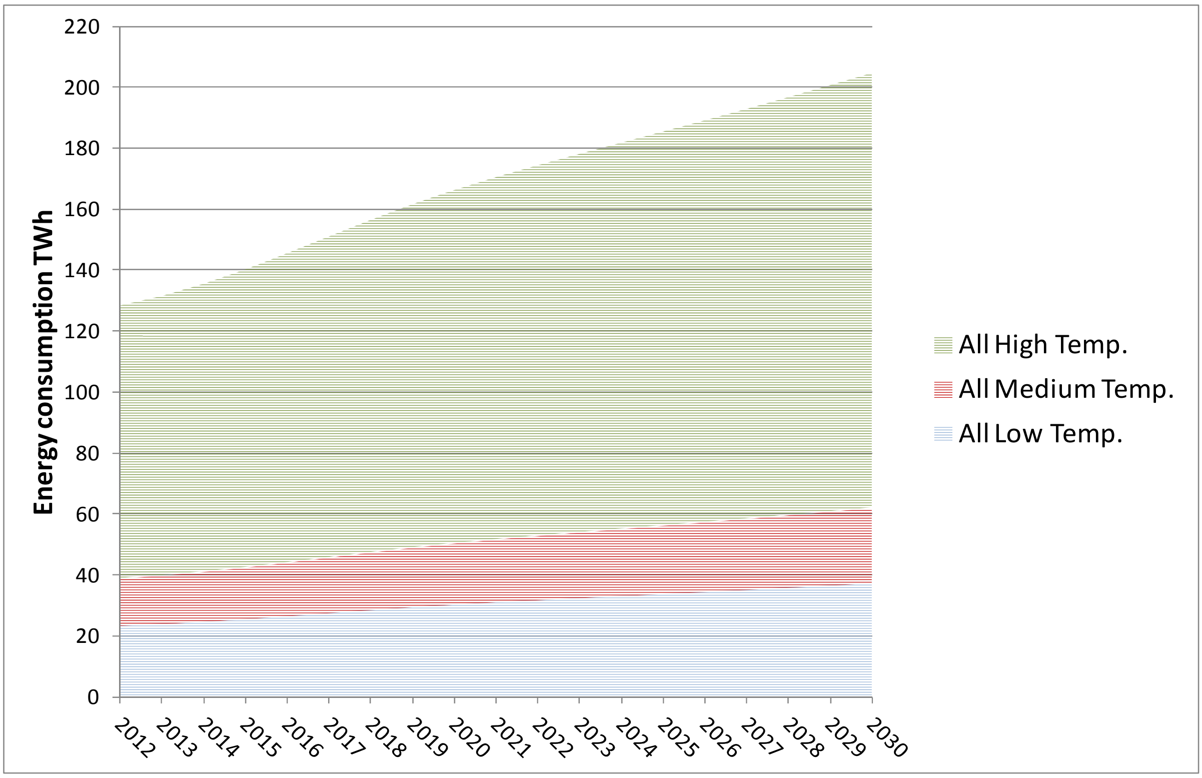
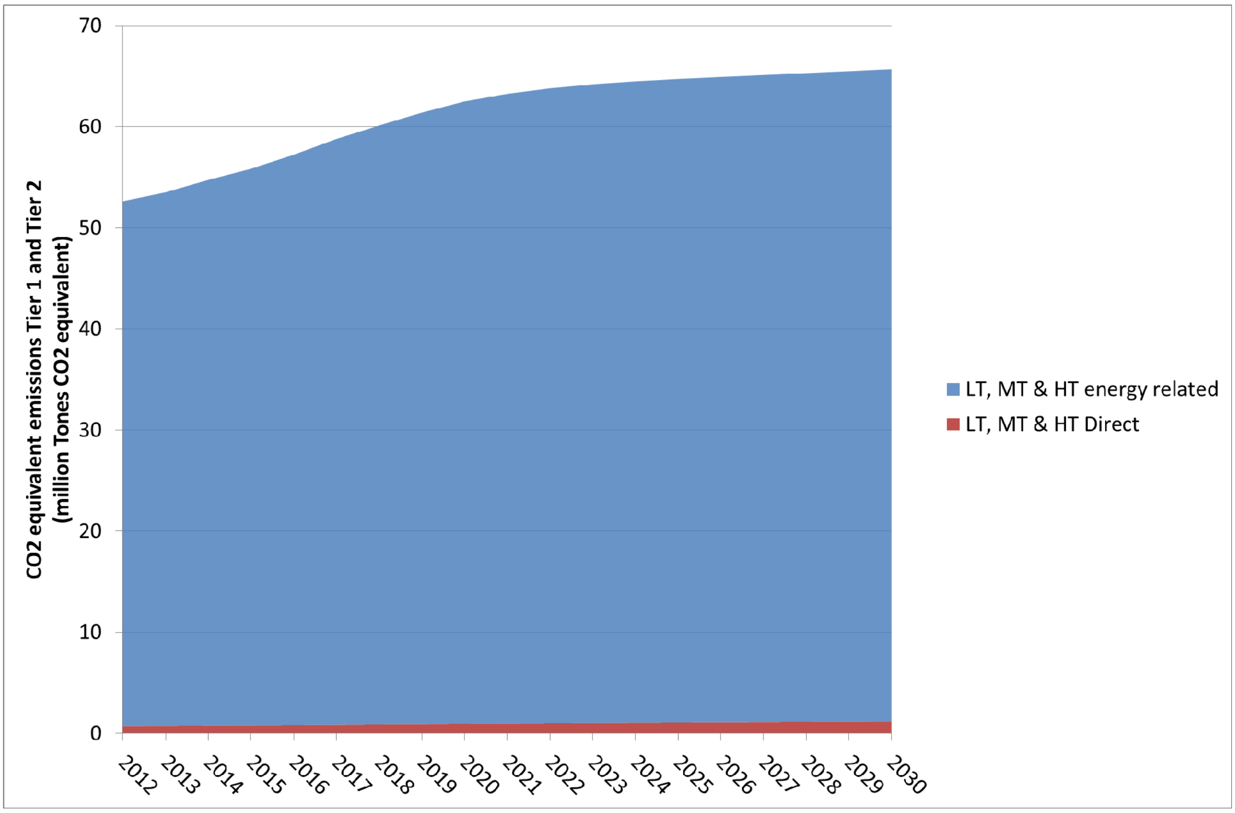


Figure 6. Global warming impact of Chillers: indirect from energy consumption and direct from refrigerant leakage



The global warming impact described and depicted in the figures above clearly indicates, also in comparison with those of other products already subject to ecodesign regulations, that the criterion of significant environmental impacts (Article 15(2) (b) of the Ecodesign Directive) is met.

3.2. Improvement potential (Article 15 (2) (c))

Competent design can significantly increase efficiency from a poor level at minimal cost for both products; all parties consulted agreed that this is indeed the case. However, the very strong competitive focus on prices in the market, as described in Chapter 3, makes it difficult even for these inexpensive measures to be taken up. Further improvements would tend to be more costly and time-consuming because of the need of substantial redesign and the necessity to overcome significant obstacles such as space constraints (often efficient components need more room).

The preparatory study showed that, in the case of condensing units, a mix of technology improvements which adds 20% to the cost can pay back in less than 1 year (larger heat exchanger, improved or even variable speed compressor). The same source indicates that best available technology might be 80% more expensive but pay back in 4 years.

The situation is similar for chillers: a mix of technology improvements (such as electronic expansion valve, improved compressor, larger heat exchanger, alternative refrigerant) which adds 50% to 60% to the cost can pay back in less than 2 years, while the best available technology might cost as much as twice the base price and pays back in around 6 years.

3.3. Existing legislation and failure of market forces to address the issue (point (i) of Article 15(2) (c)

3.3.1. Existing legislation

No regulatory approach to reduce the energy consumption of condensing units and chillers has been identified in the EU to date.

Legislation on other environmental aspects

The use of (product related) hazardous substances during the production phase is dealt with by Directive 2002/95/CE on the Restriction of Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS Directive).

The end-of-life phase, including the treatment of gases causing global warming, is addressed in the Waste of Electrical and Electronic Equipment Directive 2002/96/CE (WEEE Directive). The WEEE Directive states that entities responsible for bringing these to the market products are also responsible for adequate take-back and disposal.

These products are also subject to the F-Gas Regulation EC No 842/2006 which does not directly address energy efficiency. Options for directly addressing refrigerant and global warming potential (GWP) issues are discussed under Option G in Section 6.6.

A preparatory study is being prepared by the Commission to cover air conditioning chillers. This could in due course lead to Ecodesign implementing measures or self-regulation of air conditioning chillers. These products are similar to high temperature industrial process chillers in many aspects of design and operate at the same or similar temperatures. Their usage profile over a typical year would, however, be very different: air conditioning chillers have concentrated usage during summer and warm periods, with fairly high variation in instantaneous cooling load over the course of any day and month. By contrast, industrial process chillers operate at high loading factors (mostly over 80%) and consistently during the whole year (see also Option E3).

3.3.2. Voluntary measures

A voluntary product endorsement and tax break scheme in the UK[12] has attempted to promote highly efficient condensing units and chillers (both industrial and air conditioners ones), but is limited to endorsing the better products on COP only and cannot address the wide availability of low price low efficiency products.

The industry has been working, as explained in Chapter 3, on the development of a standardized and appropriate testing methodology for energy efficiency, the SEPR, though the joint industry expert group (JIEG). The method developed has been found to be an appropriate one by the stakeholders consulted. Therefore, the technical basis for seasonal performance metrics has largely been established. Its calculation has been made easier through a calculation tool provided by the JIEG to help manufacturers calculate the SEPR from the COP of the product at four different ambient temperatures and cooling loads. Producers have just to insert the data and the SEPR is calculated automatically; this helps in particular smaller companies. Nevertheless, there are still aspects to be refined, such as how to accommodate for products incorporating two compressors, or for the different temperature profiles in Northern and Southern Europe. The development of such method into a standard would surely improve the information failure which is one of the causes of the market failure, but in the absence of an obligation to use it to publish energy performance data its effectiveness would be greatly limited by two elements. First, the time required for the development of a standard tends to be longer if not mandated by public authorities in view of a regulation. Second and most important, its uptake would be partial if not legally required: the companies that collaborated to it would use it, but not those which did not.

3.3.3. Market failures

As stated in the introduction to Chapter 3, the failure of the market to tackle the problem is due to a lack of functional information for the user, the split incentives between installers and users, and a short-sighted, but comprehensible, focus on the up-front price of the product.

[12] See http://etl.decc.gov.uk/etl/criteria/.

Also the criteria set by Article 15(2) (c) (i) and (ii) of the Ecodesign Directive can be thus considered to be fully met.

3.4. Legal basis for EU action

Article 16 of the Ecodesign Directive provides the legal basis for the Commission to adopt an implementing measure for this product category. The scrutiny of criteria enshrined in Article 15(2) of the Ecodesign Directive performed above shows that condensing units and chillers qualify for the adoption of an implementing measure setting new ecodesign requirements or self-regulation.

Furthermore, as it is the case for all five products in the professional refrigeration group, the problem is undoubtedly transnational due to the significant EU and international trade in these products. Italy, Spain, the UK and Germany account for the majority of EU production, with China, Turkey and South Korea accounting for significant imports according to research in the preparatory study and supported by stakeholder comment. Action at EU level is appropriate to ensure free circulation of goods and would also reduce the burden of testing and product development on manufacturers compared with separate measures in various Member States.

The envisaged regulation, as it is the case for all Ecodesign regulations, is fully coherent with other EU policies, and in particular it is to be seen as a contribution to decoupling economic growth from the use of resources, an objective set out in the Europe 2020 strategy (COM(2010) 2020)[13] under the flagship initiative: ‘resource efficient Europe’.

3.5 Conclusion

The analysis performed above clearly indicates that there is a currently still missed opportunity of significant energy savings to be achieved in this sector, while at the same time users currently pay higher than necessary life-cycle costs for operating condensing units and chillers. Market forces alone (see Section 3.5) are not expected to achieve them due to the characteristics of the market, and while regulatory intervention at the national level might, it would also hinder the free circulation of goods in the internal market and impose a much higher burden on producers. Therefore, action at EU level is advisable, and it could give a noticeable contribution to the achievement of the Europe 2020 targets.

4. Objectives

As laid out in Chapter 3, the preparatory study and the impact assessment study have confirmed that a potential for reducing the energy consumption of both products exists. This potential is not likely to be tapped with the current market measures and initiatives.

The **general objective** is therefore to develop a policy which corrects the market failures, and which:

– reduces energy consumption and related CO2 and pollutant emissions.

[13] Available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF

– promotes energy efficiency hence reducing energy dependence and contributing to the EU objective of saving 20% of the EU's energy consumption by 2020.

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

The **specific objectives** are:

– to facilitate removal of the poorest performing products from the market, where their life cycle cost disadvantages have proven insufficient to drive this, thereby reducing the principal-agent problem.

– to help buyers to make an informed/rational choice based on performance information that reflects real life usage, thereby moving the market to adopt improved technology solutions.

– to set incentives for producers to further develop and market energy efficient and climate-friendly technology and products.

– to generate cost savings for end-users.

The **operational objectives** are:

– to develop by 2013 an appropriate metric for energy performance that reflects real life usage.

– to make sure by 2014 that buyers receive appropriate and understandable performance information and so foster an effective competitive market driven by competition on energy performance.

– to create a framework for gathering information about energy performance that can allow for possible subsequent (self-) regulation at a review four years after entry into force.

– to achieve the objectives listed above without 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.

Chapter 5 describes the policy options have been considered to meet these objectives.

5. POLICY OPTIONS

This Chapter describes the policy options, both discarded and assessed in detail, that have been considered in the context of this impact assessment. Unless stated otherwise, they regard both condensing units and chillers.

Development of a harmonized test methodology

The lack of a harmonized methodology to calculate the energy efficiency of each product is, together with the little focus on energy efficiency and the split incentives between installer and final user, a major obstacle that impedes comparable energy consumption information and thereby the movement of the market for both products towards a more performance-based competition. Namely, even when the energy performance is declared, comparison among different products is difficult for the average informed buyer. The existence of such a methodology is a necessary prerequisite for all following options except A and B, and therefore the establishment of a fair and EU-wide means to measure energy efficiency of both products should be an immediate policy priority; it would not be sufficient to solve the market failure, since it is only one of its causes, but it would give a first, fundamental contribution to its solution. Stakeholders agreed unanimously, both in the SME and the general consultation, on this. As stated in Chapter 3, the JIEG already developed a method which has been considered appropriate by both producers and technical experts. Such method would be used as the basis of a CEN mandate to develop a harmonised standard to underpin the regulation. The mandating process has been started and is set to be concluded by middle 2013. All options except A and B would oblige producers to use this metric and display the resulting information.

Option A: No new EU action

There is no eco-design or energy efficiency related EU-level policy currently in force. If no EU action is taken the problems described in Chapter 3 and Section 3.3.3 will persist, and energy consumption is expected to increase as described under the baseline scenario in Section 3.1.2.

The "Business-as-usual" scenario is based upon this option and provides the reference for the proposed other options, on which basis savings are calculated

Option B: Adoption of existing foreign policy

No such policies were identified in the preparatory study, or in subsequent consultation and research.

Option C: Self-Regulation

This option would consist in a voluntary industry initiative for the setting of seasonal performance information and minimum requirements. Such a voluntary industry initiative would be technically feasible to negotiate, given the level of commitment and technical expertise made available through the JIEG which represents the majority of major EU manufacturers. An industry body, ASERCOM, also exists that could support and promote such an initiative; ASERCOM already operates a voluntary certification scheme for compressor efficiency. However, an undertaking to voluntarily declare performance data for all products and also withdraw the least efficient (often the cheapest) products from the market would be significantly undermined by non-signatories and non-branded products freely available on the market[14]. Manufacturers voluntarily withdrawing products would risk losing market share to cheaper alternatives that do not respect the voluntary standards. Furthermore, generating and managing the performance information is costly and thus unlikely to be universally adopted on a voluntary basis. In addition, the manufacturers represented in both the JIEG and ASERCOM have themselves stated their unwillingness to collaborate to this option for the mentioned reasons, thereby making it evidently not viable.

Option D: Mandatory information requirements

Under this option producers would be obliged to declare information about the energy performance of their products. This option is thus likely to improve the information failure described in Chapter 3, and could therefore contribute to the solution of the problem. Clearly,

[14] According to qualitative feedback in the consultation, such products represent a sizable share of the market.

it would depend on the development of a shared methodology, since users could not assess the performance across the market if each producer could develop its own. Under this regard, it is similar to the labelling scheme, with the important difference that the information would be less user friendly and comparison among products would be much more time and effort-consuming. However, there are reasons to doubt its capacity to tackle the problem in a significant way. First of all, the non-sophisticated buyers would continue to choose the cheapest products[15]; since this market segment is where most savings are to be achieved, the impact of sophisticated buyers, who are already choosing efficient products, choosing slightly more efficient ones is bound to be very limited. Second, this option would not contribute at all to remedy the principal-agent problem described in Section 3.3.3. Installers would continue to choose the cheapest products.

The consultation has made clear that industry does not believe this to be an effective option; the producers of more efficient products already experience great difficulties to market them, despite the existence of a widespread (if less accurate than the SEPR) metric, the COP. Consequently, the industry would oppose the imposition of the testing costs caused by this option as disproportionate to the benefits to be achieved. Also most Member States would not support such an option on its own. As stated by a national delegate and reported in the minutes of the Consultation Forum, "information requirements generate administrative burden for manufacturers and market surveillance authorities. Such burden is justified only if sufficient energy savings are achieved through *combined* information and performance requirements". It should be noted that if there were information requirements only, the penalties to be imposed for an untruthful declaration are bound to be limited [16], while they can amount to a withdrawal from the market for a product whose performance is found below the minimum requirement. Consequently, manufacturers would have an incentive to control the performance of their competitors (self-policing). This would not happen in the case of simple information requirements.

Consequently, Option D is discarded as a stand-alone option, but integrated in Options E1 to G since it constitutes a necessary first step for the introduction of any regulation.

Option E1: Regulatory information and minimum requirements

This option consists in the setting of both information requirements and Ecodesign Minimum Energy Performance Requirements (MEPS) for condensing units and medium and low temperature chillers. As reported above, this option would be underpinned by the use of a more appropriate performance measurement method, the SEPR, already used by the JIEG, that would have to be converted into a harmonized standard through a CEN mandate. The SEPR would be used for both larger condensing units and for chillers, while the performance of smaller (definitions are illustrated in Table 10) condensing units would continue to be measured with the COP[17]. Following the introduction of minimum performance requirements, only products above a given performance threshold would be allowed to the market. This

[15] This is likely to be the case in particular for the users of condensing units, since they tend to be smaller companies and not to buy them directly but through a third party such as an installer.

[16] The determination of the penalties, as market surveillance in general, falls within the responsibility of the Member States, and as foreseen by the Ecodesign Directive, it depends on the gravity of the non-compliance. Therefore, they can be different among countries; typically, in the case of an inaccurate declaration they consist in a fine and the order to declare the correct value in the future. Given that products are rarely tested, the risk of incurring into it can be accepted by a deliberately non-compliant producer.

[17] Smaller units tend to be used with a more stable pattern because of their specific applications and also because they are more likely to be located indoors, thereby being sheltered by seasonal variations in temperature and humidity. All stakeholders agreed that the COP is an adequate metric for them.

option would therefore be able to remove the least efficient products. It is widely supported among stakeholders (Industry, Member States, and NGOs), who however have different opinions about the stringency levels and some minor aspects of its implementation.

Option E2: Regulatory information and minimum requirements with delayed timing and lower thresholds for Condensing Units

This option would not deviate from the measures foreseen in Option E1 for chillers, while it would depart significantly from them for condensing units, since it would delay the entry into force of the MEPS on them and lower their stringency. There are different reasons for this choice: SMEs producers, which are likely to find it more difficult to comply with the regulation, are more prevalent in CUs than in chillers; the feedback on the stringency of the proposed MEPS has been much greater and concerned for CUs than for chillers; the delaying would be much more beneficial if performed for only one of the two products, so that producers[18] of both CUs and chillers not only would have more time to cope with the regulation, but could also spread the connected costs over a longer time frame. Option E2 would address most of the feedback about feasibility and timing received during the stakeholder consultation, but sacrifice some savings (of energy, emissions and users' expenditure) in order to do so.

Information requirements and Tier 1 minimum energy performance requirements are identical to those of Option E1 except for commencing in January 2015. Tier 2 MEPS would also start one year later, i.e. in January 2018, but be substantially lower.

Option E3: Addition of minimum requirements for high-temperature chillers

Option E1 could be expanded by adding MEPS also on high-temperature (HT) chillers. They fall within the scope of the regulation but it had been envisaged in the Consultation Forum working document not to place Ecodesign performance requirements on them. The main reason for this choice was the assumption that HT chillers would fall under the air conditioning chillers regulation which is currently under consideration. However, it has emerged following discussion with industry that the optimization of the performance of an industrial and an air conditioning chiller differ because the first tends to be used at a more stable load than the second. Therefore, it would be unwise to regulate them in the same way and with the same methodology: one or the other type would be optimized to score well on a metric that does not reflect its usage pattern. Given that such a distinction is advisable[19], the growing availability of data and considering that HT chillers are responsible for four times the energy consumption of the medium and low temperature ones, the setting of MEPS also on them has been analysed. However, there are significant legal and technical issues (see Sections 6.5 and 6.7) to be solved in that case. Option E3 is retained to analyse these issues and the impacts of possible MEPS.

[18] This would help SMEs in particular, since they have less access to testing facilities and fewer personnel to deal with the regulation. It should be noted that larger producers, represented in the JIEG, are generally in favour of a quicker entry into force.

[19] Clearly, the fundamental issue is the distinction of industrial and air conditioning chillers in terms of testing methodology and MEPS. After such a distinction is operated, it becomes possible to decide if it is better to regulate them separately as assumed here or both under the same regulation, but with different requirements. The later option is preferred by some producers, who would like to have only one regulation to refer to; they tend to be indifferent about which one it should be, the professional refrigeration or the air conditioners one.

Option F: Energy Labelling

This option would consist in the creation of a labelling scheme that ranks products according to their energy performance, and then conveys this information though an A to G label as it is currently done for many household products.

In the case of **chillers**, the biggest obstacle is to be found in the complexity of engineering choices involved in selecting an industrial chiller for a particular application. Selection has to take into account usage profile, operational temperatures, seasonality of demand, capacity, and many other parameters. A traditional A to G energy label could arguably oversimplify to the point of misleading a proportion of buyers into making a sub optimal choice for their particular application. A chiller that may be the most cost and energy efficient solution for one application may be sub-optimal for another. Many industry representatives in the consultation did not support the idea of a conventional labelling scheme for these reasons. However, there may be situations in which labelling could be beneficial, in particular within specific types or sizes of equipment or applications.

In the case of **condensing units**, while other stakeholders who replied to the consultation questionnaire supported such an option, manufacturers raised a series of substantial objections. Apart from the general risk of oversimplifying as described for chillers above, they again pointed at the lack of sufficient data, and stressed that condensing units are only components: labels should apply to the finished system rather than to them as a component. On balance, it is apparent that no labels can be designed at present but this should be considered at first regulatory review when more data are publicly accessible. Clearly, the objection that the whole refrigeration system rather than a single component should be labelled would still need to be overcome.

Concluding, there are great obstacles for the creation of an energy labelling scheme for these products, and the necessary data are currently not yet available; therefore, this option is not retained for the time being, but it should be further investigate at the time of the review, as suggested by a significant number of stakeholders, including producers.

Option G: Malus/bonus based on GWP of refrigerants

This option consists in the creation of a system that would reward low GWP gases with a lower minimum requirement (Bonus) and/or penalise high GWP gases with a higher one (Malus). Stakeholders views on this topic are highly divided. Some Member States would support the introduction of a malus/bonus system, while others would oppose it; environmental NGOs are strongly in favour. The industry is against it[20], citing the risk of double regulation (all refrigeration products are already covered by the F-gas regulation), the diversity of product types and applications which does not allow for a system covering all of them in the same manner, the impossibility of using low GWP gases such as hydrocarbons or ammonia in some applications due to safety risks or regulations, and noting how in most cases the introduction of MEPS would anyway push the market toward the adoption of low GWP gases where technically possible, since they tend to be more efficient (with the partial exception, according to the consultation replies, of CO2 as a refrigerant). However, it should be noted that it was the industry to call for the bonus foreseen in the air conditioning regulation. The possibility of encouraging the adoption of low GWP gases has to be

[20] During the consultation process, no producer, including those of products using low GWP refrigerants, called for the introduction of such a scheme.

considered carefully, in particular when they struggle to find their way to the market and the direct emissions are a significant share of the total as is the case for condensing units. Therefore, Option G is retained for further analysis for them.

Overview of the retained options

The following table presents an overview of the retained options for both products.

Table 4. Summary of options

	Not Retained	Retained	Earmarked for review
Option A: No new EU action		✓ (as baseline)	
Option B: Adoption of existing foreign policy	✓		
Option C: Self-Regulation	✓		
Option D: Mandatory information requirements	✓ (integrated in all options)		
Option E1: Minimum Energy Performance Requirements (MEPS)		✓	
Option E2: Minimum Energy Performance Requirements (MEPS) with delayed timing and lower thresholds for Condensing Units		✓	
Option E3: Addition of minimum requirements for high-temperature chillers		✓	
Option F: Energy Labelling			✓
Option G: Malus/bonus based on GWP of refrigerants		✓	

6. IMPACT ANALYSIS OF THE RETAINED OPTIONS

This chapter looks into the impacts of the retained policy options. They are assessed against the baseline scenario which describes the impacts in case the Commission decides not to put forward any measures.

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.

6.1. Development of a harmonized test methodology

As stated in Chapter 5, the existence of such methodology is a necessary prerequisite for all options. Therefore, it must be clearly stated that their adoption should be made conditional on its development. The eventual regulation will make the entry into force of its requirements explicitly dependent on it.

6.2. Option D: Regulatory information requirements

As stated in Chapter 5, this option is not retained as a stand-alone option, but will be integrated in the following ones. Essentially, producers would be required to declare energy performance through the COP, which means at full load, for smaller appliances and the SEPR for larger units, which captures also partial load performance for different ambient conditions. In addition, cooling capacity and intended operating temperature would have to be declared. The mandatory information requirements to be reported in the product documentation files are listed in Annex III, first for condensing units, then for chillers.

6.3. Option E1: Regulatory information and minimum requirements

This section is devoted to the content of Ecodesign Minimum Energy Performance requirements (MEPS) that can be imposed on both products, and then to their economic, environmental and social impacts. When there are no substantial differences between the two products, they will be analysed jointly; when there are, separately. This is obviously the case for the stringency level of the MEPS.

6.3.1 Stringency of minimum requirements

Condensing Units

The proposed COP/SEPR **minimum performance requirements** are shown in Table 5 with Tier 1 in January 2014 and Tier 2 in January 2017[21]. As stated in Section 6.2, the COP is used for smaller units and the SEPR for larger ones.

Table 5. Proposed minimum energy performance requirements for condensing units

	COP or SEPR Applicable	Tier 1 COP/SEPR requirement, January 2014	Tier 2 COP/SEPR requirement, January 2017

[21] These dates (and those regarding chillers) are conditional on the availability of a metric to test the products and a sufficient time (estimated in about half a year) between this availability and the entry into force of the requirements to give producers enough time to test their products and prepare the technical files. Importantly, the time between the Tiers should stay the same.

Medium Temperature 0.2 to 1kW	COP	1.20	1.40
Medium Temperature 1 to 5kW	COP	1.40	1.60
Medium Temperature 5 to 20kW	SEPR	2.25	2.55
Medium Temperature 20 to 50kW	SEPR	2.35	2.65
Low Temperature 0.1 to 0.4kW	COP	0.75	0.80
Low Temperature 0.4 to 2kW	COP	0.85	0.95
Low Temperature 2 to 8kW	SEPR	1.50	1.60
Low Temperature 8 to 20kW	SEPR	1.60	1.70

The stringency of the requirements and its impact on the existing product database is detailed in the table in Annex VI; the main effects would be the following:

- Tier 1 results in a rise in average COP/SEPR of between 1% and 15% and removes between 4% and 19% of the analysed dataset (depending on which capacity/temperature segment). Requirements are more demanding for the smaller low-temperature segment products, which was reflected in the consultation feedback which made mention of how hard some producers will find these levels.

- Tier 2 Results in an additional rise in average COP/SEPR from the base case of between 7% and 18%. Tier 1 and Tier 2 combined remove between 28% and 54% of products in the analysed dataset.

There is limited public domain data on product performance using the proposed SEPR and therefore the setting of more stringent requirements carries the risk of proving unworkable or disproportionately penalising some product types.

Feedback from consultation on relative stringency varied greatly about the effect on the market and the ability to meet the proposed requirements in the available time; this was seen as particularly a problem for low-temperature units which would require more design changes, and also for the smaller units subject to severe size constraints (fitting into the space at top or bottom of refrigerated cabinets for example). Size constraints could be a particular challenge where a unit is replacing an older unit installed inside a cabinet or other confined space; possible exemptions at this regard can be envisaged. The conclusion reached is that the levels are challenging, but achievable. Stringency should be carefully reviewed at the regulation review based on the far more comprehensive product data that should be available by then. Given the available data, it would be premature to set already Tier 3 requirements, as it has been proposed by some Member States.

Chillers

The proposed SEPR minimum performance requirements are shown in Table 6 and Table 7 below with Tier 1 in January 2014 and Tier 2 in January 2017.

Table 6. Tier 1 and Tier 2 requirements for air cooled chillers.

AIR COOLED INDUSTRIAL PROCESS CHILLERS	Tier 1 SEPR requirement Jan 2014	Tier 2 SEPR requirement Jan 2017
Medium temp <300 kW	2.24	2.58
Medium temp >300 kW	2.8	3.22
Low temp <200 kW	1.48	1.7
Low temp >200 kW	1.6	1.84
Source / rationale	MT and LT: thresholds proposed by JIEG and endorsed through consultation. Thresholds coincide with 79% and 97% of their respective market average performance in 2011.	MT and LT: 15% higher than Tier 1, as proposed by JIEG and endorsed through consultation.

Table 7. Tier 1 and Tier 2 requirements for water cooled chillers.

AIR COOLED INDUSTRIAL PROCESS CHILLERS	Tier 1 SEPR requirement Jan 2014	Tier 2 SEPR requirement Jan 2017
Medium temp <300 kW	2.86	2.58
Medium temp >300 kW	3.8	3.22
Low temp <200 kW	1.82	1.7
Low temp >200 kW	2.1	1.84
Source / rationale	MT and LT: thresholds proposed by JIEG and endorsed through consultation. Thresholds coincide with 79% and 97% of their respective market average performance in 2011.	MT and LT: 15% higher than Tier 1, as proposed by JIEG and endorsed through consultation.

The stringency of the requirements and its impact on the existing product database is detailed in the table in Annex VI; the main effects would be the following:

- Tier 1 is deliberately designed as an early but not very demanding level, resulting in an energy saving from the stock of only between 1% and 2.5% depending on the product type. This allows manufacturers to focus on capacity building for the product information and develop products in time for the more stringent Tier 2.

- Tier 2 saves between 8% and 8.5% compared to base case. The greater share of the impact of the regulation is so clearly to be attributed to Tier 2.

As regards the relative proportion of products that would be removed from the market at each tier, its estimation is difficult because only by one consultation respondent (a European industry association) gave a quantified answer. This indicated that between 5% and 10% of products would be removed by Tier 1 and between 11% and 20% by Tier 2. However, the relative leniency of the thresholds envisaged should avoid causing a market shock while already leading to substantial savings. Stringency should be carefully reviewed at the regulation review based on the far more comprehensive product data that should be available by then.

6.3.2 Economic impacts

6.3.2.1 Energy savings

Condensing Units

Figure 7 shows the impact of Option E1 on energy consumption compared to the baseline. Figure 8 shows how the energy savings evolve; Figure 7 combines the impact of low and medium temperature products, while Figure 8 separates them to show how MT CUs are the category leading to the most significant savings. Both consumption and savings are summarised in Table 8. Tier 1 is projected to create annual savings of just 5% per year compared to the base case by 2020, while Tier 2 is projected to create savings of up to 9% compared to the base case by 2030. The annual energy consumption (AEC), COP and SEPR data on which the savings are based, including typical market average before and after each tier and best available performance are given in the table reported in Annex VI. That table also shows details of average savings for each of the subcategories[22].

Table 8. Energy consumption and savings including Greenhouse Gas emissions savings for condensing units under Option E1

[22] Note that the annual energy consumption figures are significantly lower than those reported in the preparatory study for condensing units, in most part due to an erroneous assumption there about the average product size.

	Baseline energy use TWh	Energy use under Option E1 (TWh)	Energy saving of Option E1 (TWh)	Energy saving over base case of Option E1 (%)	CO2 equiv saving (TEWI, million tonnes) of Option E1
2012	68,8	68,8	0,0	0%	0,0
2020	74,8	71,4	3,4	5%	1,3
2030	81,6	74,3	7,3	9%	2,5

Figure 7. Annual electricity consumption for LT and MT condensing units for baseline scenario, and for combined Tier 1 and Tier 2 requirements.

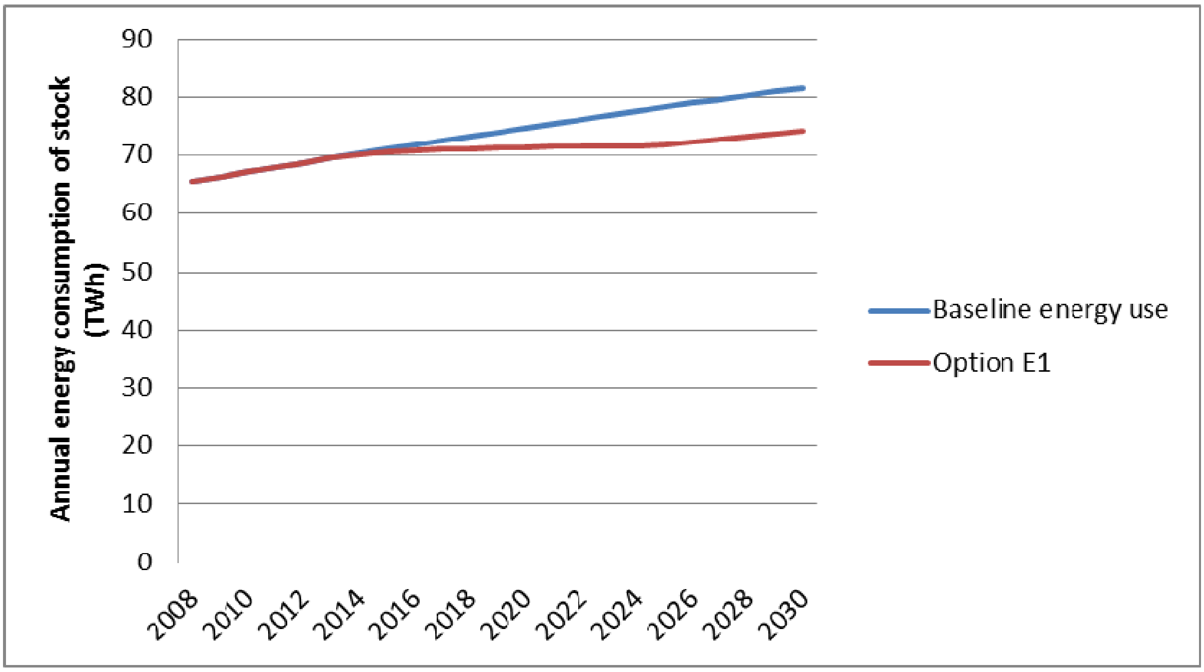
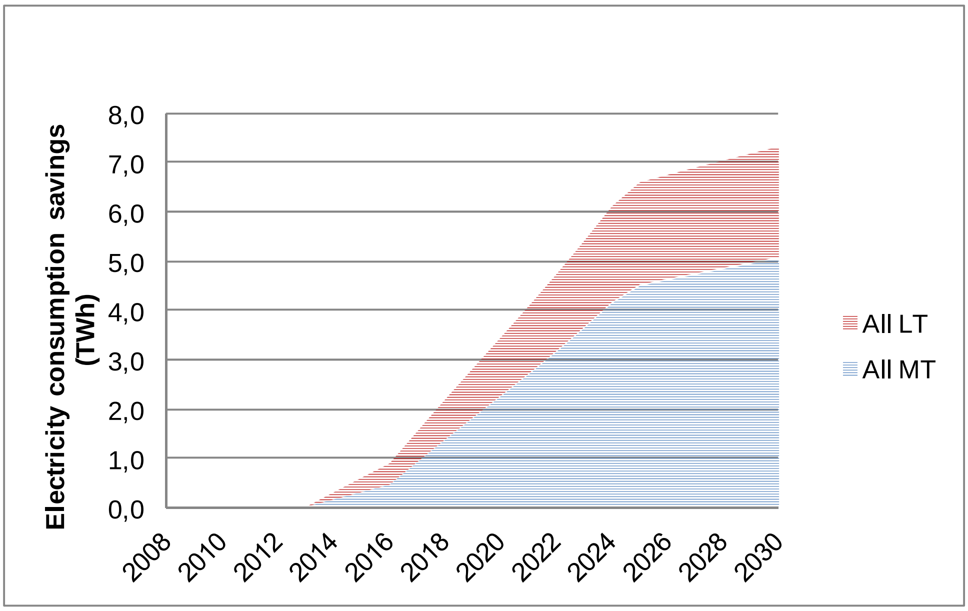


Figure 8. Combined electricity savings from Tier 1 and Tier 2 for Medium Temperature (MT) and Low Temperature (LT) Condensing units.



Chillers

Figure 9 shows the proportional impact of Tier 1 and combined Tier 1/Tier 2 on energy consumption. Figure 10 shows how the energy savings accumulate for the low and medium temperature products: the situation is reversed in comparison with condensing units, with low temperature products being responsible for the greater share of savings. Figures are then summarised in Table 9.

Overall:

- Tier 1 is projected to create energy savings of around 1% per year by 2030 compared to the base case.
- Tier 2 is projected to increase energy savings to around 7% per year by 2030 compared to the base case.

The annual energy consumption (AEC) and SEPR data on which the savings are based, including typical market average before and after each tier and best available performance are given in table reported in Annex VI. The only product performance data available was gathered from brochures from a few manufacturers during the preparatory study. After review during the consultation this was considered as small, skewed and not representative of the whole market and so could not be used as the basis for performance analysis. Instead, the JIEG provided market best and worst figures for the purposes of their own market analysis and for this impact assessment. The Tier 1 MEPS are estimated by the JIEG to remove around 10% of the market. In the absence of a product performance database (the data do report the performance of products, but not their sales numbers), savings have been estimated by using the number of products as a proxy, and reducing the weight of the outliers, both the best and the worst performing ones, assuming that they are less frequent as confirmed by anecdotal evidence.

Table 9. Energy consumption and savings including Greenhouse Gas emissions savings for process chillers under Option E1

	Base case energy use TWh	Energy use under Option E1 (TWh)	Energy saving of Option E1 (TWh)	Energy saving over base case of Option E1 (%)	CO2 equiv saving (TEWI, million tonnes) of Option E1
2012	39,0	39,0	0,0	0%	0
2020	50,4	49,3	1,2	2%	0,45
2030	62,1	57,9	4,3	7%	1,45

Figure 9. Annual electricity consumption for LT and MT industrial process chillers for baseline, Tier 1 and combined Tier 1 and Tier 2 under Option E1.

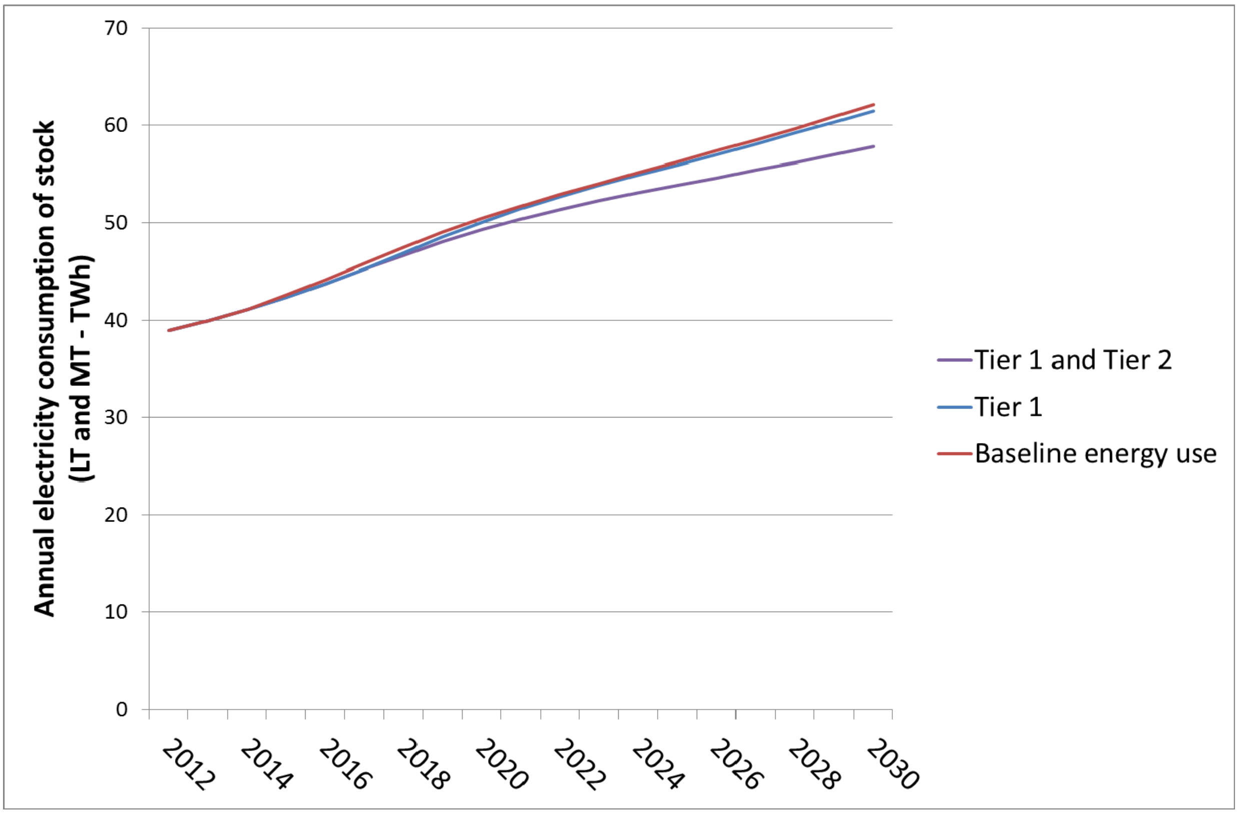
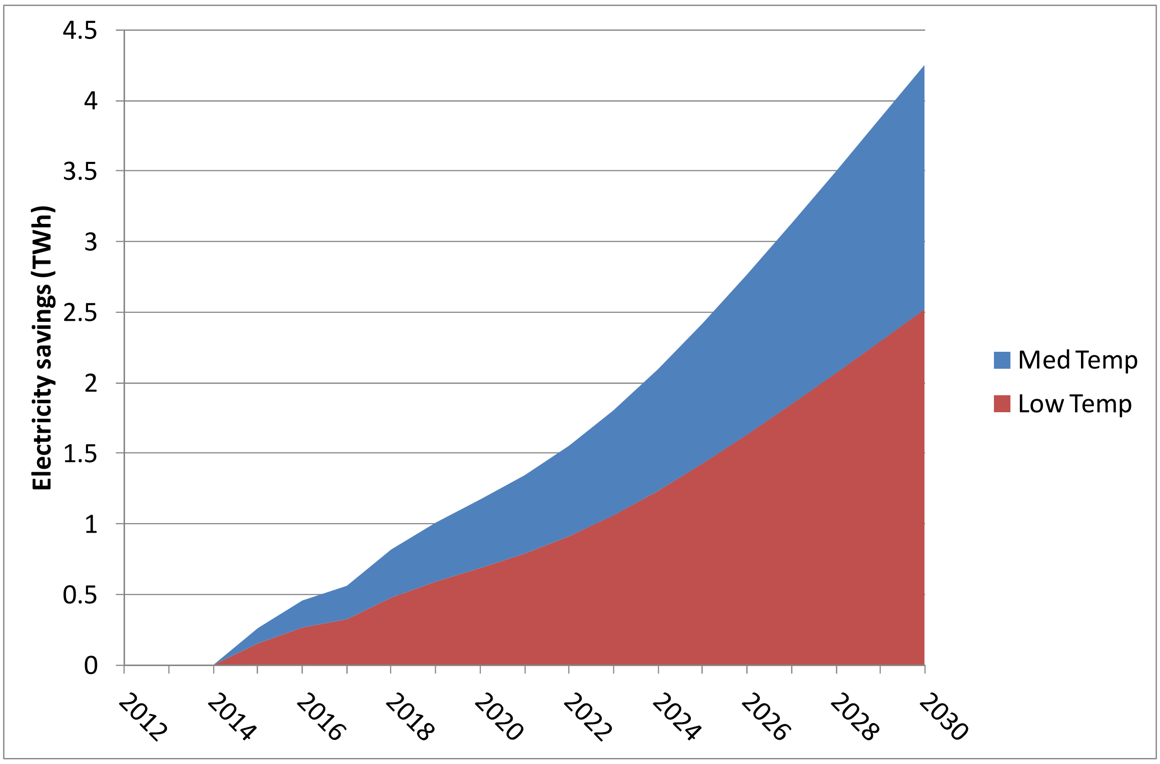


Figure 10. Combined electricity savings for MT and LT temperature chillers under Option E1.



6.3.2.2 Product price increases

Condensing Units

Final product prices are set to increase due to the use of improved but more expensive technologies. Many respondents to the May 2012 stakeholder consultation suggested higher price increases for this option than initially estimated before the consultation. The price increases estimated by the impact assessment study took into account this feedback, and are shown in Table 10. Tier 1 would result in an average 2% price rise for medium temperature condensing units and no change in the average price of low-temperature units. Tier 2 would result in price rises of between 14% and 18% depending on the product category. Respondents to the consultation were equally divided on whether increased prices could be passed on to buyers. This was seen as particularly problematic for smaller capacity condensing units. On balance it has to be acknowledged that manufacturers will be faced with increased price pressures, but costs of better technologies should decrease as production numbers rise thanks to economies of scale (for instance, high quality compressors would move from niche to mainstream components). Moreover, the main price effect of the regulation would be to remove the cheapest products from the market, and therefore to move consumers towards slightly more expensive, but more efficient, ones. It is unlikely that the price of these products, already existing on the market, would decrease following an increase in the demand for them. The experience of other Ecodesign regulations (the experience of household refrigerators has been considered with particular attention, being related products) suggests that in the long run the profitability of a sector does not change following its regulation, implying that costs are indeed passed on to users. In this IA costs increases have been consequently considered as falling on the purchasers; it should be noted that, at least in the short run, some of them could fall on the producers.

Table 10. Condensing units - base case prices and percentage increases following Tiers.

	Base case price (Euro)	% price increase base case to post Tier 1	price increase base case to post Tier 1 (Euros)	% price increase base case to post Tier 2	price increase base case to post Tier 2 (Euros)
Medium Temperature 0.2 to 1kW	€ 500	2%	€ 10	15%	€ 75
Medium Temperature 1 to 5kW	€ 1,800	2%	€ 36	14%	€ 252
Medium Temperature 5 to 20kW	€ 3,700	2%	€ 74	18%	€ 666
Medium Temperature 20 to 50kW	€ 8,500	2%	€ 170	18%	€ 1,530
Low Temperature 0.1 to 0.4kW	€ 600	0%	€ 0	15%	€ 90
Low Temperature 0.4 to 2kW	€ 800	0%	€ 0	14%	€ 112
Low Temperature 2 to 8kW	€ 4,300	0%	€ 0	18%	€ 774
Low Temperature 8 to 20kW	€ 7,500	0%	€ 0	18%	€ 1,350
Source / rationale	Prices judged from catalogues and quoted in the consultation – these were not disputed by respondents (only comments on the price increases)	As used for consultation, taking on board feedback from some respondents that MT increases are likely - but kept low as low proportion of market affected	calculated from base price and % price increase	Straight average of the consultation feedback (including where respondents agreed with suggested consultation figure)	calculated from base price and % price increase

Chillers

The impact of the setting of MEPS on product prices is shown in Tables 11 and 12. It would result in an average 1% to 3% product price rise after Tier 1 (with many products unaffected) and 10% to 15% cost rise after Tier 2. The price increases are due to the addition of improved technologies such as improved controls and electronic expansion valves. These figures were agreed through the stakeholder consultation process. As for condensing units, consultation views were mixed on whether the cost increases could all be passed on to consumers. It is here assumed that product cost increases can be passed on to buyers because the marginal increase is not large and will be highly cost-effective for end users due to significant energy savings.

Table 11. Air cooled chillers - base case prices and percentage increases following Tiers.

AIR COOLED CHILLERS	Base case price per unit (Euro)	% price increase base case to post Tier 1	price increase base case to post Tier 1 (Euros)	% price increase base case to post Tier 2	price increase base case to post Tier 2 (Euros)
Medium temp <300 kW	€ 28,000	3%	€ 840	15%	€ 4,200
Medium temp >300 kW	€ 90,000	1%	€ 900	10%	€ 9,000
Low temp <200 kW	€ 31,000	3%	€ 930	15%	€ 4,650
Low temp >200 kW	€ 94,000	1%	€ 940	10%	€ 9,400
Source / rationale	As used in stakeholder consultation	As used in stakeholder consultation - only 2 consultees answered on price question - both agreed with all	Calculated from %	As used in stakeholder consultation - only 2 consultees answered on price question - both agreed with all	Calculated from %

Table 12. Water cooled chillers - base case prices and percentage increases following Tiers.

WATER COOLED CHILLERS	Base case price per unit (Euro)	% price increase base case to post	price increase base case to post Tier 1	% price increase base case to post	price increase base case to post Tier 2

		Tier 1	(Euros)	Tier 2	(Euros)
Medium temp <300 kW	€ 42,000	3%	€ 1,260	15%	€ 6,300
Medium temp >300 kW	€ 135,000	1%	€ 1,350	10%	€ 13,500
Low temp <200 kW	€ 46,500	3%	€ 1,395	15%	€ 6,975
Low temp >200 kW	€ 141,000	1%	€ 1,410	10%	€ 14,100
Source / rationale	Water cooled price assumed to be 50% greater than air cooled price	Assumed same as air cooled	Calculated from %	Assumed same as air cooled	Calculated from %

6.3.2.3 Impact on users

Condensing Units

There are two kinds of costs connected to the use of a condensing unit: the purchase price described above (other possibilities such as leasing are very rare in this market) and the running electricity costs. Figure 11 and Table 13 summarise the cost savings to users arising from Option E1, which are net savings when product price increases are more than offset by energy savings. Figure 12 compares the annual expenditure by users after the introduction of Option E1 with the baseline scenario. Following the Ecodesign regulations standard practice, energy costs are assumed to rise at 4% per year above inflation and all costs are discounted at 4% per year. Installation and maintenance costs are not affected. These net savings rise to over €1000 million per year at 2030 for both low and medium temperature condensing units. This is equivalent to 11% of the 2030 baseline expenditure on product sales and energy costs. The annual savings shown in Figure 11 begin to level off in 2026 because the most inefficient products get out of the sample are diminishing year on year and so incremental savings each year are diminishing. The apparent drop in savings in 2017 in Figure 11 is due to the fact that it has been assumed, in the model employed, that the product price rises due to introduction of Tier 2 take effect immediately, while the energy savings accumulate over time.

Figure 11. Annual expenditure net savings by users (new sales and energy consumption discounted at 4% per year) for Option E1, condensing units.

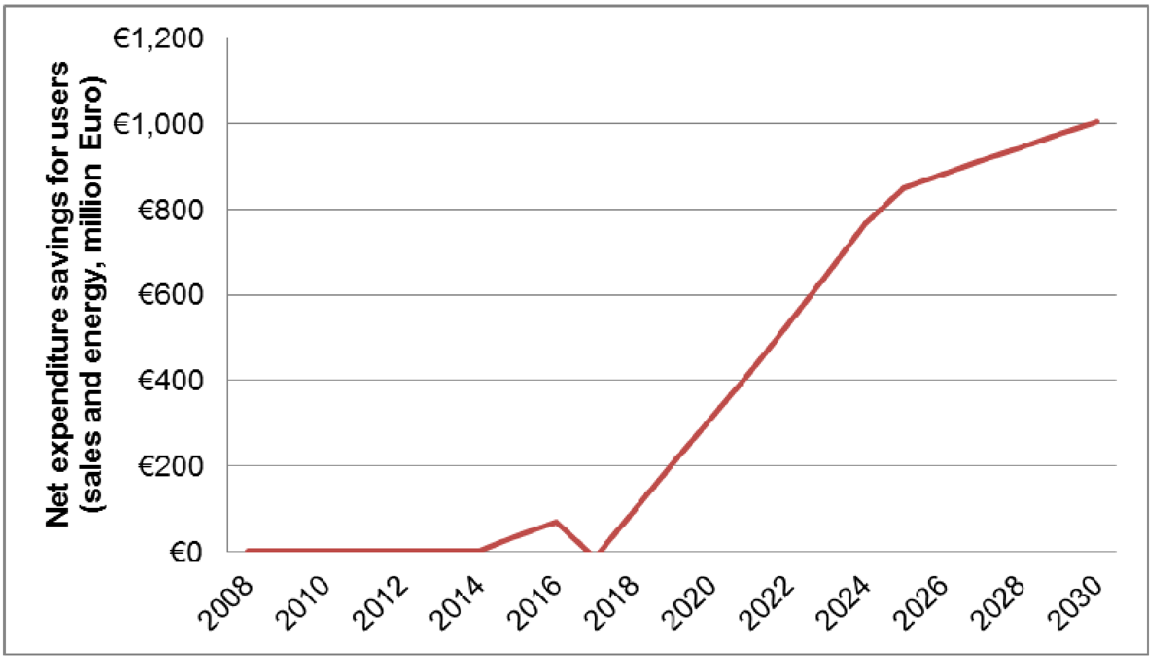


Figure 12. Annual expenditure by users of Option E1 compared to baseline scenario.

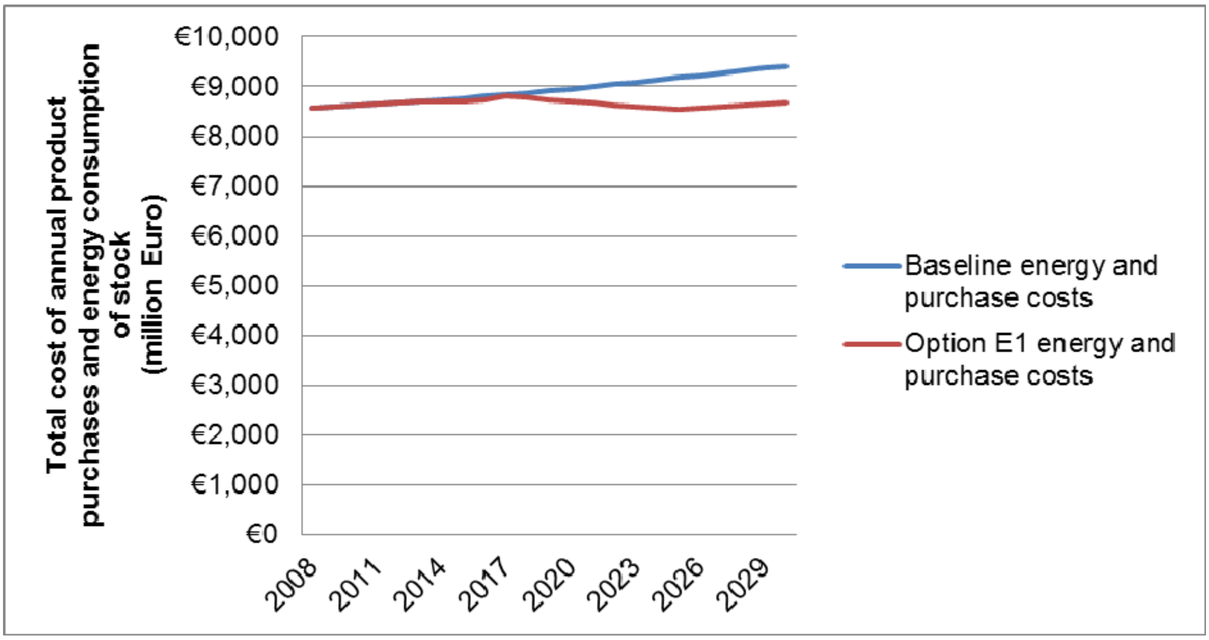


Table 13. Summary of energy consumption and net savings for condensing units

	Base case energy use	Energy use (TWh)	Energy saving	% energy saving over base case	Net cost saving to end users

	TWh		(TWh)		(million Euros)
2012	68,8	68,8	0,0	0%	€ -
2020	74,8	71,4	3,4	5%	€ 312
2030	81,6	74,3	7,3	9%	€ 1.005

It is clear that the product cost increases would be more than compensated for users by significant energy savings.

Chillers

The net savings for users resultant from Option E1 are shown in Figure 13 and are summarised in Table 14. The expenditure on products sold in each year combined with energy costs to users is shown and compared to the baseline scenario in Figure 14 and Table 14. These net savings rise to around €534 million per year at 2030 for low and medium temperature chillers. This is equivalent to 6% of the 2030 BAU expenditure (€ 9.200 million). As in the case of CUs, the product cost increases would be clearly more than compensated for users by energy savings; the latter are however less significant, due to the relative less stringent requirements imposed on them, as detailed and explained in section 6.3.1.

Figure 13. Annual expenditure net savings by users for Option E1, MT and LT Chillers

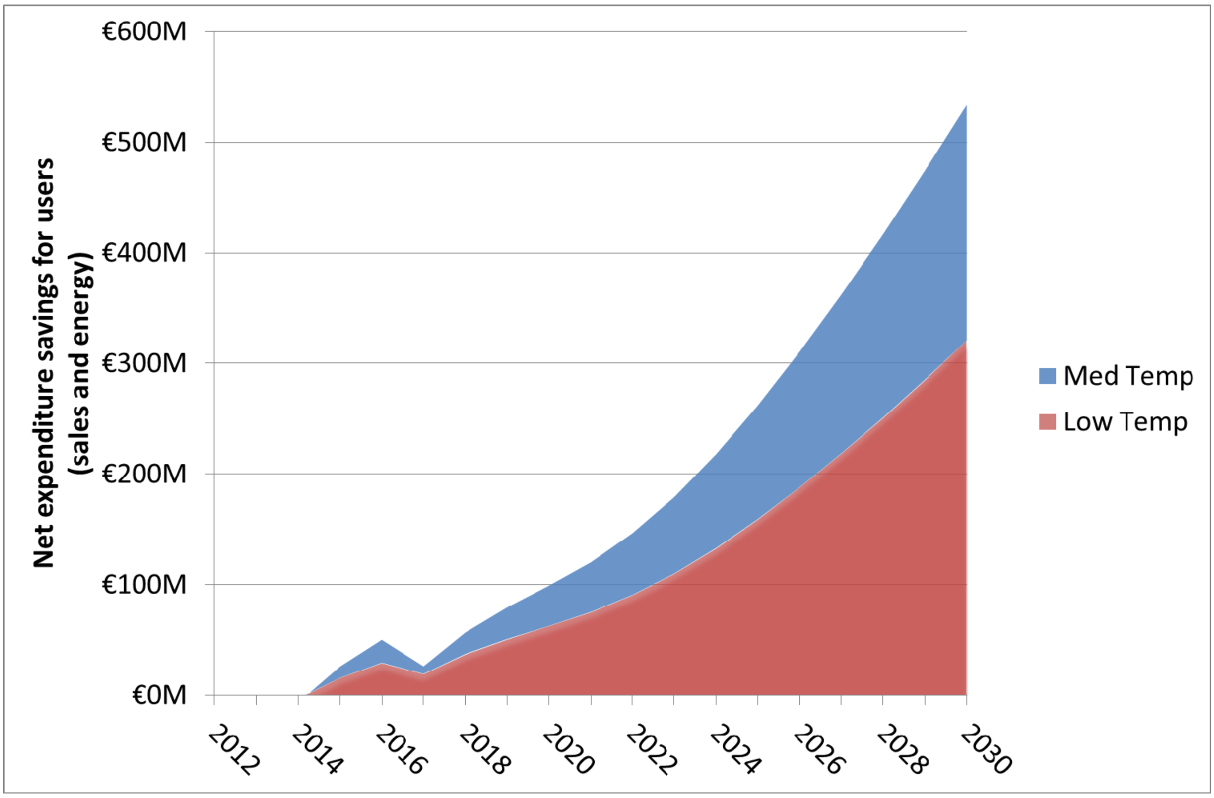


Figure 14. Annual expenditure by users on new sales and energy consumption for Option E1, MT and LT Chillers

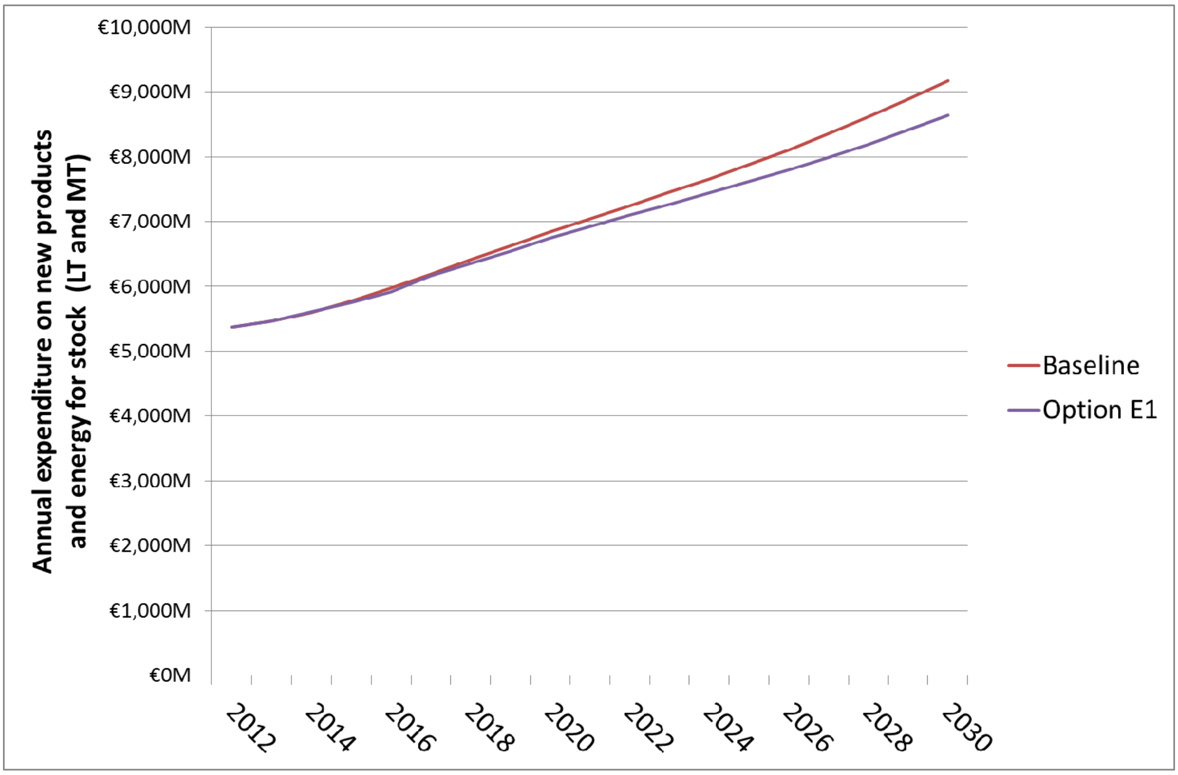


Table 14. Summary of energy consumption and net savings for process chillers

	Base case energy use TWh	Energy use (TWh)	Energy saving (TWh)	% energy saving over base case	Net cost saving to end users (million Euros)
2012	39,0	39,0	0,0	0%	€ -
2020	50,4	49,3	1,2	2%	€ 99,1
2030	62,1	57,9	4,3	7%	€ 533,9

6.3.2.4 Impact on manufacturers

The cost for manufacturers

The impact is due to the introduction of information requirements described in Section 6.2 (Option D) and detailed in Annex III.

The methods applied to quantify the cost that mandatory information requirements would impose on manufacturers have been estimated by the IA study through specific enquiries and the consultation process and are detailed in Annex V. The costs are estimated for the first year of introduction of the requirements; they will decrease substantially afterwards, since only new products would need to be tested and some costs, such as the preparation of a metal stamp to label products, would be a one-off fixed cost.

The results are shown in Table 15 for condensing units and Table 16 for chillers. The costs are substantial, in particular in the case of chillers, where they equate to 1% of the estimated sales. The difference among the two products is due to a lower sales base in the case of chillers, so that the costs of testing cannot be spread among as many units as in the case of condensing units.

Table 15. Summary of marginal costs to condensing units manufacturers in 2014 from information requirements under Option E1.

Type of cost	Indicative marginal cost per manufacturer (Euro)	Indicative marginal cost for all EU manufacturers (Euro)	Assumptions and Comments
Product testing	€44,800	€1.5 million	Assumes that current testing[23] becomes 20% more expensive and is required on 40% more products due to this regulation. Equates to about 0.13% of the value of EU sales.
CE marking	€1.500 + €0.5 per sale c. €7,500 per manufacturer average (assuming about 12,000 sales per manufacturer)	€78.000 + €316.000 = €394.000	Assumes €1,500 of additional CE marking costs per manufacturer as a result of regulation, 52 manufacturers. Sales of 631,000 units per year.
Technical documentation	€86.400	€2.77 million	Assumes 60% of model variants require different technical documentation costing 2 days per product at €300 per day.
Authority	€300	€0.016 million	One 5 day inspection every 5

[23] These assumptions are based on the following elements. Testing would become 20% more expensive because of the need to test at different load capacity to calculate the SEPR; The cost to calculate the COP would not change. More products will have to be tested (40%) than currently done on a voluntary basis. The cost increase is less than proportional thanks to the use of calculation from a base model.

inspections			years (at €300 per day).
Total	**€138.700**	**€4.7 million**	Equates to 0.4% of estimated €1.100 million annual sales for these products.

Table 16. Summary of marginal costs to chillers (LT and MT) manufacturers in 2014 as a result of the regulation.

Type of cost	Indicative marginal cost per manufacturer (Euro)	Indicative marginal cost for all EU manufacturers (Euro)	Comments
Product testing	€37.500	€0.75 million	Assumes that current testing becomes 20% more expensive and is required on 25% more products due to this regulation. Equates to about 0.2% of the value of EU sales.
CE marking	€1.500 + €0,5 per sale = c. €1,700	€30.000 + €3.460 = c. €33.500	Assumes €1.500 of additional CE marking costs per manufacturer as a result of regulation. Sales of 6,920 units per year – assume equal share amongst 20 suppliers for this calculation.
Technical documentation	€130.000	€2.6 million	Assumes 60% of model variants require different technical documentation costing 2 days per product at €300 per day.
Authority inspections	€300	€0.006 million	One 5 day inspection every 5 years (at €300 per day).
Total	**€170.300**	**€3.4 million**	Equates to 0.9% of estimated €400 million annual sales for these products.

6.3.2.5 Impact on competitiveness, innovation and trade

The MEPS requirements should not influence the **cost competitiveness** of companies active on the EU market, since the regulation falls equally on all producers and importers: the increased costs for testing and conformity assessment would affect them equally. Looking upstream along the value chain the increased demand for higher quality inputs, such as more efficient compressors, should decrease their price over time thanks to economies of scale, thereby improving their cost competitiveness also in higher segments of the markets.

The regulation will encourage investment in product development and innovation, thereby having a significant positive effect on the **innovative capacity** of the industry. Such innovative focus has previously been constrained by the focus on price and not by any lack of technological solutions, hence rapid improvements could be achieved. The more stringent second-tier will guarantee much wider deployment of superior controls, electronically controlled fans, high efficiency motors and electronic expansion valves. Suppliers of these components could see a significant increase in market, providing a further boost to capacity for innovation and the price of these components should then fall. There was widespread agreement, during the stakeholder consultation, that the measures would encourage investment in product development and innovation.

Regarding the competitiveness of the users, the proposals will drive the adoption of very cost-effective technologies which result in medium term net cost savings to the end users (through reduced energy costs). This could result in a small net increase of their competitiveness. The share of energy costs in total costs varies enormously across end-user sectors. For some, such as cold storage and food processing, refrigeration energy costs can be a significant part and these end users will experience notable benefits. For many others, cooling costs may be an extremely small component of overall operating costs and so have a negligible overall effect on competitiveness.

In terms of **international competitiveness**, the EU would be the first trading block to impose minimum requirements on these products. If other were to follow suit, as it appears likely, EU manufacturers would be at a distinct advantage for competing on energy efficiency in the future. Since all manufacturers will face more costs for testing and conformity, the playing field for EU and imported products will remain level. The regulation could stop some poor efficiency (perhaps cheaper) imports, while on the other hand the price increases caused by Tier 2 requirements might, by moving the EU market towards more value-added products, make it slightly more difficult for EU-based companies to compete on prices abroad in the lower segments of the market. Finally, the MEPS could significantly boost imports of better heat exchangers, electronic controls and other components, bringing increased competition for EU component manufacturers.

6.3.2.6 Impact on SMEs

Installation and maintenance work, which is where the majority of SME businesses are focused for this sector, will not be significantly affected.

SME producers of chillers are rare, while a significant number of SMEs assemble condensing units from components; these companies will generally have to pay for external testing, whereas most large manufacturers already have in-house test rooms (which are very expensive to build, equip and run). This could disadvantage smaller players and result in them narrowing their product range, since products sold in low numbers would incur disproportionately large testing costs. Some small suppliers could be forced to withdraw from this market. The impact on SMEs could be mitigated through several means, in particular a reasoned scheduling (also with regards the other professional refrigeration products) of the entry into force of the MEPS and the publication of good practice guidelines on how to appropriately reduce the burden testing through use of calculation, extrapolation and representative models, and about the information requirements and the technical documentation that has to be kept by manufacturers. Such guidance could be produced by manufacturers' industry association(s), then reviewed and published by the European Commission.

SMEs are also represented in many end-user sectors. These SMEs may face a small initial increase in capital costs for refrigeration equipment. However, these costs will be recouped in the short to medium term through reduced energy costs. There should therefore be a positive impact on their competitiveness in the medium term.

6.3.3. Social impact

The regulation is not set to have significant social impacts, other than the possible small negative effect on the employment by the SME producers mentioned in the previous section. This reduction in employment is possible but it is not feasible to quantify this. It should be very small in the case of chillers, given that producers are mostly large companies. Many manufacturers of condensing units are also large companies well equipped to deal with the additional testing and technical analysis required, but a significant number of SMEs are also producers. As stated above, it is possible that some SMEs may withdraw from this market, but the chances of this happening can be reduced in the ways described.

6.3.4 Environmental impact

As stated in Section 3.1.2, the main environmental impact related to both products that falls within the scope of the regulation is its contribution to global warming.

The main consequence of the regulation is represented in Figure 15 and Figure 16, for condensing units and chillers respectively. The net result is a significant reduction in TEWI emissions due to reduced energy consumption, measured in CO2 equivalent savings. There might be an additional, but very small, positive effect driven by the encouragement of the adoption of more energy efficient, low GWP gases, and by the increase in typical product quality of manufacture and removal of the very cheapest of constructions, thereby reducing also the global warming effect due to leakages. This has not been quantified, since it would have been too speculative, and its magnitude would be in any case too small to change the overall conclusion. Details about the calculation of the TEWI numbers are available in Annex II.

Figure 15. TEWI figures for condensing units for baseline and for Option E1.

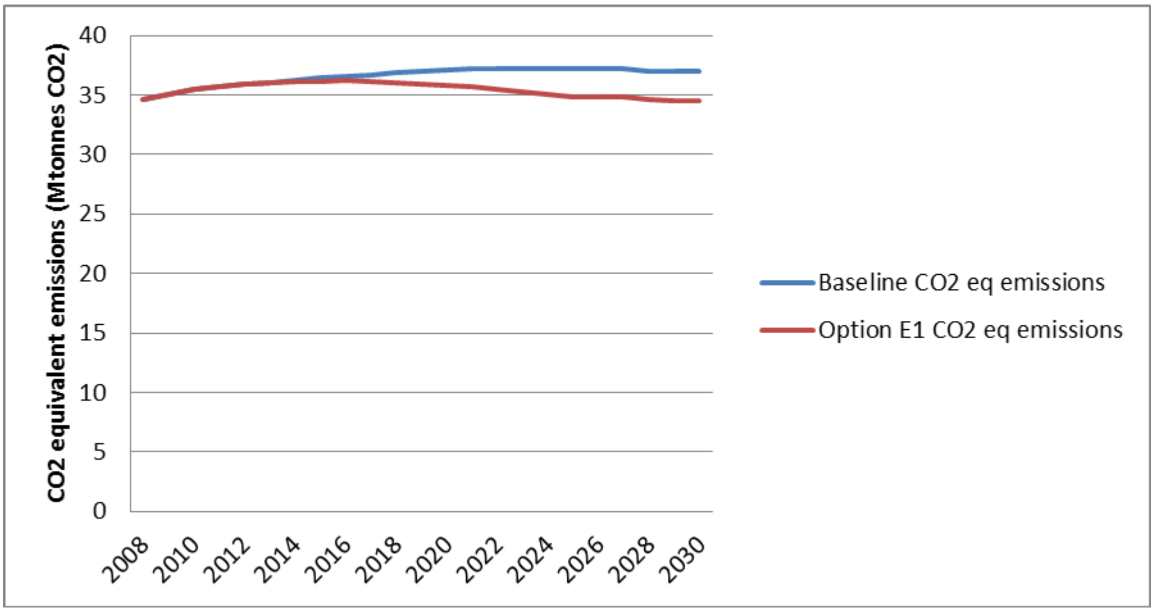
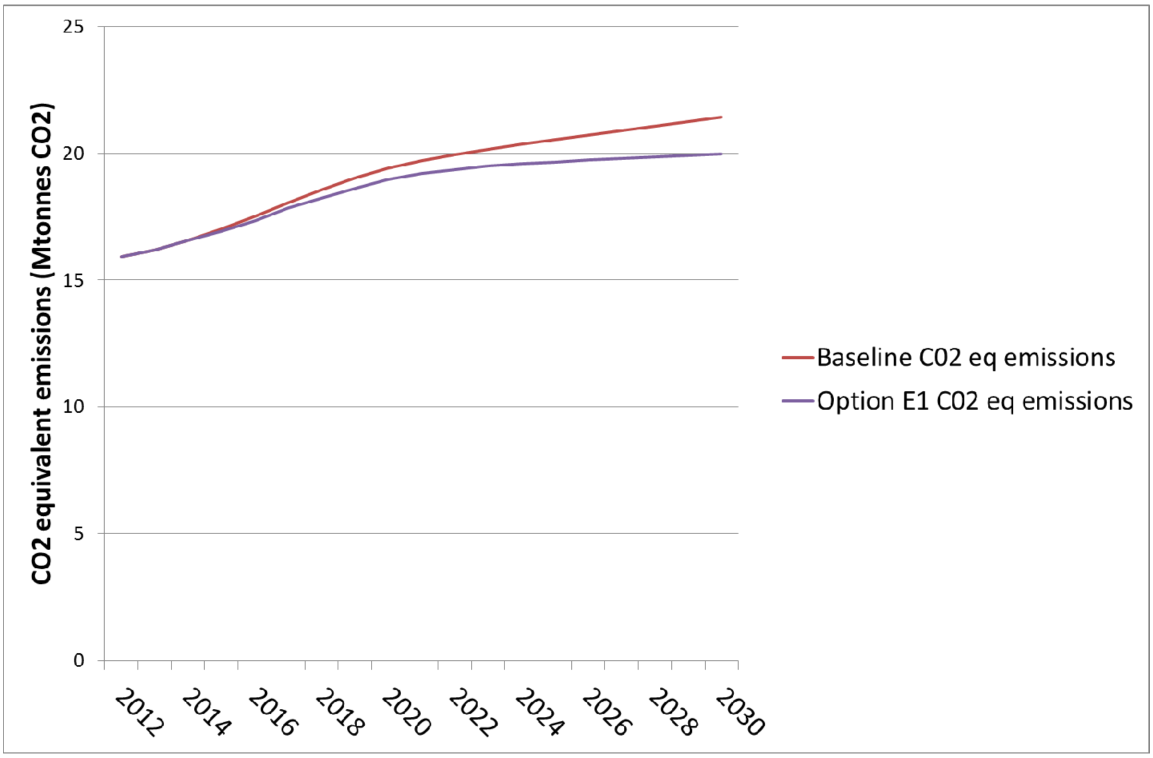


Figure 16. TEWI figures for MT and LT chillers for baseline and for Option E1.



6.4. Option E2: Regulatory information and minimum requirements with delayed timing and lower thresholds for Condensing Units

Option E2 would affect only condensing units for the reasons stated in Chapter 5.

The main difference between Option E2 and Option E1 consists in the imposition of less stringent MEPS. Since the Tier 1 MEPS foreseen under Option E are already not challenging, only the Tier 2 ones will be changed, in the way presented below. Furthermore, the entry into force of the requirements will be delayed by one year for both tiers. The following table presents the Option E2 Tier 2 requirements in comparison with those of Option E1. The difference is small in absolute terms, but it would affect many products, since the MEPS fall on a very densely populated section of the market. The levels of the MEPS have been decided considering the feedback from stakeholders, while aiming at making them ambitious enough to still have a significant impact on the market and on energy consumption.

Table 16. Comparison of Option E1 and Option E2 Tier 2 MEPS for condensing units

	COP or SEPR Applicable	Tier 2 COP/SEPR requirement, Option E2	Tier 2 COP/SEPR requirement, Option E1
Medium Temperature 0.2 to 1kW	COP	1.32	1.40
Medium Temperature 1 to 5kW	COP	1.55	1.60
Medium Temperature 5 to 20kW	SEPR	2.46	2.55
Medium Temperature 20 to 50kW	SEPR	2.56	2.65
Low Temperature 0.1 to 0.4kW	COP	0.77	0.80
Low Temperature 0.4 to 2kW	COP	0.88	0.95
Low Temperature 2 to 8kW	SEPR	1.57	1.60
Low Temperature 8 to 20kW	SEPR	1.65	1.70

The impact of Option E2

It has been decided to represent all major impacts of Option E2 in the same table, and compare them immediately with those of Option E1, rather than to use a graph for each impact kind (energy use, energy savings, TEWI savings, and cost savings to end users); namely, since the trends would be the same for both options for each impact, it seems more important to focus on the magnitude of the impacts rather than their direction, which is the same for both options.

Table 17. Summary of impacts for medium and low temperature condensing units, for Option E1 and Option E2 (in red)

	Base case energy use TWh	Energy use (TWh)		Energy saving (TWh)		CO2 equiv saving (TEWI, million tonnes)		Net cost saving to end users (million Euros)		% energy saving over base case	
2012	68.8	68.8		0,0		0,0		-		0%	
2020	74.8	71.4	71.9	3.4	2.9	1.3	1.1	312	219	5%	4%
2030	81.6	74.3	75.7	7.3	5.9	2.5	2.0	1,005	781	9%	7%

Energy consumption impacts and net savings to users

Given its less ambitious MEPS, it is no surprise that Option E2 achieves inferior savings to Option E1. In comparison with the base case scenario, 2.9 and 5.9 TWh would be saved in 2020 and 2030 respectively. It should be noted that users would be benefitting much less from Option E2 than from Option E1: about one hundred million Euro less would be saved by 2020 and two hundred million by 2030. This happens despite the reduced impact on prices of Option E2, which is more than offset by the reduced energy savings it achieves.

TEWI impacts

The TEWI savings, since they are calculated on the basis of the energy savings with the method detailed in Annex III, would decrease by the same proportion as the energy consumption.

Impact on manufacturers

In absolute terms, the impact on manufacturers will not deviate from the one described in Section 6.3. However, it would be spread over a longer period, and would therefore be less burdensome for the producers in general and the smaller among them in particular. While it is not always true that SMEs would struggle more than large companies to meet the MEPS in terms of technology (there are innovative SMEs focusing on high quality products), they usually have fewer technical staff and limited access to testing facilities, and would therefore be better able to accommodate the financial burden imposed by the regulation if allowed more time. This would also allow adequate time for ‘good practice’ guidance in dealing with the calculations, testing and extrapolation techniques to become established by the industry associations, and for this information to trickle down also to smaller producers that are not always represented in them. A delayed entry into force would also benefit producers of more than one product in the professional refrigeration category[24], by spreading the compliance burden both in terms of effort and costs over a longer period.

Social impacts

Social impacts are similar to the ones described in section 6.3.3 under Option E1, but they would be mitigated by the loosening of the requirements and, above all, by the additional year allowed for producers to react. SMEs producers in particular would benefit from this; the fact that they are more often producing CUs than chillers is the main reason why the delayed timing has been envisaged for CUs.

Impact on competitiveness and innovation

The situation is similar as in Option E1, but with a somewhat reduced push towards higher efficiency products, and with the advantage for producers to have an extra year to accommodate design changes and plan for product developments.

Indirect economic impact

Whilst the additional time could result in less price increases than under Option E1 as supply chains have the additional year to gear up, this effect would be small and a conservative approach would be to assume the same basic economic impact.

Timing of implementation

This is, together with lower MEPS, the crucial difference between options E1 and E2. The delayed entry into force of the requirements allows producers an additional year after the publication of the new harmonised test method.

6.5. Option E3: Addition of minimum requirements for high-temperature chillers

High temperature process chillers are proposed to be included within the scope of the regulation under Option E1 (and E2) but without being subject to requirements. Option E1 assumes that such requirements cannot be set for high temperature chillers until further performance data is available, which is likely to be at the time of the 1st regulatory review envisaged for 2018. However, it is possible to set such requirements already, even if with a lower level of confidence than in the case of low and medium temperature chillers. Option E3 consists in their inclusion, and the impact that it would have; it is bound to be significant, as high temperature chillers account for the majority of the stock and of the energy consumption of all types of industrial process chillers (see Figures 2 and 5).

6.5.1 Stringency of minimum requirements

[24] While a few large companies are active in all five professional refrigeration products, most companied are not; there are however significant overlaps between the producers of CUs and chillers, as confirmed by the consultation.

The impact assessment contractor estimated possible thresholds based on the available estimated average and best performance levels in the current market (derived from limited data provided by the JIEG), assuming similar levels of relative ambition to the thresholds proposed for medium and low temperature chillers – these are shown in the following tables.

Table 18. Tier 1 and Tier 2 requirements for air cooled chillers, including values for high-temperature chillers, measured as the SEPR ratio.

AIR COOLED INDUSTRIAL PROCESS CHILLERS	Tier 1 SEPR requirement Jan 2014	Tier 2 SEPR requirement Jan 2017
High temp <300 kW	*2.48*	*2.85*
High temp >300 kW	*2.72*	*3.13*
Medium temp <300 kW	2.24	2.58
Medium temp >300 kW	2.8	3.22
Low temp <200 kW	1.48	1.7
Low temp >200 kW	1.6	1.84
Source / rationale	MT and LT: thresholds proposed by JIEG and endorsed through consultation. Threshold s coincide with 79% and 97% of their respective market average performance in 2011. HT: 80% of market average SEPR for 2011.	MT and LT: 15% higher than Tier 1, as proposed by JIEG and endorsed through consultation. HT: 15% higher than Tier 1 (same as done by JIEG for MT and LT)

Table 19. Tier 1 and Tier 2 requirements for water cooled chillers, including values for high-temperature chillers, measured as the SEPR ratio

WATER COOLED INDUSTRIAL PROCESS CHILLERS	Tier 1 SEPR requirement Jan 2014	Tier 2 SEPR requirement Jan 2017
High temp <300 kW	*4.4*	*2.85*
High temp >300 kW	*4.72*	*3.13*
Medium temp <300 kW	2.86	2.58
Medium temp >300 kW	3.8	3.22
Low temp <200 kW	1.82	1.7
Low temp >200 kW	2.1	1.84
Source / rationale	MT and LT: thresholds proposed by JIEG and	MT and LT: 15% higher than Tier 1, as

	endorsed through consultation. Thresholds coincide with 79% and 97% of their respective market average performance in 2011. HT: 80% of market average SEPR for 2011.	proposed by JIEG and endorsed through consultation. HT: 15% higher than Tier 1 (same as done by JIEG for MT and LT)

6.5.2 Economic impacts

6.5.2.1 Energy savings

The figures for high-temperature chillers should be treated with a higher degree of caution due to the limited data set they are drawn upon. Nevertheless, the scale of consumption and savings is probably of the correct order of magnitude when compared with those from low and medium temperature appliances. By far the most significant potential energy impact would be achieved by focus on the high temperature air cooled chillers, which account for over half of the total energy use of all chiller types. Table 20 summarizes their impact for both air cooled and water cooled types, while figures 17 and 18 show their impact in terms of annual electricity consumption and savings. Figure 18 in particular allows seeing the incremental savings due to the inclusion of HT chillers.

Table 20. Summary of consumption and savings for industrial process chillers for Option E3.

	Base case energy use TWh	Energy use (TWh)	Energy saving (TWh)	CO2 equiv saving (TEWI, million tonnes)	Net cost saving to end users (million Euros)	% energy saving over base case
2012	128,4	128,4	0,0	0,0	€ -	0%
2020	166,3	162,0	4,4	1,7	€ 380,7	3%
2030	204,8	189,7	15,1	5,1	€ 1.893,9	7%

Figure 17. Annual electricity consumption of industrial process chillers under Option E3 for base case, Tier 1 and combined Tier 1 and Tier 2.

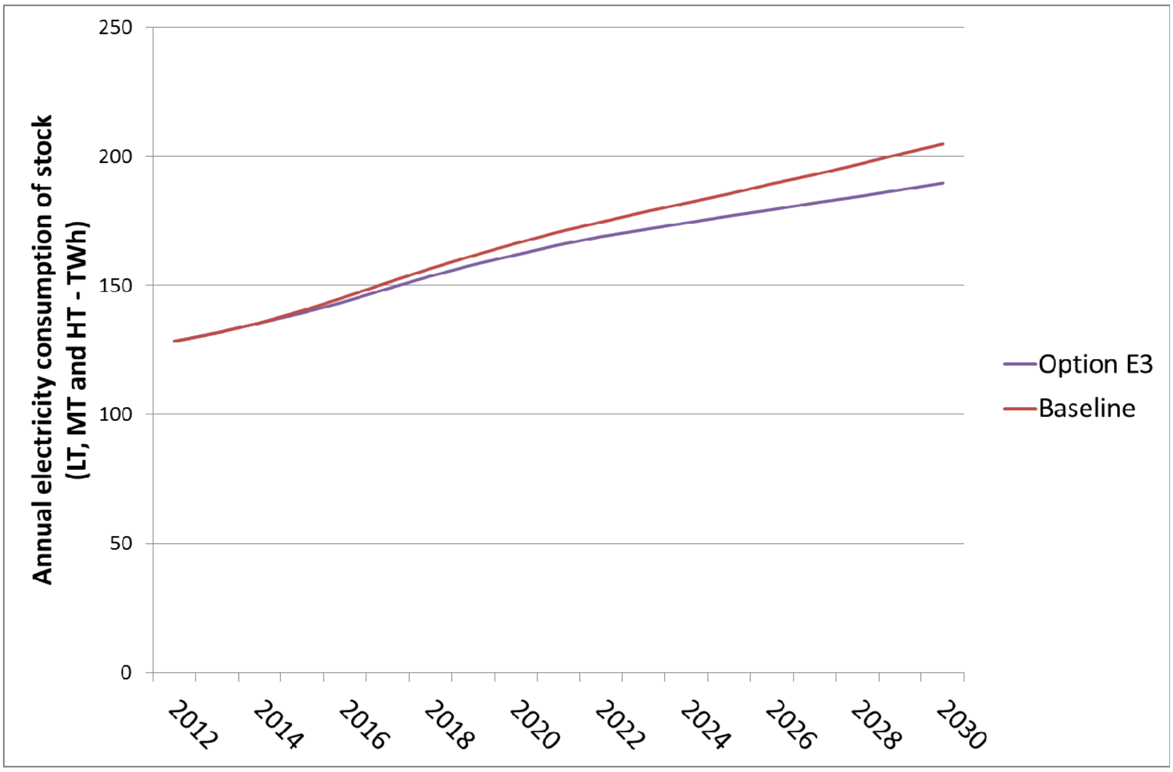
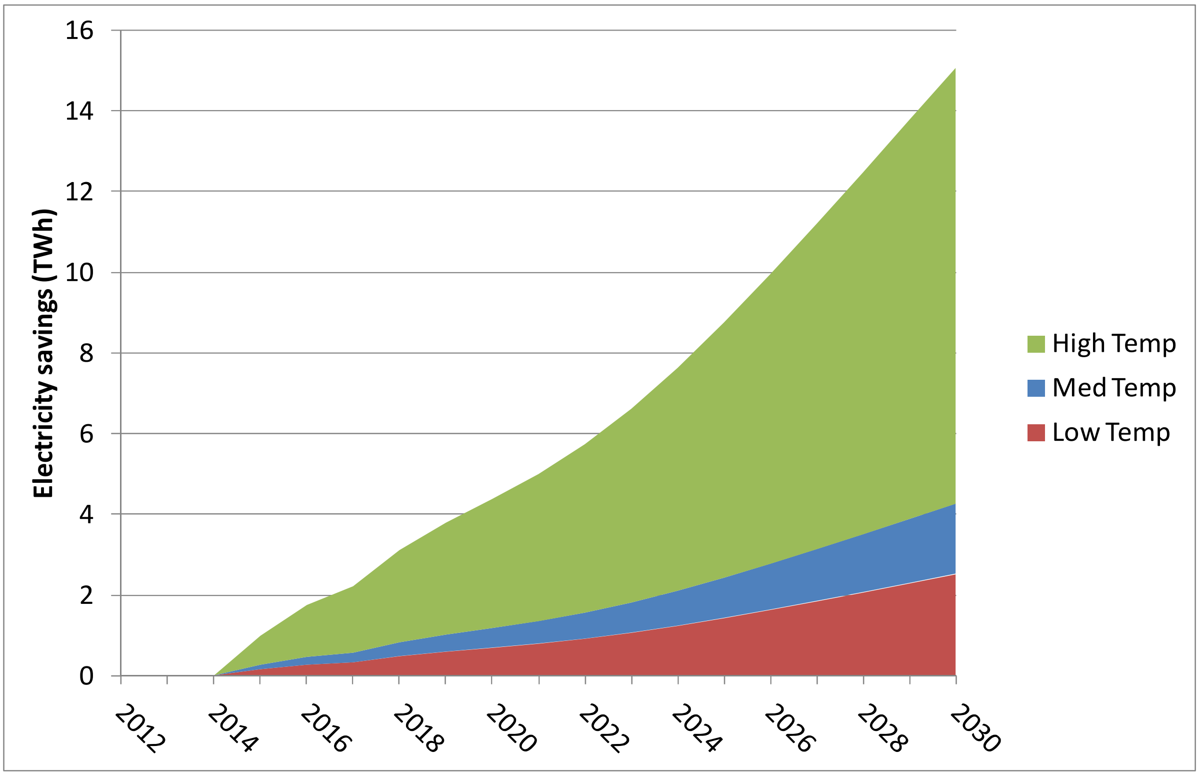


Figure 18. Electricity savings from for HT, MT and LT chillers under Option E3



The impact of the inclusion of HT chillers MEPS is clearly very large: the electricity savings increase from 1.2 and 4.3 TWh in 2020 and 2030 to respectively 4.4 and 15.1.

6.5.2.2 Product price increases

Product price increases have been quantified and are presented in the following tables.

Table 21. HT air cooled chillers - base case prices and percentage increases following Tiers.

AIR COOLED CHILLERS	Base case price per unit (Euro)	% price increase base case to post Tier 1	price increase base case to post Tier 1 (Euros)	% price increase base case to post Tier 2	price increase base case to post Tier 2 (Euros)
High temp <300 kW	€ 18,000	3%	€ 540	15%	€ 2,700
High temp >300 kW	€ 59,000	1%	€ 590	10%	€ 5,900
Source / rationale	As used in stakeholder consultation	As used in stakeholder consultation - only 2 consultees answered on price question - both agreed with all	Calculated from %	As used in stakeholder consultation - only 2 consultees answered on price question - both agreed with all	Calculated from %

Table 22. HT water cooled chillers - base case prices and percentage increases following Tiers.

WATER COOLED CHILLERS	Base case price per unit (Euro)	% price increase base case to post Tier 1	price increase base case to post Tier 1 (Euros)	% price increase base case to post Tier 2	price increase base case to post Tier 2 (Euros)
High temp <300 kW	€ 27,000	3%	€ 810	15%	€ 4,050
High temp >300 kW	€ 88,500	1%	€ 885	10%	€ 8,850
Source / rationale	Water cooled price assumed to be 50% greater than air cooled price	Assumed same as air cooled	Calculated from %	Assumed same as air cooled	Calculated from %

6.5.2.3 Impact on users

As in the case of the energy consumption, these impacts are noticeably higher than the ones achieved without the inclusion of HT chillers. Figures 19 and 20 represent them graphically. The net savings rise to nearly €1.9 billion per year in 2030 for high, medium and low temperature chillers combined. This is equivalent to just over 6% of the 2030 BAU expenditure of €30.4 billion. The drop in savings in 2017 in 20 is due to the fact that the product price rises due to introduction of Tier 2 are assumed to take effect immediately, while the energy savings accumulate gradually.

Figure 19. Annual expenditure by users on new sales and energy consumption of chillers for baseline and Option E3.

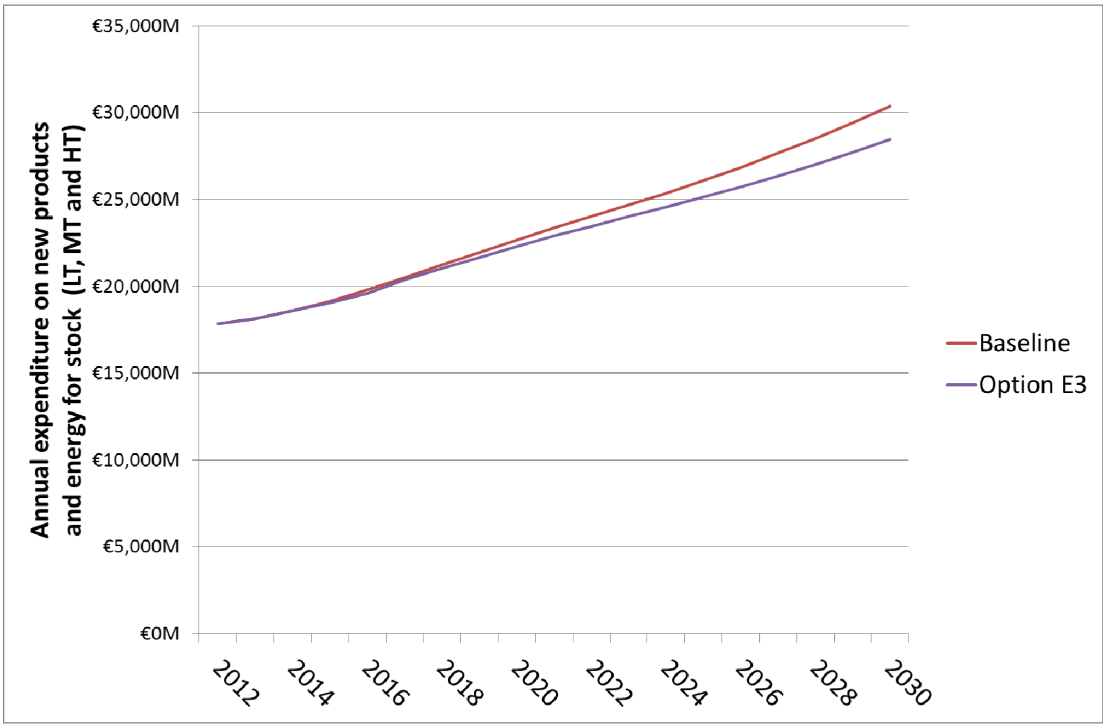
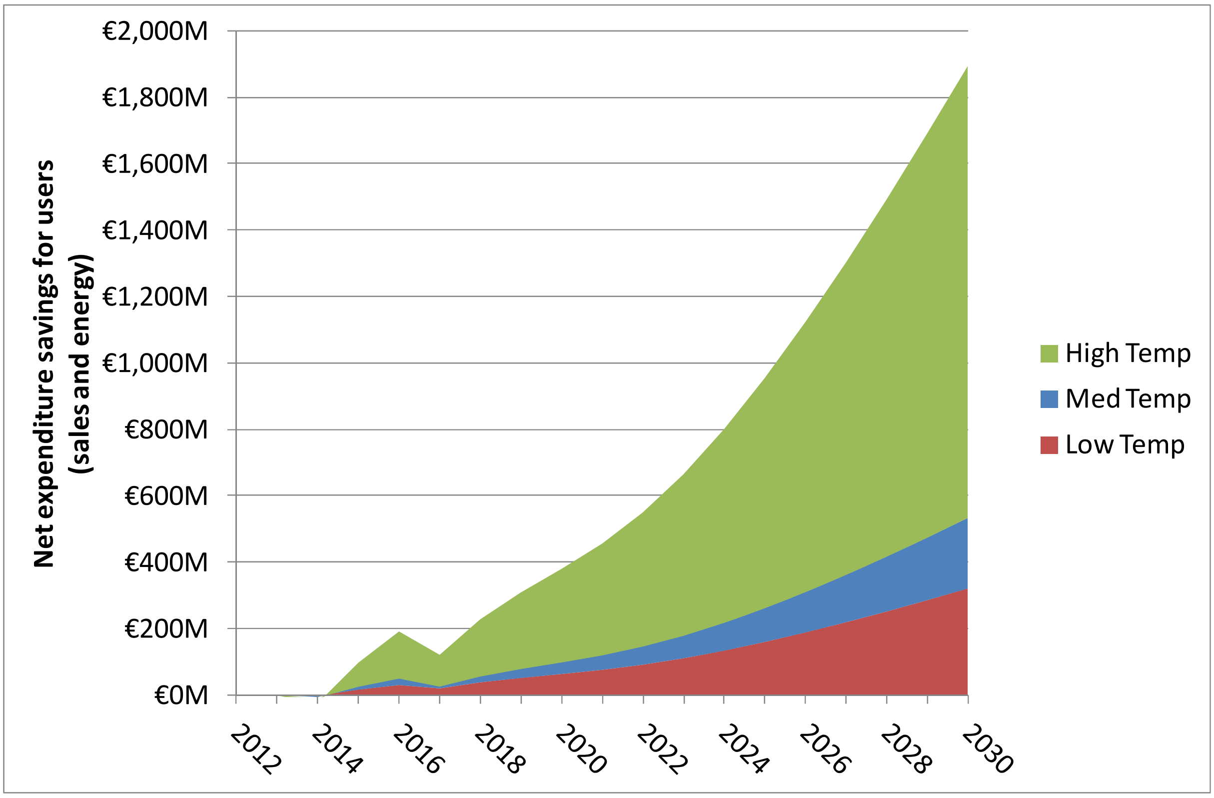


Figure 20. Annual net savings by users for Option E3.



6.5.2.4 Impact on manufacturers

The cost of testing and of the other administrative costs for HT chillers is assumed to be similar to the costs of testing MT and LT chillers; its calculation is also detailed in Annex V, with totals approximately proportionate to the relative sales. The total amount of these costs connected with Option E3 (i.e., related to all chillers: HT, MT and LT) are represented in Table 22.

Table 22. Summary of marginal costs to manufacturers in 2014 as a result of Option E3.

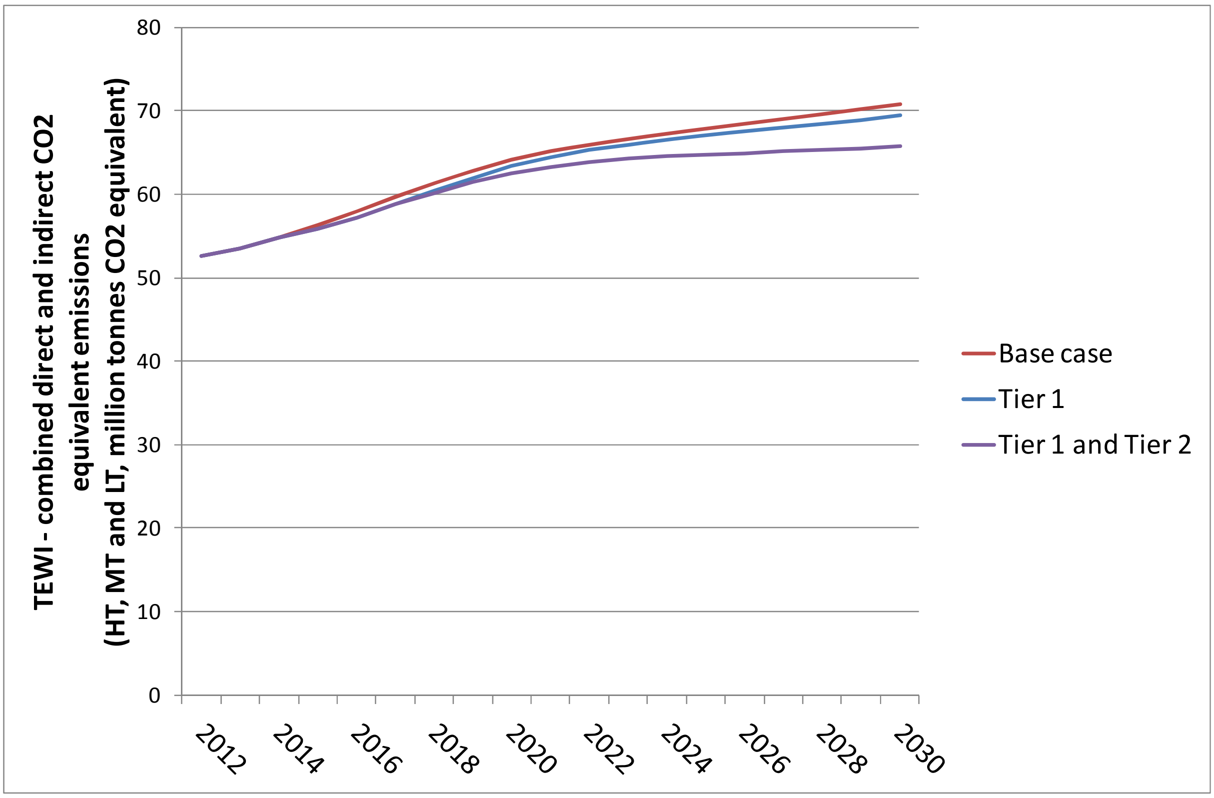
Type of cost	Indicative marginal cost per manufacturer (Euro)	Indicative marginal cost for all EU manufacturers (Euro)	Comments
Product testing	€187.500	€3.75 million	Assumes testing for HT, MT and LT is 5 x that for MT and LT alone (based on sales ratios).
CE marking	€1.500 + €0,5 per sale = c. €2.400	€30.000 + €17.300 = c. €47.300	Assumes €1.500 of additional CE marking costs per manufacturer as a result of regulation. Sales of 34,600 per year – assume equal share amongst 20 suppliers for

			this calculation.
Technical documentation	€650.000	€13 million	Assumes 60% of model variants require different technical documentation costing 2 days per product at €300 per day.
Authority inspections	€300	€0.006 million	One 5 day inspection every 5 years (at €300 per day).
Total	**€840.200**	**€16.8 million**	Equates to 1% of estimated €1.400 million annual sales for these products.

6.5.3 Environmental impact

These are calculated by translating the energy savings shown in Figure 21 into the CO_2 equivalent (TEWI). The same assumptions made for Option E1 hold here. As in the case of energy savings, the added value of setting MEPS for HT chillers is very high.

Figure 21. TEWI for HT, MT and LT chillers.



6.6. Option G: Malus/bonus measures regarding GWP of refrigerants

The rationale behind a bonus/malus system is that the use of low GWP gases should be encouraged when it leads to lower overall emissions. Products using a low GWP refrigerants would receive a bonus so that it would be easier for them to meet possible minimum energy performance requirements, which would then become effectively lower for them (or, conversely, a malus could be imposed on products using high GWP gases). Therefore, this option would be an addition to other options, rather than one standing on its own.

A malus system would be impractical in the case of chillers and condensing units, since the diversity of product types and applications for industrial purposes is such that a very detailed knowledge of each market segment, corroborated by robust data, would be necessary to establish a fair system; otherwise some segment would be much more penalised, since low GWP gases alternatives are not available for all segments: a malus would amount to raising the MEPs for them alone.

A bonus system instead could be applied in a fairer way, since it would reward low GWP alternatives where they are applicable, while not affecting the picture where they are not. It would be beneficial in particular for the development of new technology, since the switch to such gases would be costly for manufacturers. Namely, they would need to invest into research and development, adaptation of the production facilities, training of personnel for production and maintenance, redesigning and modification of the product or its components.

Condensing units

The case for foreseeing a bonus for CUs is strong, basically because of of two elements:

- The market diffusion of low-GWP gases alternatives (C02, hydrocarbons, Ammonia, HFOs) to F-gases is low. According to replies to the consultation, they are either non-existent on the market or representing a share well below 5%. This situation is confirmed by analysis of the market including the recently published SKM Enviros report. Therefore, a bonus could help offset the higher costs connected with the development of low GWP alternatives to F-gases through reduced investment in energy efficiency.
- The direct emission impact is large. It amounts to 20% of the total TEWI emission at present, and it is projected to rise to 25% as the energy mix will move towards renewable energy sources. This would allow to set a bonus large enough for producers to consider using it, without seeing the emissions savings from a reduced direct impact being more than compensated by larger emissions form energy consumptions.

Chillers

The case for foreseeing a bonus for chillers is not as strong as for CUs: the wide variety of technical solutions in all market segments, of the end of life treatments (which influences the refrigerant gas leakage) together with the technological evolution which occurred over the last years, makes not easy to derive general conclusions on the usefulness of introducing a bonus.

Nevertheless, it has been finally judged as appropriate to also introduce the bonus in the case of chillers, basically because it has been seen as a powerful driver for the introduction of technologies based on low-GWP gases, together with an expected diminution of the direct emissions impact.

In the consultation, the following barriers to the use of low GWP refrigerants were cited in descending order of frequency of mentions:

- Safety of product
- Lack of training for staff
- Maintenance of product
- Cost of refrigerant
- Higher energy consumption

Clearly, a bonus would do little to address the safety barriers, especially when they arise from a regulation rather than from technical issues. However, it should help address the others, by making it easier to find the resources to invest into tackling them through reduced investments in energy efficiency. Obviously, it would support the use of gases, in particular CO2, which is likely to be less performing especially in warmer climates. In order to maximise its impact, it could be granted to all appliances using gases with a GWP lower than 150, as done for the air conditioning regulation; to strive for a lower threshold could prevent the development of gases with a reasonably low GWP without assuring noticeably better results (the gases currently used have a much higher GWP than 150).

The size of the bonus

The bonus allowing appliances using low GWP refrigerants a reduction of the energy efficiency requirements has to strike the right balance between giving too little an incentive to develop low GWP gases solutions and lowering too much the level of energy efficiency ambition. Clearly, the bonus should be in any case higher than the measurement tolerances (around 8%) admitted for testing energy efficiency. A simple analysis based on the share of 80% indirect emissions through energy use and 20% direct ones through refrigerant gases leakage suggests that a bonus in the range of 10%-15% (e.g., a 10% bonus is foreseen by the air conditioning regulation[25]) would be the most appropriate solution also for condensing units; this is not surprising, given the similarities between these products. An inferior bonus would be too low to be interesting for producers, while a superior one could risk compromising the goal of energy efficacy too much; this would be particularly counterproductive if the F-gas regulation currently being proposed will be successful at

[25] Its impact assessment is available at http://ec.europa.eu/governance/impact/ia_carried_out/docs/ia_2012/swd_2012_0035_en.pdf

reducing direct emissions: the price to be paid in terms of energy-related emissions would stay the same[26], while the gains achievable through the reduction of direct emissions would decrease substantially. Such a reduction is explicitly targeted through reduced leakages and the substitution of the gases with the highest GWP with more climate friendly ones. At this regard, also the possibility of encouraging the use of HFC gases with a lower GWP than the widely used 404A (GWP: 3,922) has been investigated; however, many CUs are sold without being loaded with a refrigerant charge. They are designed or optimized for use with certain refrigerants, which makes it possible to distinguish among CUs using very different gases such as hydrocarbons, ammonia or HFCs; this is not the case within the HFC family. Without knowing which HFC gas is eventually going to be used, it is not possible to support the ones with the lower GWP.

The impact of the bonus

At present, it is impossible to quantify the impact of the bonus in terms of emission savings. The market share of low GWP gases is extremely low, and there is no clearly discernible trend to be projected in the future; any assumption would be speculative. Furthermore, the air conditioning regulation is not yet in force, and therefore the impact of the bonus it foresees cannot be used as an indication of the probable effect. The envisaged bonus should, however, balance the trade-off between direct and indirect emissions for the single product in a way that compensate higher emissions related to energy use with lower emissions related to refrigerant gas losses in the atmosphere. Thereby at an aggregate level the overall impacts should not change dramatically by the share of products that will exploit the bonus. The exploitation of the bonus would be entirely optional: producers would be free to target higher energy efficiency with a high GWP gas or lower energy efficiency with a low GWP gas depending on their specific cost structure and expertise. Thus this freedom of choice would, while making quantification of the impacts impossible, allow producers to choose the lowest-cost option for them, thereby reducing the costs of the regulation. The bonus is very likely to assist innovation in the field of alternative refrigerant gases, but at the same time reducing it in terms of energy efficiency.

The timing of the bonus

The bonus should aim at encouraging the development of not yet ripe alternatives to high GWP gases; therefore, it would be advisable to make it temporary and remove it once they are mature enough to compete without the bonus, especially if they are more energy efficient than the alternatives and the market is driven by energy efficiency. Therefore, it would be best to consider its prolongation or elimination at the time of the review of the regulation 4 years after its entry into force. This would be also an occasion to monitor the effectiveness of the bonus and its eventual revision.

[26] Condensing units have an expected lifetime of 8 years, and chillers of 15. This means that a product manufactured in 2018 and making use of the bonus (Tier 1 is too low to require redesign; only after Tier 2 it would become necessary) would be active until 2026 if a CU and 2033 if a chiller. It is reasonable to assume that by then the leakage rates, both during use and at end of life, will have improved substantially. However, its energy efficiency would be the same. This could easily lead to higher overall emissions.

6.7. Risks and uncertainties

The main uncertainties, apart from those regarding the effect of a bonus for low GWP gases described above, are related to the lack of detailed product market data. This problem has been overcome by making use of reasonable assumptions which have been then checked and validated by the stakeholders. One of the most fundamental assumptions, with a significant impact on outcomes, is that the JIEG dataset is representative of the whole market, including its efficiency profile. The data is representative of 5 major manufacturers, but does not include small suppliers, nor are they representative of products imported from the Far East, Turkey and other smaller supplying nations. It is possible that the JIEG dataset consists of better performing products than these other imports and so the energy savings are underestimated. The proposed minimum requirements are thus grounded on industry feedback and on trust in the mentioned manufacturer group. However, the data have been independently verified and widely accepted during the consultation, with the exception of the ones regarding high temperature chillers. In their case, the performance data is considered by the JIEG itself significantly less robust than that for low and medium temperature chillers, and therefore MEEPs based on them present a much higher risk of being either too stringent, causing a market shock, or too lax, thereby failing to achieve the objectives.

Another important risk emerges from having two regulations in place for similar products, i.e. the professional refrigeration regulation assessed in this IA for HT chillers for industrial applications, and the possibly upcoming air conditioning chillers regulation for HT chillers for air conditioning applications. While stakeholders stated that generally they know if a HT chillers is meant to be used in one context or the other, given the different usage profiles (continuous and stable in one case, more variable in the other), there is a clear lack of adequate technical definitions of the two types of product and of a legally appropriate mean to distinguish them for market surveillance and enforcement purposes. This would be necessary since the two types of HT chillers are outwardly identical in most cases (the differences are rather at levels of components and controls). The risk, confirmed in the stakeholder consultation, that without a clear coordination of the MEPS affecting both types of HT chillers some producer may opt for the less stringent regulation should also be considered. In particular, since the air conditioning chillers regulation should come into force later, it is possible that, in order to avoid the professional refrigeration regulation, HT chillers for industrial applications would be simply rebranded as air conditioning ones.

Compliance can be expected to be good from all major EU manufacturers, most of which have actively participated in the consultation. It might not be high amongst smaller suppliers at least initially, but it can be increased through allowances for an economically viable schedule of testing and update of technical documentation, such as the delayed entry into force described in Option E2. It is unlikely that significant monitoring and enforcement resources will be directed at product testing in the short-term and so compliance will be heavily reliant on the accuracy of data declared by manufacturers. The EU manufacturers work closely together and indeed most already collaborate on an industry-wide product data certification scheme for compressors and so the technical capacity for monitoring such things in the sector is well proven. Given the investment they will be making in performance information and product development, manufacturer vigilance will be high and all are technically able on these matters. It is therefore likely that products suspected of not complying will be reported to the authorities if it is in the economic interest of a competing producer, which it almost certainly will be (self-policing). If compliance was seen to be poor, the benefits described in this impact assessment would rapidly deteriorate, particularly with regard to the possibility of differentiating better performing products and so attracting and justifying buyer investment.

6.8. Timing of implementation

The following table gives an overview of the timing envisaged for all five professional refrigeration products.

Table 26. Summary of implementation timing

Product	Information requirements	Tier 1	Tier 2	Tier 3
Condensing Units (Option E1)	January 2014	January 2014	January 2017	TBD
Condensing Units (Option E2)	January 2015	January 2015	January 2018	TBD
Chillers (LT and MT)	January 2014	January 2014	January 2017	TBD
Chillers (HT, Option E3)	January 2014	January 2014	January 2017	TBD
Storage cabinets	January 2015	January 2015	January 2016	January 2018
Blast cabinets	January 2015	TBD	TBD	TBD
WICR	TBD	TBD	TBD	TBD

TBD: to be decided

The timing is subject to which option will be retained. The choice is to be made between having the regulation come into force as quickly as possible for the greatest number of products possible, in order to minimize energy consumption as well as emissions and maximize users savings, and on the other hand scheduling the entry into force of the requirements of different products to reduce the negative impact on manufacturers, smaller ones in particular. It should be noted that, as specified in the impact assessment for professional storage cabinets and blast cabinets, the possibility of delaying the entry into force written above for some (smaller) subcategory of storage cabinets has been considered, and may be adopted by the regulatory committee later on.

7. COMPARING THE OPTIONS

Each option has been scored according to the anticipated impacts of the policy, using three criteria: effectiveness, efficiency and coherence. Table 28 reports the quantified impacts already presented in Chapter 6, but summing those of condensing units with those of chillers, while Table 27 summarizes the results in qualitative terms.

Table 27. Summary of quantified impacts

Option	Total energy savings (2030, TWh)	Total TEWI savings (2030, Million tonnes)	Total savings to users (2030, million Euro)	Total costs to manufacturers [27] (first year, million euro)
Option A: No New EU action	0	0	0	0
Option E1: Minimum Energy Performance Requirements (MEPS)	11.6	3.9	1,539	8.1
Option E2: Lower MEPS and delayed timing for CUs	10.2	3.45	1,315	8.1*
Option E3: addition of MEPS for HT chillers	22.4	7.6	2,899	20.5
Option G: Bonus/malus				

[27] As explained in Section 6.3.2.4, these costs are estimated for the first year of introduction of the requirements, when they have the highest impact on producers; they will then decrease substantially.

based on GWP of refrigerants	11.6**	3.9**	1,539**	8.1**

*The amount is the same as in Option E1, but it would be spread over two years, thereby reducing substantially its impact on producers.

** It is not possible to determine how many producers would use the bonus at present. Therefore, the results are as in Option E1.

Table 28. Summary of policy option comparison

Option	Effectiveness to deliver objectives	Efficiency	Coherence
Option A: No New EU action	0	0	0
Option E1: Regulatory information and minimum requirements	✓✓✓	✓✓	✓✓
Option E2: Regulatory information and minimum requirements with lower thresholds and delayed timing for Condensing Units	✓✓	✓✓✓	✓✓
Option E3: Addition of minimum requirements for high-temperature chillers	✓✓✓✓	✓✓	✗
Option G: Malus/bonus and/or other measures regarding GWP of refrigerants	✓✓✓	✓✓✓	✓✓

Scoring key: ✓✓✓✓ = very large positive ✓✓✓ = large positive, ✓✓ = sizable positive ✓ = small positive, 0 = neutral, ✗ = small negative, ✗✗ = large negative.

In terms of effectiveness all retained options score well, the reason being that they would all remove the least efficient products from the market and provide buyers with appropriate performance information, thereby reducing sensibly energy consumption and creating savings for users; however, Option E2 is somewhat inferior to E1, while E3 is vastly superior to both: as shown in Table 28, it would double all savings (energy, TEWI and to users). The impact of Option G is presented as the same as Option E1, since the effect of the bonus for CUs and process chillers using low GWP refrigerant gases cannot be quantified, as explained in Section 6.6. However, its push towards a greater use and quicker adoption of such low GWP gases is likely to give a positive contribution to the reduction of climate-damaging emissions, one of the objectives of this regulation and of the Ecodesign Directive.

In terms of efficiency, Option E2 would be more efficient than both Option E1 and Option E3, since the costs imposed on manufacturers, SMEs in particular, would be spread over a longer period; on the other hand, the lower thresholds would reduce energy savings and benefit users less: they would not be able to reap about two hundred million Euro of savings achieved under Option E1. Option E1 and E3 can be deemed equally efficient: E3 would achieve much higher energy and TEWI savings, but also impose a proportionally higher burden on producers. Option G would be as efficient as Option E1 in terms of savings (The requirements would be the same) while it is difficult to assess its effectiveness in pushing the market towards low GWP gases at this stage, since it is not possible to estimate how many companies would use the bonus; but since in any case its introduction would not impose noticeable additional costs, while giving a clear incentive to reduce the sizeable direct emissions of CUs, the overall efficiency of Option G can be deemed higher than the one of Option E1.

Both Option E1 and E2 score well in terms of coherence with other EU policies, with Option E2 closer to the spirit of the Small Business Act and Option E1 to the Europe 2020 goal of sustainable growth because of its higher savings. Option E3 deserves an inferior score because it presents a clear and risky overlap with another EU regulation, the air conditioning chillers regulation, which still needs to be resolved. Option G scores on par with Option E1 and E2 in terms of coherence, being on the positive side closer to the aims of the F-gas regulation (helping remove F-gases) and more aligned with the existing regulation on air conditioning which already foresees a bonus (See footnote 9), but on the negative side also adding this topic to the Ecodesign regulation, thereby making it slightly heavier and covering the topic of refrigerant gases in different regulations.

Assessment of the preferred option

Overall, the option which presents the better effectiveness, efficiency and coherence profile is Option G. It scores as well as Option E1 in terms of quantifiable impacts, and offers the chance to facilitate innovation in the research and application of low GWP gases for condensing units, where such support is needed.

Moreover, there is a qualitative element from Option E2 that could be easily integrated into Option G without diminishing its potential, which would stay as shown in Table 27. The delayed timing foreseen by Option E2 for condensing units could be added to Option G but without the lower MEPS thresholds: this way the same level of savings of energy, emissions and to users would be achieved, only one year later, helping companies to better cope with the regulatory burden by spreading it over a longer time frame. This would help in particular SMEs, which are more present in the condensing units sector. The combination of Option G with this element from Option E2 can thus be considered the **preferred Option**.

However, if the issues affecting HT chillers (lower amount of available data, unclear boundary with the air conditioning chillers regulation) were to be resolved, Option E3 would probably become superior, given its much greater potential to reduce energy consumption and deliver savings to users.

8. MONITORING AND EVALUATION

The main monitoring element will be the tests carried out to verify the respect of energy efficiency information and minimum requirements. This monitoring should be done by market surveillance carried out by Member State authorities to ensure that requirements are met. The absence of products failing to meet the requirements will be the main indicator of progress towards a more energy efficient market.

The baseline for this regulation is based on limited evidence, in particular on the market stock, sales and average performance levels. This is the reason behind the relatively low stringency of Tier 1 and the absence of a Tier 3. Hence an early review is recommended and should begin at an early opportunity to ensure full information is available for a robust assessment.

Specific indicators to monitor the evolution of the policy will be:

1. Availability of the necessary harmonised test methodologies by mid 2013. This requires collaboration with the relevant CEN committee.

2. Availability of performance and other data on manufacturer websites and in technical documentation in line with the mandatory requirements. This can easily be assessed with a survey carried out by someone with a reasonable knowledge of refrigeration engineering on behalf of the Commission. This could be expressed as a percentage of models for which the mandatory COP and SEPR information is found, with a survey covering at least half of the major suppliers in the EU and several major importers. Assessment of this should begin in mid-2015 in order to allow time for corrective action before review of the regulation must start, which will require a reasonable product performance data set.

3. Accuracy of performance information reported. There are 2 levels at which this can be assessed: firstly correlation of declared COP / SEPR values with other published performance data (i.e. COP and capacity data, often available through product selection software). Secondly, practical testing of products which should be selected as mainstream products with significant sales, with testing targeted at products for which data has been notified as potentially misleading. It is suggested that the first enforcement testing should begin in mid-2015, allowing time for manufacturers to adopt the new test and calculation methodology and get used to them.

4. Absence of products not meeting the minimum requirements. This can be achieved through a simple survey of manufacturer performance data, carried out with the survey on data availability. A baseline survey would be valuable during 2014, with follow-up surveys required in early 2015 to ensure Tier 1 compliance, followed by another survey in late 2017 for Tier 2.

Annex I: Consultation Forum Minutes

MEETING OF THE CONSULTATION FORUM UNDER ARTICLE 18 OF THE ECODESIGN OF ENERGY-RELATED PRODUCTS DIRECTIVE (2009/125/EC)

POSSIBLE ECODESIGN IMPLEMENTING MEASURES AND ENERGY LABELLING REQUIREMENTS FOR PROFESSIONAL REFRIGERATION PRODUCTS

Held on 19 January 2012 (09:30 – 17:30)
Centre A. Borschette, Rue Froissart 36, 1040 Brussels

Chair: Kirsi Ekroth-Manssila
Assistants: Laure Baillargeon, Tobias Biermann, Ugo Miretti

1. Welcome, introduction, approval of the agenda

THE CHAIR welcomed the participants and recalled that the objective of this meeting was to get feedback and a clear 'mandate' from CF members on the appropriateness of Ecodesign and Energy Labelling requirements for professional refrigeration products. The vote in the Regulatory Committee was expected to take place in the first quarter of 2013.
THE COMMISSION presented the introduction working document (EDCF-2012-02-19-Doc01). Professional refrigeration products were primarily intended for the storage of foodstuff whereas commercial refrigeration was intended for the display and selling of foodstuff. This distinction was mainly useful for distinguishing between professional storage cabinets (ENTR Lot 1) and commercial display cabinets (ENER Lot 12). The Commission insisted on the role of food hygiene rules, installation and maintenance for these products, as well as the significant share of SMEs in this sector. The aggregated energy consumption of professional refrigeration products was 295 TWh in 2008 and estimated to grow up to 344 TWh in 2020. The saving potential from the envisaged Ecodesign requirements was estimated at 29 TWh in 2020 (including 21 TWh from condensing units). However, estimates needed refinement during impact assessment.
GERMANY, THE NETHERLANDS, THE UNITED KINGDOM, ITALY asked for good coordination in the process for adopting Energy labelling and Ecodesign requirements, to avoid, in particular, that delegated acts under the Energy labelling Directive would be finalised before the vote in the Regulatory Committee on corresponding Ecodesign implementing regulations. **ITALY AND THE NETHERLANDS** suggested putting a priority on some professional refrigeration products, taking into account criteria of Article 15 of the Ecodesign Directive (in particular, saving potential and sales), in order to avoid that the preparation of some Regulations could delay the swift adoption of others. **THE COMMISSION** explained that running parallel processes with different timings would be very complicated to manage, but that it would aim at avoiding delays.

2. Possible Ecodesign requirements for condensing units

THE COMMISSION presented the working document on condensing units (EDCF-2012-02-19-Doc06 to 06.2 and EDCF-2012-02-19-PPT05).
AUSTRIA stated that the adoption of a new standard on measurement of seasonal efficiency of condensing units should not delay the adoption of Ecodesign requirements. **CEN CENELEC** considered that no distinction should be made between professional and commercial condensing units. However, an update of EN13771 should be envisaged to allow for higher variability of test results as this test protocol was initially created for air-conditioning units also used in B2C markets. **THE NETHERLANDS** agreed that standards made for products sold in large numbers were not necessarily suitable for professional equipments, and asked why noise was covered by Ecodesign requirements for air-conditioners but not for condensing units. The impact assessment should demonstrate how Ecodesign requirements would promote more efficient technologies, including through benchmarks.
THE NETHERLANDS, ITALY, ECOS, GERMANY supported a formula linking COP/ SEPR to cooling capacity rather than fixed COP or SEPR values by segment (whether linear or curved). **SWEDEN** underlined that the Commission should not be afraid of high market cut-off through Ecodesign requirements (as shown by the example of circulators, with a market cut-off of 95%). Tier-3 requirements could also be envisaged to anticipate on a future review which might turn to be more complicated than expected, except if a solution could be found to allow easier update of the Regulation. The use of CO2 as refrigerant (R744) was very efficient in indirect systems; it could be promoted through legal requirements (e.g. bonus or ban). **THE UNITED KINGDOM** suggested using the ambitious recommendations from the preparatory study as benchmark levels. The use of low GWP refrigerants could at least be supported by information requirements. **AUSTRIA** asked whether energy labelling of chillers and condensing units was envisaged. Any trade-off between energy efficiency and alternative refrigerants such as CO2 should be identified by the impact assessment. **ECOS** supported the introduction of Tier-3 requirements, voluntary benchmarks and legal provisions promoting the use of low GWP refrigerants. **DENMARK** indicated that CO2 was also used in direct systems in supermarkets, but underlined that the market for condensing units also included smaller users. **GERMANY AND INFORSE** supported more ambitious Tier-2 requirements. **ITALY** underlined that Tier-3 requirements, if erroneous or excessively ambitious, could also create undue market shocks.
ASERCOM indicated that the use of CO2 as refrigerant was suitable in colder climates and reminded that condensing units were tested with ambient temperature +32°c. In addition, condensing units were sold as incomplete systems, and therefore tested according to a pre-set evaporating temperature (-10°c or -35°c). Once installed, the evaporating temperature might actually be higher. Besides, suitable compressors for CO2 condensing units were not available yet. The market for refrigeration systems in supermarkets could hardly be compared with the market for condensing units. **EUROVENT** suggested that COP or SEPR could be calculated and not necessarily tested in order to decrease testing costs. **THE NETHERLANDS** opposed to this suggestion, and asked that refrigerants would be addressed at least through information requirements.

THE COMMISSION summarised and concluded that the draft Regulation would not distinguish between "professional" and "commercial" condensing units. Noise was not relevant at first sight (Machinery Directive, no data) but this should be confirmed after impact assessment; information requirements could be envisaged if relevant. The impact assessment would need to further investigate the impacts on costs, technologies and energy savings of the envisaged requirements, so as to adjust the stringency of Tier-1 and Tier-2 requirements if necessary, taking into account, in particular, the best available technology (or product) and the least life cycle cost. Voluntary benchmarks, Tier-3 requirements and labelling would have to be considered among possible policy options. A more in-depth technical analysis of the refrigerants issue was still necessary, including availability and market penetration of technologies, their costs, related safety issues, other technical constrains and any trade-off with energy efficiency. This was necessary to properly impact assess the various policy options (ban, bonus, information requirements). The impact assessment would also consider the appropriateness of a formula linking COP/ SEPR to cooling capacity. The Commission indicated that COP and SEPR could be calculated when basing on "representative models" (in that case, the representative model would have to be tested but COP and SEPR values for "equivalent" models could be derived from these test results).

3. Possible Ecodesign requirements for refrigeration process chillers

THE COMMISSION presented the working document on refrigeration process chillers (EDCF-2012-02-19-Doc05 to 05.2 and EDCF-2012-02-19-PPT04).
THE NETHERLANDS, BELGIUM, ITALY, SWEDEN stated that the data presented was not sufficient to substantiate the proposed Ecodesign requirements. **THE NETHERLANDS** recommended that the Commission envisaged the adoption of information requirements only, in case the lack of data for chillers would risk delaying the decision-making process. **ITALY** underlined that information requirements generated administrative burden for manufacturers and market surveillance authorities. Such burden was justified only if sufficient energy savings were achieved through combined information and performance requirements. **THE NETHERLANDS** replied that providing information on energy performance was usually a contractual obligation on B2B markets anyway, and that a harmonised standard was already available for chillers. The Commission should confirm whether information requirements implied product testing by market surveillance authorities or merely a check that required information was provided in product technical documentation. **SWEDEN** indicated that the burden of the proof was on manufacturers to demonstrate the accuracy of the information contained in product documentation. Information requirements were useful to allow designers and manufacturers to compare and thus optimise their products. The existing measurement standard was suitable, provided tolerances would be clearly specified. In Sweden, chillers were used as an alternative to condensing units to reduce refrigerants charges. **BELGIUM** added that data was only available for HFC models, whereas HC models were already being used in Nordic countries. More data should be provided on the energy efficiency of models placed on the market today, but also on the link between refrigerants and energy consumption. **NORWAY** recalled that the base case was using R134a and R404a, but that the use of low GWP refrigerant such as R290 allowed higher energy efficiency. **DENMARK** recommended

that envisaged requirements would be compared to existing minimum requirements in Australia and New Zealand. **ASERCOM, EUROVENT** explained that the lack of data had been the very reason for establishing a joint expert group, and that industry was supportive of minimum performance requirements. Performance data was not available, but the group had assessed the feasibility of minimum requirements on the basis of a detailed thermodynamic analysis. **ECOS** underlined the risk of adopting not very ambitious minimum performance requirements due to lack of data. These requirements would stay in place until the review in 4 years. This would constitute a missed opportunity for energy savings. **CEN CENELEC** stated that chillers for air-conditioning and for refrigeration at high operating temperature (+6°c) had identical technical features and that manufacturers did not know which application their products were intended for. Additional testing for refrigeration chillers was not useful and, besides, SEPR rating conditions were not suitable for air-conditioning chillers. Verification tolerances for air-conditioning chillers were 5%. **ASERCOM** replied that a single measurement standard could not be applied to air-conditioning and refrigeration chillers due to different load profiles and cooling demand over the year.

THE COMMISSION summarised and concluded that the impact assessment would look for additional data on energy consumption of models currently sold on the EU market, and/or that the thermodynamic and technical analysis would be beefed up. Additional background on low GWP refrigerants would be sought, in particular on the link between refrigerants and energy consumption. The intention remained to adopt minimum performance requirements for chillers, on the basis of a specific measurement standard for refrigeration applications[28]. The impact assessment would include some international benchmarking. Administrative burden would be investigated through a specific SME consultation. High temperature chillers for air-conditioning would fall in the scope of ENTR Lot 6 whereas high temperature chillers for refrigeration fell in the scope of ENTR Lot 1.

4. Possible Ecodesign and Energy labelling requirements for professional refrigerated cabinets

THE COMMISSION presented the working document on professional refrigerated cabinets (EDCF-2012-02-19-Doc02 and EDCF-2012-02-19-PPT01).

AUSTRIA recommended using a single measurement standard (EN 23953) for commercial display cabinets and professional storage cabinets with transparent doors. The Option 2 formula needed refinement but was preferable to Option 1.
EFCEM suggested paying special attention to testing costs due to the significant proportion of SME assemblers and because of the high degree of customisation of products. Besides, manufacturers had to ensure that their products deliver the expected functionality also in extreme ambient conditions. The product data from the English and Danish voluntary schemes (measured with EN441) was not representative of the market. EFCEM was going to submit additional data and an alternative proposal of measurement method. **EUROVENT**

[28] In case a model is intended for use in both air-conditioning and refrigeration applications, this model should therefore be tested both with EN14511/EN 14825 (SEER) and with the specific refrigeration standard (SEPR).

estimated that testing results under EN441 and EN23953 were equivalent. But the door opening protocol in EN23953 was not suitable for professional cabinets. Option 1 seemed more convenient for users and more in line with the English scheme. Option 2 included inconsistencies. **THE NETHERLANDS** supported Option 2. International benchmarking should be beefed up. Article 4(2) of the Ecodesign Regulation on household washing machines could serve as an example how to deal with ‘equivalent’ models to reduce testing costs to manufacturers. According to data presented by **ITALY** (EDCF-2012-02-19-PPT01.2), the base case was overestimated. Data showed that it was appropriate to differentiate products according to design and operating temperature, but not to volume. Therefore, Option 2 could be acceptable if refined with 4 sub-categories. The proposed requirements were not realistic when compared to market reality, in particular for under-counter models and chest freezers. The case of chest freezers deserved special attention to avoid inconsistencies or loopholes in legislation. The technical features of domestic and professional models were almost identical, but these would be covered by different Ecodesign requirements and measurement standards. **BELGIUM** supported Option 2. Besides, meters displaying energy consumption in real time should be required on all models. **DENMARK** acknowledged that data from the Danish voluntary scheme was not representative of the market. Minimum performance requirements and energy labelling requirements should be made more stringent. The energy consumption measured with EN23953 was ~10% lower than with EN441, and results of comparative tests would be submitted to the Commission. However, these comparative results were available for energy efficient models only, and might not be valid for other models. The Option 2 formula could be linear or curved against volume, and this should be elaborated on the basis of product data. The method for net volume measurement and calculation was not sufficiently clear. **SWEDEN, ECOS** supported the adoption of minimum performance requirements and energy labelling requirements, but these should be made more stringent. **ECOS** requested that the use of low GWP refrigerants would be incentivised and asked why noise was submitted to information requirements for domestic fridges and not for professional fridges. **EFCEM** replied that noise was not problematic in professional environments and that testing noise performance was excessively costly.

THE COMMISSION summarised and concluded that minimum performance requirements and labelling classes would be refined during impact assessment, taking into account new data submitted in the next few weeks –data should first be made comparable. Based on the discussion, the intention was to refine Option 2 to eliminate inconsistencies, and elaborate a formula against volume and with 4 sub-categories according to design and operating temperature. Energy consumption would be measured according to a standard specific to professional refrigerated cabinets. Additional evidence should be sought on low GWP refrigerants. It was intended to beef up international benchmarking. The calculation and measurement of net volume, the special case of chest freezers and the possible general requirement on energy meters would also be analysed in more details. Professional storage cabinets with transparent doors could be distinguished from commercial display cabinets according to intended use. It was not intended to exclude these from the scope of the future Regulation. However, noise did not seem to deserve further consideration.

5. Possible Ecodesign requirements for blast cabinets

THE COMMISSION presented the working document on blast cabinets (EDCF-2012-02-19-Doc03 and EDCF-2012-02-19-PPT02).

ECOS considered that the data presented was not sufficient to substantiate the proposed Tier-1 requirements. In addition, no benchmark and no Tier-2 requirements were proposed. A mid-term target was at least necessary. **DENMARK** broadly supported the proposed approach and the introduction of minimum performance requirements. However, the proposed test material (smashed potatoes) should be changed. **THE UNITED KINGDOM** suggested distinguishing between “pass-through” models and “conveyer belt” models, and to set an upper threshold in terms of capacity to better define the scope of the Regulation. The Commission selected the English temperature cycle as a reference for testing. However, many models were designed for use in other EU countries where less stringent temperature settings were tolerated. These models might not be able to reach the English temperature requirements. **ECOS** insisted that the future harmonised standard should be uniform and reproducible. The French standard AC D40-003 was a suitable hygiene standard but might need adaptation for energy consumption measurement. **SWEDEN** indicated that models placed on the market in Sweden and Finland were designed to comply with local food safety rules, with much lower temperature requirements compared to the English cycle. These might not be able to comply with requirements based on the English cycle, or would be put at a disadvantage. The Commission could propose information requirements only as a first step. **EFCEM** indicated that the English cycle was defined by Health Guidelines and was not mandatory in the UK. The Regulation could base on another cycle, as a compromise. However, the difference between plug-in blast cabinets (integral condenser) and remote blast cabinets (attached to a remote condensing unit) should be carefully taken into account in the test protocol and in terms of measured energy consumption. The proposed minimum performance requirements were too stringent. **BELGIUM** asked how new data could be obtained, and whether energy labelling was envisaged. **AUSTRIA, THE NETHERLANDS** suggested not proposing any Ecodesign Regulation for blast cabinets. **EFCEM** indicated that some test results with the French standard could be made available. **ECOS** supported the adoption of Ecodesign requirements. Sales of blast cabinets followed a growing trend and would increase in the future. **SWEDEN** indicated that national regulations should be further analysed. Ecodesign requirements might not be adequate if national regulations were too diverging. However, Sweden supported the introduction of Ecodesign requirements in principle if a proper harmonised standard could be elaborated. **BELGIUM** supported the adoption of an Ecodesign regulation.

THE COMMISSION summarised and concluded that new data would be looked for during impact assessment. If no data was available, mandatory information requirements on the basis of a proper harmonised standard could be an acceptable first step, before a review in maximum 4 years, or the Commission could consider “no action” as the preferred policy option. The French standard seemed acceptable for the bulk of the test protocol, but some further discussion would be held on the adequate temperature cycle and on the test material. In addition, national regulations on food hygiene would be further analysed.

6 Possible Ecodesign requirements for walk-in cold rooms

THE COMMISSION presented the working document on walk-in cold rooms (EDCF-2012-02-19-Doc04 and EDCF-2012-02-19-PPT03).

EFCEM did support the introduction of insulation requirements (U values). **EUROVENT** supported the introduction of insulation requirements. However, the U values associated with various thicknesses as presented in the working document needed to be corrected. **NORWAY, DENMARK, ECOS** supported more stringent U values. **GERMANY** supported more stringent U values for doors and windows. **SWEDEN, ECOS** supported the introduction of Ecodesign requirements for cold rooms in general. Sweden, in particular, recommended more stringent U values in low temperature cold rooms – these should correspond to at least 160-mm thickness. Besides, consistency between proposed U values and national building regulations should be checked. **DENMARK** offered to share data on insulation in the residential sector. **ECOS** stated that the overall level of ambition of the working document was not sufficient, with no Tier-2 requirements and no benchmarks, despite the availability of some highly performing technologies such as vacuum insulation panels. The cost of insulation much depended on the considered lifetime (much longer for vacuum insulation panels than for polyurethane). **GERMANY** stated that voluntary benchmarks should be considered. **NORWAY** indicated that many cold rooms were renovated rather than replaced and wondered to which extent this could be considered under the Ecodesign Directive. **THE UNITED KINGDOM** supported the use of gross storage volume (rather than net storage volume) and 1% tolerances for all thermal bridges values. The recent US test protocol on walk-in cold rooms should also be considered as a valuable precedent. Beer cellars, hence any cold room operating above 8°c, should be excluded from the scope of the Regulation. **EUROVENT** supported the use of gross storage volume and suggested to differentiate between several categories of cold rooms according to volume. Proposed U values were slightly too stringent and alternative proposals would be submitted to the Commission. Besides, U values should refer to initial lambda values (as opposed to aged lambda values). **PAN AND PRO EUROPE** offered to provide additional data on U values of insulating panels. The aged lambda value was already dealt with under EN14509. Vacuum insulated panels were not covered by existing standards.
ITALY, THE UNITED KINGDOM, HUNGARY, ECOS wondered how market surveillance could work in practice, notably for checking the proper construction of a kit or the proper installation of a customised cold room. **ECOS** observed that installers would be in charge of placing on the market and CE-marking for customised cold rooms. **ITALY** underlined that cold rooms could not be withdrawn from the market if not compliant, especially if forming part of the building.

THE COMMISSION summarised and concluded that it would be checked whether walk-in cold rooms usually form part of the building and whether and how these products were addressed by national building regulations. The intention was to go ahead with mandatory requirements on insulation (U values), installation requirements and information requirements. However, additional data would be looked for during impact assessment in order to ensure that U-value requirements were adequate. Depending on data availability, benchmarks and Tier-2 requirements could be envisaged. The Commission agreed to use gross storage volume as a basis. Significant standardisation work was necessary (including for example to cover vacuum panels with existing standards). An informal meeting with standardisers and representatives of industry would be organised soon to discuss standardisation needs on insulation and refrigeration efficiency.

Annex II Electricity Emissions factors

To estimate the impact of energy consumption (or savings) on the atmosphere one has to consider the greenhouse gases emissions connected with the production of energy. Clearly, they vary a lot according to the energy source used (coal, wind, gas, etc). While we know the energy mix currently in use, we have to assume the energy mix in the future to estimate the potential future emissions. The energy mix is then translated into emission factors, which one multiplies by the energy consumption to have the corresponding emissions, expressed in TEWI. In the case of this IA, as in all Ecodesign regulations, the emission factors are from the MEErP 2011 Methodology, final report, part 1[29]. The downward trend visible in Table 23 is due to the expected rise of renewable energy sources within the energy mix.

Table 28: Electricity emission factors used

Year	Electricity emissions factor kg CO_2/kWh
2010	0.41
2011	0.407
2012	0.404

[29] Methodology for Ecodesign of Energy---related Products (MEErP 2011), Methodology Report Part 1: Methods, COWI / Van Holsteijn en Kemna B.V. (VHK), prepared for DG ENTR under contract SI2.581529, Delft, 28 November 2011. page 142.

2013	0.401
2014	0.398
2015	0.395
2016	0.392
2017	0.389
2018	0.386
2019	0.383
2020	0.38
2021	0.376
2022	0.372
2023	0.368
2024	0.364
2025	0.36
2026	0.356
2027	0.352
2028	0.348
2029	0.344
2030	0.34

Annex III: Information Requirements

The information requirements that producers will have to make available to customer are listed below. The timing implies the adoption of Option E1, but it can be delayed in case of the adoption of Option E2 or the unavailability of a testing methodology in the foreseen time frame.

Condensing Units

Smaller capacity units:

From January 1, 2014 onwards, the following parameters shall be reported in the product documentation accompanying remote condensing units falling into the scope of the present Regulation which have smaller cooling capacity than 5kW and 2kW for medium and low operating temperatures respectively:

- Intended operating temperature(s), expressed in °C
- COP at full load and +32°C ambient temperature, rounded to two decimal places, and corresponding cooling capacity and power input, expressed in kW and rounded to three decimal places
- COP at full load and +25°C ambient temperature, rounded to two decimal places, and corresponding cooling capacity and power input, expressed in kW and rounded to three decimal places

Note that COP is retained in the information requirements for smaller products despite the introduction of SEPR for higher capacity product segments. This is because the smaller capacity units are most often used in an indoor environment.

This excludes:

- Condensing units operating at high temperature intended for air-conditioning (indicatively corresponding to H1 temperature class, i.e. +10°C), including "split systems" sold with a remote evaporator
- Monoblock units which include the evaporator
- Compressor packs or racks which include compressors only, with no condenser

Larger capacity units:

From January 1, 2014 onwards, the following parameters shall be reported in the product documentation accompanying remote condensing units falling into the scope of the present Regulation which have higher cooling capacity than 5kW and 2kW for medium and low operating temperatures respectively:

- SEPR, rounded to two decimal places, and corresponding cooling capacities and power inputs at all reference points A, B, C and D, expressed in kW and rounded to three decimal places

Higher ambient temperature units:

January 1, 2014 onwards, the following parameters shall be reported in the product documentation accompanying remote condensing units falling into the scope of the present Regulation which are intended to be useable in ambient conditions above +35°C:

- COP at full load and +43°C ambient temperature, rounded to two decimal places, and corresponding cooling capacity and power input, expressed in kW and rounded to three decimal places

In feedback from the stakeholder consultation, all but one agreed that the information requirements were reasonable and appropriate, some also supporting addition of peak load COP as well as seasonal efficiencies.

Chillers

The **mandatory information requirements** are:

From January 1, 2014 onwards, the following parameters shall be reported in the product documentation for refrigeration process chillers (:

- Intended operating temperature(s), expressed in °C
- COP at full load and +35°C ambient temperature (air cooled) / +30°C cooling liquid temperature (water cooled), and corresponding cooling capacity and power input expressed in kW, with rating temperature of test liquid
- SEPR and corresponding cooling capacities and power inputs at all reference points A, B, C and D, expressed in kW, with rating temperature of test liquid

Note that COP is retained in the information requirements despite the introduction of SEPR. This is because full load performance information is also of value to designers, particularly as industrial process chillers are often used at or close to full load for a significant proportion of time. This was a specific request of a number of consultation respondents.

Annex IV: Data Sources and Modelling

Condensing Units

The data used in this IA can be divided into two categories: those about the efficiency profile of the products, and those about their stock and sales numbers.

From the point of view of the stock and sales numbers, this IA relies mostly on the data used in the preparatory study (Table 2-14), available at http://ecofreezercom.org, which were extrapolated up to the EU 27 from estimates for France contained in a commercially produced British building services research report. This is undoubtedly the most significant source of uncertainty in the estimates of energy consumption and savings potential for this product impact assessment. Uncertainty is compounded as the scale up factor is that the French market accounts for 12.6% of EU 27 market, which in turn is based on manufacturer estimates for retail display cabinets and vending machines. It is unknown whether this would result in an over or under-estimate, nor of the magnitude of uncertainty. The estimate has been then slightly inflated to account for industrial application units which were not included in the preparatory study totals (Preparatory study source was quoted as commercial units only, and it is estimated that industrial products account for 10% of the overall total of stock and sales).

From the point of view of the efficiency profile of the products, the data from the preparatory study has been found unfit for use in this IA for two reasons: first, having been derived from producers' brochures, there was no assurance that they were comparable; second, they were limited only to the COP, a metric that does not reflect real-life usage. Therefore, the IA is based on the dataset provided by ASERCOM, the international industry association for manufacturers of compressors and condensing units, via the joint industry expert group (JIEG). The dataset was accumulated from publicly available information on products from 5 major suppliers who are members of ASERCOM. ASERCOM has confirmed that the data collected are representative for the product offering of the suppliers and no products were deliberately omitted. The data are anonymous and include cooling capacity and COP and also a sub-set with cooling capacity and SEPR. Count of products included is shown in Table 2. No firm statistics are available, but these products probably account for around 50% of the market, given that they are sourced from the major suppliers but many smaller suppliers and importers are not included. It should be noted that the data has been then revised following the indications emerged during the stakeholders' consultations. The following table illustrates the data set used.

Table 27. Count of products included in the ASERCOM / JIEG data set, and in the preparatory study dataset for comparison.

	Count of products included in JIEG data set	Count of products included in Preparatory study data set
Medium Temperature 0.2 to 1kW	67	361
Medium Temperature 1 to 5kW	114	
Medium Temperature 5 to 20kW	108	
Medium Temperature 20 to 50kW	44	
Total	**333**	
Low Temperature 0.1 to 0.4kW	36	164
Low Temperature 0.4 to 2kW	61	
Low Temperature 2 to 8kW	49	
Low Temperature 8 to 20kW	30	
Total	**176**	
Grand total	**509**	**525**

Chillers

The same situation as in the case of CUs applies to chillers: the data about stock and sales numbers also come from the preparatory study, while those about the energy performance of the products were provided by ASERCOM, the international industry association for manufacturers of compressors and condensing units, via the joint industry expert group (JIEG), and then revised following the result of the consultation process and the opinion of the contractor to the IA.

Annex V

Calculation of testing, CE marking, and technical documentation costs

Condensing Units

Cost of testing

Estimated costs for testing to generate the information for the mandatory information requirements and to ensure compliance with the minimum performance requirements ranged from €5,000 for a 1kW unit up to €12,000 plus cost of product for an 18kW unit, with 3 man days as the estimated time taken to carry out the testing in in-house facilities.

In the stakeholder consultation, estimated costs of carrying out a product test were mostly supported; of the objections, one thought they were too low one thought too high. One suggested that calculation methodologies must be used instead of physical testing for many products in order to reduce the total cost, estimating its own testing costs for 194 representative models at €1.6 million.

An average cost of a test of €10.000 is assumed for all sizes, including cost of product. This assumes that manufacturers produce a range of small to large capacity units and so costs will average out over those needing SEPR and those only needing COP.

The range of testing facilities available to manufacturers, and so the cost of testing, varies significantly between different manufacturers and so the accuracy of this analysis is further reduced.

The proposed requirements result in the following impacts to cost of testing:

- The number of tests and complexity of analysis is increased due to the move from full load COP single measurement to the 4 measurements required to calculate the seasonal efficiency. Making four measurements does not equate to 4 times the testing cost since the majority of costs and time are for the product set up and dismantling; an increase of 20% is assumed for the purposes of this analysis.
- The number of products required to be tested will probably increase due to the need for increased robustness of data and regulatory accountability. Product testing is required anyway for characterising performance for product selection, but much use is made of calculation to date – more will have to be based on real testing in future. This increase it has been estimated at around 40% more tests than prior to the regulation.
- The nature of tests and the equipment required to carry them out remain identical before and after the proposed regulations. It is arguable that additional test facilities may be required due to the additional tests per product, but the availability of extensive calculation and mathematical modelling methods mean that manufacturers have a short term alternative whilst a test program proceeds and there should be no shock investment required. This approach can also ensure that performance data can be developed at reasonable cost (i.e. without testing) for most products sold in very small numbers.

Testing is not required for every model in a family as extensive use is made of mathematical modelling of performance. The following assumptions are made:

- Main manufacturers have between 10 and 30 families of applicable product (small producers would have perhaps 5) – assume average of 20

- Each family contains 5 to 20 product variants - assume 12 average
- Testing is required on 20% of variants within each family, with the remainder covered through extrapolation or calculation from the tested results
- If testing is required once every 3 years, then 33% of the total testing is required in each year.

Thus under the base case (prior to the proposed regulations), the average number of tests per year for a typical manufacturer might be:

(20 families x 20% of 12 variants) x 33% each year = 16 tests per year

Total current costs per manufacturer and for the sector for current testing might be:

- Assuming a typical €10,000 per test, total cost of around €160,000 per year per major manufacturer
- The preparatory study identified 12 major manufacturers in Europe (Table 2-16 in the preparatory study task 2 report) with costs of €160,000 each; to which might be added 40 smaller companies with costs half this size, or €80,000 each. This indicates an annual cost to the industry for standard testing of around €5.1 million.
- For context, this is equivalent to around 0.5% of the value of 2008 EU sales (based on product prices quoted in table 10, with EU sales valued at €1,100 million).

According to the numbers above, the *net* effect of this regulation might add 20% to the cost of each test and result in 40% more tests being carried out per year. The net impact is therefore €5.1 million x 20% x 1.4 = €1.5 million to the sector, or about 0.13% of the €1,100 million value of annual EU sales.

Other administrative compliance costs

The potential administrative compliance costs to manufacturers associated with the proposed regulation comprise:

- Costs of revising product information for users to include the mandatory information requirements;
- Costs of changes to CE labels; and
- Costs of undergoing compliance inspection and monitoring by public authorities

Some of these tasks may previously have been carried out on a voluntary basis by manufacturers (in discussions there seemed to be some manufacturers who did not CE mark the product as it is not a completed product and only a component – this is seen as an error anyway and all condensing units would certainly have to be CE marked in future). The additional costs outlined below are therefore a worst case estimate of the additional administrative burden.

The aim of this calculation is to cover technical analysis only in revising the claimed product performance data to the new metrics. Technical analysis will be incurred on all products that are tested, plus perhaps half of the remaining variants (total around 60%) as some variations do not affect energy performance:

- Number of products to be analysed is 60% of 12 variants for 20 families or 144 products
- Allowing 2 days per product at €300 per day
- Details must be established over a period of 1 year from availability of the test method (early 2013) to start of information requirements (January 2014).

This implies a one-off cost for major companies of 144 x 2 x 300 = €86,400 per manufacturer or €1.04 million in total and 72 x 2 x 300 = €43,200 per manufacturer or €1.73 million in total for the 40 smaller companies with half the product range. Costs of preparation of technical literature are therefore €2.77 million for the EU industry as a whole.

Most condensing units are already CE marked. Additional CE marking costs are incurred to update the information, and edit the data associated with each product:

- Since the same changes occur to all products, there would be a one-off fixed cost for preparing a new metal label stamp to label products, plus associated documentation, suggested at €1,500 per manufacturer and so €78,000 across the EU (52 manufacturers).
- There would then be a cost of €0,5 per product sold to affix the amended CE label; total product sales are approximately 631,000 per year (2008, Table 3), giving a total cost of around €316,000 across the EU. This cost would only apply to products requiring re-labelling. New products manufactured after the label had been revised would not incur additional costs.

As the information requirements and minimum performance requirements are now mandatory, we assume that there will be additional inspection and enforcement by the regulatory authorities to ensure compliance. This will result in costs for manufacturers in preparing for and undergoing inspections. Assuming that:

- each manufacturer will be inspected once every five years
- preparation for and undergoing inspection will require 5 days at €300 per day (€1,500)

This implies an annual cost of 52 x 0.2 x1,500 = c. €15,600

Chillers

Cost of testing

Estimated costs for testing to generate the information for the mandatory information requirements and to ensure compliance with the minimum performance requirements ranged from €7,000 for a single low capacity (say 100kW) unit up to €18,000 for a high capacity unit (say 800kW), with 5 man days and 3 man days as estimated time taken to carry out the testing in in-house facilities.

The range of testing facilities available to manufacturers, and so the cost of testing, varies significantly between different manufacturers and so the accuracy of this analysis is further reduced: two of the seven manufacturer respondents to the stakeholder questionnaire have in-house test facilities, one for up to 1,400 kW and one up to 8,000 kW. These two would need to test products up to 130 kW and 900 kW respectively for these regulatory measures. A third respondent would require testing for products up to only 35 kW capacity which would require lower costs per product.

The proposed requirements result in the following impacts to cost of testing:

- The number of tests and complexity of analysis is increased due to the move from full load COP single measurement to the 4 measurements required to calculate the seasonal efficiency. Making four measurements does not equate to 4 times the testing cost since the majority of costs and time are for the product set up and dismantling; an increase of 20% is assumed for the purposes of this analysis.
- The number of products required to be tested will probably increase due to the need for increased robustness of data and regulatory accountability. Since product testing is required anyway for characterising performance for product selection, this increase it has been estimated at no more than 25% more tests than prior to the regulation.
- Industrial process chiller models tend to have a fairly long period of sales without major redesign, the market does not move quickly and so repetition of testing is unlikely to be required in less than 5 years for any given model. The new regulation should serve to accelerate innovation and so result in a slightly shorter product life-cycle. The effect of this has not been quantified.
- The nature of tests and the equipment required to carry them out remain identical before and after the proposed regulations. It is arguable that additional test facilities may be required due to the additional tests per product, but the availability of extensive calculation and mathematical modelling methods mean that manufacturers have a short term alternative whilst a test program proceeds and there should be no shock investment required. This approach can also ensure that performance data can be developed at reasonable cost (i.e. without testing) for most products sold in very small numbers.

Testing is not required for every model in a family as extensive use is made of mathematical modelling of performance. Considering only low and medium temperature chillers, the following assumptions are made:

- Manufacturers have between 5 and 20 families of applicable product - assume 12 average
- Each family contains 20 to 40 product variants - assume 30 average
- Testing is required on 20% of variants within each family, with the remainder covered through extrapolation or calculation from the tested results
- If testing is required once every 5 years, then 20% of the total testing is required in each year.

And so prior to these regulations, the average number of tests per year for a typical manufacturer might be:

(12 families x 20% of 30 variants) x 20% each year = 15 tests per year

So total costs per manufacturer and for the sector for current testing might be:

- Assuming a typical €10,000 per test, total cost of around €150,000 per year per major manufacturer
- The preparatory study identified 20 major manufacturers in Europe (Table 2-16 in the preparatory study task 2 report) which might indicate an annual cost to the industry for standard testing of around €3 million.
- For context, this is equivalent to around 0.75% of the value of EU sales (based on sales and product price quoted in Table 12, Table 13 and Table 24 which imply EU sales value of €400 million LT & MT only).

Effect of this regulation: according to the numbers above, the effect of this regulation might add 20% to the cost of each test and result in 25% more tests being carried out per year. The net impact is therefore €3 million x 20% x 1.25 = €0.75 million to the sector, or about 0.2% of the €400 million value of annual EU sales.

Other administrative compliance costs

The potential administrative burdens to manufacturers associated with the imposition of information requirements comprise:

- Costs of revising product information for users to include the mandatory information requirements;
- Costs of changes to CE labels; and
- Costs of undergoing compliance inspection and monitoring by public authorities

Some of these tasks may previously have been carried out on a voluntary basis by manufacturers; the additional costs outlined below are therefore a worst case estimate of the additional administrative burden.

Two out of four manufacturer respondents to the stakeholder consultation agreed that revising product information would cost around €4,000 for each product for analysis and preparation; around €1,500 for changes to CE marking; and with no cost for changes to advertising and customer communications (this would be done when other changes are required anyway). One respondent disagreed stating that:

"*Cost of documentation is much more than €4k taking into account multiple documents and multiple languages it can reach depending on the case 8 to 10 times the amount proposed. Changes to advertising in customer communications is not zero, manufacturers may have to reconsider completely the message(s) and promises*".

This was the only such claim amongst the few replies and much of the cost of producing publicity can be offset if update occurs at the time of other necessary updates happening for other reasons. This comment is therefore set aside. But the costs are analysed in more detail below, as inadequate details were previously established to explain and justify those figures.

The aim of this calculation is to cover technical analysis only in revising the claimed product performance data to the new metrics. Technical analysis will be incurred on all products that are tested, plus perhaps half of the remaining variants (total 60%) as some variations do not affect energy performance:

- Number of products to be analysed is 60% of 30 variants for 12 families or 216 products
- Allowing 2 days per product at €300 per day
- Details must be established over a period of 1 year from availability of the test method (early 2013) to start of information requirements (January 2014).

This implies a one-off cost of 216 x 2 x 300 = c.€130,000 per manufacturer, or €2.6 million for the EU industry as a whole (20 manufacturers) for technical performance information analysis.

Chillers are already CE marked. Additional CE marking costs are incurred to update the information, and edit the data associated with each product:

- Since the same changes occur to all products, there would be one-off fixed cost for preparing a new metal label stamp to label products, plus associated documentation, suggested at €1.500 per manufacturer and so €30,000 across the EU.
- There would then be a cost of €0.5 per product sold to affix the amended CE label; total product sales are approximately 6,920 per year (LT and MT only, 2011, Table 23), giving a total cost of around €3,500 across the EU. This cost would only apply to products requiring re-labelling. New products manufactured after the label had been revised would not incur additional costs.

As the information requirements and minimum performance requirements are now mandatory, we assume that there will be additional inspection and enforcement by the regulatory authorities to ensure compliance. This will result in costs for manufacturers in preparing for and undergoing inspections. Assuming that:

- each manufacturer will be inspected once every five years
- preparation for and undergoing inspection will require 5 days at €300 per day (€1,500)

This implies an annual cost of 20 x 0.2 x 1,500 = c. €6,000 across the EU

High Temperature Chillers

The cost of testing for HT chillers is assumed to be similar to the costs of testing MT and LT chillers, with totals approximately proportional to the relative sales. The ratio of HT chiller sales to MT/LT sales is 4:1 (27,700: 6,900). Therefore costs of testing for HT plus MT and LT will be around (4 x €0.75 million) + €0.75 million = €3.75 million. Similarly, for other administrative burdens, the total cost for HT, MT and LT would imply a one-off average cost of (5 x €130,000) = €650,000 per manufacturer, or €13 million for the EU industry as a whole (20 manufacturers) for technical performance information analysis. CE marking would cause costs of €1,500 per manufacturer and so €30,000 across the EU regardless of sales, plus €0,5 per product sold to affix the amended CE label; total product sales are approximately 34,600 per year, giving a total cost of around €18,000 across the EU. This cost would only apply to products requiring re-labelling. Costs of inspection would be identical (same number of inspections regardless of quantity of products sold), i.e. annual cost of c. €6,000. These costs are summarised in Table 18.

Annex VI

Assessment of the relative stringency of requirements: Condensing Units

Statistics to assess relative stringency of Tiers by each capacity category.

	COP or SEPR applicable	2011 Average COP or SEPR	2011 Best COP or SEPR	Average COP / SEPR after Tier 1	% of JIE dataset removed by Tier 1	% rise in average COP/SEPR from base case as a result of Tier 1	Average COP / SEPR after Tier 2	% of JIEG dataset removed by Tier 1 and Tier 2	% rise in average COP / SEPR from base case as a result of Tier 2	2011 average DIVIDED BY 2011 BAT COP / SEPR
MT 0.2 to 1kW	COP	1.42	1.86	1.43	4%	1.0%	1.57	54%	10.3%	76%
MT 1 to 5kW	COP	1.64	2.28	1.66	6%	1.4%	1.76	45%	7.2%	72%
MT 5 to 20kW	SEPR	2.64	3.60	2.73	6%	3.2%	2.88	35%	9.0%	73%
MT 20 to 50kW	SEPR	2.71	3.50	2.81	9%	3.9%	2.94	36%	8.8%	77%
MT 0.1 to 0.4kW	COP	0.80	1.00	0.85	19%	5.7%	0.87	36%	8.4%	80%
MT 0.4 to 2kW	COP	0.95	1.30	1.04	15%	9.1%	1.07	28%	12.1%	73%
MT	SEPR	1.46	1.97	1.68	6%	15.1%	1.72	29%	18.1%	74%

[30] Calculated from 'sales x AEC' for each category, then calculate proportion of each to the total.

2 to 8kW										
MT 8 to 20kW	SEPR	1.61	1.98	1.73	10%	7.6%	1.78	43%	10.5%	81%
Comments					Significant Tier 1 impact on LT smaller products, but low on others.			Biggest impact on MT smaller products, less so on LT smaller	Fairly wide spread – 7% to 18%.	Indicates scope for improveme nt not much difference between categories

Assessment of the relative stringency of requirements: Chillers, air cooled

Statistics to assess relative stringency of Tiers by each capacity category.

AIR COOLED CHILLERS	Market average SEPR 2011	BAT SEPR 2011	Tier 1 SEPR	Market average SEPR after Tier 1	Tier 2 SEPR	Market average SEPR after Tier 2	Base case / BAT as %	Tier 1 MEPS / BAT as %	Tier 2 MEPS / BAT as %	Tier 1 MEPS / 2011 Average as %	Tier 2 MEPS / 2011 average as %	Comment on apparent internal consistency of Tiers and performance data
High temp <300 kW (note: data is speculative for HT chillers)	3.10	3.70	*2.48*	3.18	*2.85*	3.36	84 %	67%	77%	80%	92%	***Hypothetical only.*** Comfortable. Numbers fit - could be more stringent ?

High temp >300 kW (note: data is speculative for HT chillers)	3.40	3.80	*2.72*	3.49	*3.13*	3.69	89 %	72%	82%	80%	92%	***Hypothetical only.*** T2 average close to 2011 BAT
Medium temp <300 kW	2.70	3.40	2.24	2.76	2.58	2.93	79 %	66%	76%	83%	96%	Comfortable. Numbers fit - could be more stringent ?
Medium temp >300 kW	3.00	3.70	2.8	3.03	3.22	3.24	81 %	76%	87%	93%	107 %	Tier 1 MEPS already move close to market average; T2 MEPS above 2011 average.
Low temp <200 kW	1.59	1.90	1.48	1.60	1.7	1.71	84 %	78%	89%	93%	107 %	Tier 1 MEPS already move close to market average; T2 MEPS just above 2011 average.
Low temp >200 kW	1.70	1.95	1.6	1.71	1.84	1.83	87 %	82%	94%	94%	108 %	T2 average very close to

												BAT

EN

EN

Assessment of the relative stringency of requirements: Chillers, water cooled

Statistics to assess relative stringency of Tiers by each capacity category.

WATER COOLED CHILLERS	Market average SEPR 2011	BAT SEPR 2011	Tier 1 SEPR	Market average SEPR after Tier 1	Tier 2 SEPR	Market average SEPR after Tier 2	Base case / BAT as %	Tier 1 MEPS / BAT as %	Tier 2 MEPS / BAT as %	Tier 1 MEPS / 2011 Average as %	Tier 2 MEPS / 2011 average as %	Comment on apparent internal consistency of Tiers and performance data
High temp <300 kW (note: data is speculative for HT chillers)	5.50	6.70	*4.4*	5.64	*5.06*	5.97	82 %	66%	76%	80%	92%	**Hypothetical only.** Comfortable. Numbers fit - could be more stringent?
High temp >300 kW (note: data is speculative for HT chillers)	5.90	7.00	*4.72*	6.05	*5.43*	6.40	84 %	67%	78%	80%	92%	**Hypothetical only.** T2 average close to BAT
Medium temp <300 kW	3.60	4.30	2.86	3.69	3.29	3.91	84 %	67%	77%	79%	91%	Comfortable. Numbers fit - could be more stringent?
Medium temp >300 kW	3.90	4.50	3.8	3.91	4.37	4.20	87 %	84%	97%	97%	112 %	Tier 1 MEPS

												already almost at market average; T2 MEPS far above 2011 average. Very large movement of 2011 average required to achieve these figures.
Low temp <200 kW	2.00	2.30	1.82	2.02	2.09	2.16	87%	79%	91%	91%	105%	T2 average very close to BAT
Low temp >200 kW	2.25	2.70	2.1	2.27	2.42	2.43	83%	78%	90%	93%	108%	T2 average close to BAT

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PART 2/2

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 professional refrigerated storage cabinets, blast cabinets, condensing units and process chillers

{C(2015) 2881 final}
{SWD(2015) 96 final}

Acronym List

AEC	Annual Energy Consumption
B2B	Business to Business
B2C	Business to Consumer
CECED*	Conseil Européen de la Construction d'appareils Domestiques (European Committee of Domestic Equipment Manufacturers)
CEN	Comité Européen de Normalisation (European Committee for Standardization)
CEN TC44 WG2	CEN Technical Committee 44 Working Group 2
COP	Coefficient Of Performance
EFCEM	European Federation of Catering Equipment Manufacturers
EEI	Energy Efficiency Index
ENEA*	Ente per le Nuove tecnologie, l'Energia e l'Ambiente (National Agency for new technologies, Energy and Environment)
GWP	Global Warming Potential
HC	Hydro Carbons
HFC	Hydro Fluoro Carbons
MEPS	Minimum Energy Performance Standards
MS	Member State
SAEC	Standard Annual Energy Consumption
SEPR	Seasonal Energy Performance Ratio
SME	Small and Medium-sized Enterprise
TWh	Terawatt hour
TEWI	Total Equivalent Warming Impact

* The current name does correspond anymore to the initials which formed the acronym in the past

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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying document to the

Draft Commission Regulation implementing Directive 2009/125/EC of the European Parliament and of the Council and Directive 2010/30/EU of the European Parliament and of the Council with regard to ecodesign requirements for professional storage cabinets and blast cabinets

Lead DG: ENTR

Associated DG: ENER

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

Agenda planning or WP reference: 2012/ENTR/025

1. Policy Context

The Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the Commission to set ecodesign requirements for energy-related products[1] (hereafter referred to as the Ecodesign Directive) is to be implemented by the European Commission through regulations dealing with the product groups identified by the Ecodesign Working Plans. The Ecodesign Working Plan for 2009-2011[2] identified "refrigerating and freezing equipment" as one of the ten priority product groups. DG Enterprise explored, within this group, the possibility of setting Ecodesign requirements on the category of professional refrigeration, which includes five products: professional storage cabinets, blast cabinets, condensing units, industrial process chillers and walk-in cold rooms. Following the usual practice in Ecodesign regulations, also the possibility of introducing a labelling system under the Energy Labelling Directive (2010/30/EU) of the European Parliament and of the Council has been explored.

The impact of different options of the regulations that might cover the five products belonging to the professional refrigeration group have been analysed in three reports. These reports are consistent, having been developed in parallel, and can therefore be read as a single one; they are kept separate mainly for readability. Two reports cover two products each: professional storage cabinets and blast cabinets in one case, condensing units and industrial process chillers in the other. The reason for their merging is to be found in the strong similarities in terms of user profile, technology, and market conditions. The fifth product, walk-in cold rooms, has been kept separate because of its unique characteristics within the group.

This report covers professional storage cabinets (from now on referred to simply as storage cabinets) and blast cabinets. A professional storage cabinet is a product very similar to household fridges or freezers, but built for being able to withstand the much more demanding conditions (higher temperature and humidity, more frequent openings) of a professional

[1] OJ L 285, 31.10.2009.
[2] COM (2008) 660

environment such as, for example, the kitchen of a restaurant. A blast cabinet is meant to rapidly cool down cooked food, which is then stored elsewhere, thereby making it possible to conserve it longer and with a better quality. Both products are affected not only by the performance requirements required by users, but also by food safety rules.

2. Procedural issues and consultation of interested parties

2.1. Organisation and timing

No ecodesign requirements within the framework of the Ecodesign Directive have so far been set on these products.

A preparatory study[3] was carried out from December 2008 to November 2010. It provided the European Commission with technical background supporting the design of eco-design requirements following the methodology defined in Annex I and II of the Ecodesign Directive.

The impact assessment was launched in February 2012 and supported by an Interservice Steering Group including CLIMA, COMP, ECFIN, ENTR, ENV, INFSO, LS, MARKT, RTD, SANCO, SG, TRADE. The ISG met on February the 23, July the 5th, November the 7th and assisted during all critical steps of the impact assessment, namely: drafting of the working document for stakeholder consultation and design of the impact assessment and policy options.

An Impact Assessment study for each of the five products falling in the category of professional refrigeration was carried out from March 2012 to October 2012 to provide the European Commission with technical background supporting an eventual eco-design regulation.

2.2. Impact Assessment Board

[*Section to be completed further to the IAB meeting*].

2.3. Transparency of the consultation process

The opinion of stakeholders was already gathered throughout the process through numerous bilateral meetings and the Consultation Forum provided for in the Ecodesign Directive. The preparatory study consulted manufacturers in three stakeholder meetings and registered stakeholders were granted access to the documents available on the project website http://ecofreezercom.org

The following consultations were then held during the impact assessment process (more information about type of consultation, participants and topics is available in Annex I):

- The Ecodesign Consultation Forum, set up in accordance with Article 18 of the Ecodesign Directive, was consulted on 19 January 2012 with the participation of Member States, consumer organisations, environmental NGOs and the manufacturers represented by CECED (Conseil Européen de la Construction d'appareils Domestiques). The working document presenting the policy options was sent one month in advance of the meeting. All replies to the working document as well as the minutes of the meeting are available on the CIRCA website. The minutes of the Consultation Forum are also available in Annex I.

[3] Preparatory Study for Eco-design Requirements of EuPs, Lot 1 Refrigerating and freezing equipment. Available on: http://ecofreezercom.org

- An SME consultation to collect feedback on the proposed regulation, its modifications following the Consultation Forum and its impacts was held through the European Enterprise Network from 30 March to 21 May 2012 for blast cabinets and from 4 June to 16 July 2012 for storage cabinets.
- A stakeholder consultation to collect feedback on the proposed regulation, its modifications following the Consultation Forum and its impacts was held from 4 April to 10 May 2012 for blast cabinets and from 21 June to 20 July 2012 for storage cabinets.
- Additional meetings were held to identify key issues of concern, discuss data analysis process, label thresholds and options, and finally to review the proposals; details are available in Annex I.

2.4. Outcome of the consultation process

Member States largely agreed with the introduction of regulatory measures for storage and blast cabinets, collaborated in the definition of a shared methodology, and some provided useful data from national schemes already in place and explained the relevant national regulations. However, they differed in the suggested level of requirements, largely reflecting different average efficiency levels in their home markets; a few MSs also called for the adoption of incentives for climate-friendly low GWP (Global Warming Potential) gases as refrigerants.

Environmental NGOs were generally supportive of the measures, but also stated their support for more stringent requirements and underlined that the use of low GWP refrigerants should be incentivised. Furthermore, they supported the adoption of Ecodesign requirements also for blast cabinets, since their sales numbers are growing among others because of the movement towards more stringent food safety laws. Lastly, they also called for the introduction of noise requirements[4] for professional fridges similar to those in place for domestic fridges.

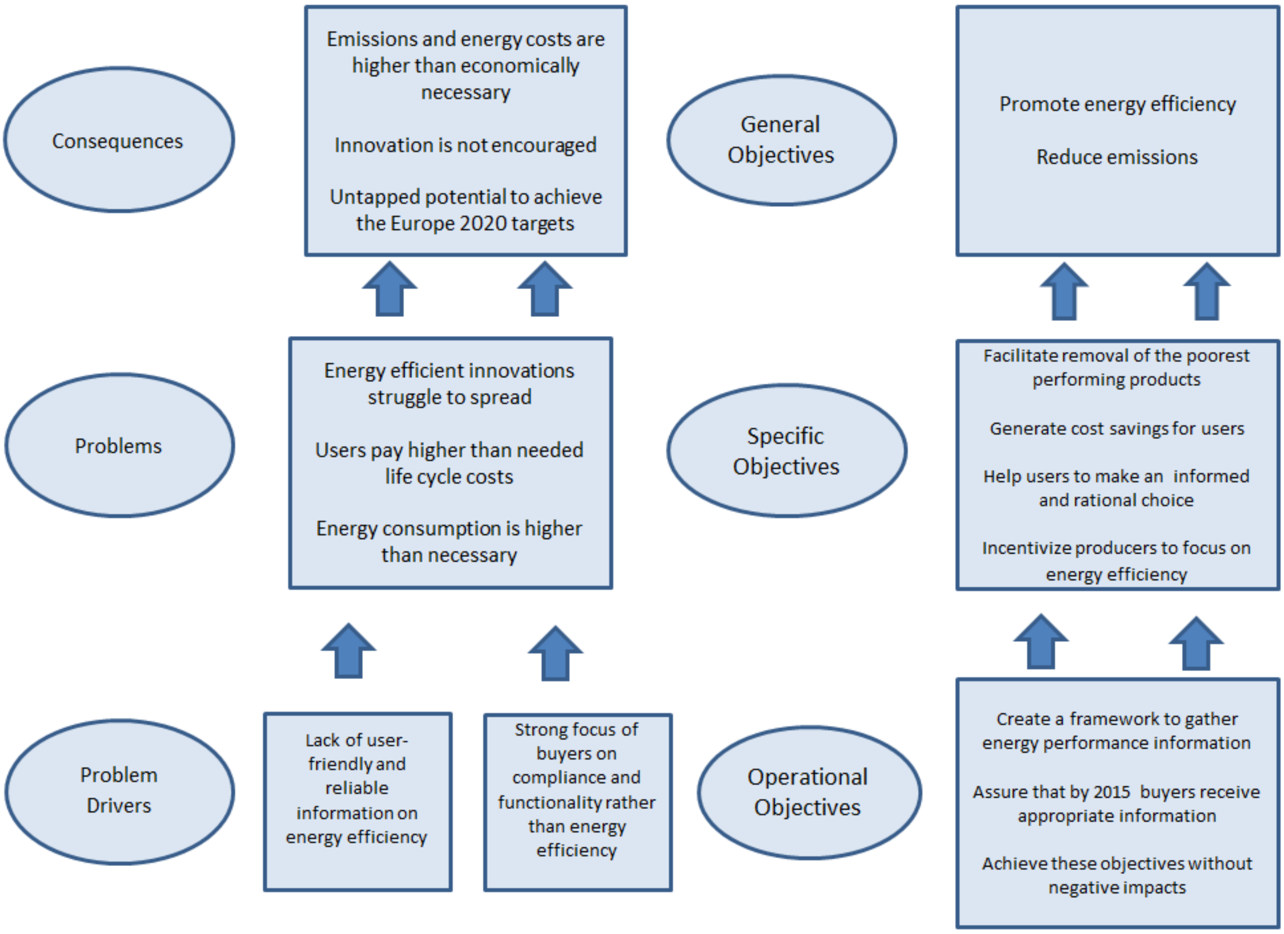
The consultation with the **industry** (both associations and individual companies), gave a substantial contribution to the impact assessment. In particular, it confirmed the major issues to be overcome. In the case of blast cabinets the industry stressed that, despite their technical similarities with storage cabinets, regulatory options were drastically limited as long as a widely shared methodology and the data originating from it are lacking. The consultation process, together with the technical analysis by the impact assessment contractor, highlighted how the data collected in the preparatory study and the policy proposals based on them were not adequate (see details in Annex III). In the case of storage cabinets the numerous meetings held and the consultations helped to better define the product categories (a vital task in such a segmented market; more information in this regard in Annex II), check the reliability of the data and of the assumptions based on them, decide on exclusions and exemptions from the regulation, agree on the test methodology, and identify important issues for SMEs (Small and Medium-sized Enterprises). For the latter, it emerged that the cost of testing was clearly on top of the agenda, and important suggestions were made about how to reduce it. The overall support of the industry increased noticeably thanks to the extensive consultation performed, the consideration of the issues raised, and the inclusion of the data provided by the industry in the data set used for the regulation.

[4] This option has not been investigated further because most stakeholders agreed that it should not be a priority, because these products are used in noisy professional environment,

3. Problem definition

The market for both storage and blast cabinets is driven primarily on purchase price, so that purchase decisions are driven by short-term benefits. This happens despite the fact that both products are bought, rather than by consumers, by professionals who could be better placed to correctly value the trade-offs between purchase price and cost of use. However, most buyers are in fact SMEs with little technical knowledge in the field of energy performance, and, most importantly, they have good reasons not to focus on it. Namely, their priority purchase criteria are rather compliance with food safety rules and functionality. Energy costs, while being significant in aggregate over the product's lifetime, constitute a very small percentage of their total costs, which are usually driven by personnel, rent and ingredients. Moreover, it would cost them substantial amounts of time and effort to acquire the information necessary to compare the energy performance of different products, since there is no easy instrument such as a label to do so. On the contrary, the energy performance information available to users is very limited. Often, and particularly in the case of blast cabinets, manufacturers do not declare any energy consumption information, and even when they do, the absence of an agreed and widely used harmonized methodology to test energy efficiency means that it is not comparable from one manufacturer to another. Consequently, buyers have no means to determine energy efficiency performance levels across the whole market, and thus to estimate the resulting life cycle costs and relative ranking in efficiency of products. This has resulted in limited market penetration of cost-effective energy-saving technologies, with cheap and inefficient products continuing to be a key offering even from manufacturers that also produce significantly more efficient and value-added products. Furthermore, even the existing more efficient products are typically not sold on the basis of their energy efficiency but rather of their associated quality, reliability and, especially in the case of blast cabinets, capacity to meet the national food hygiene regulations. This market situation persists despite the availability of accessible and cost-effective savings that the market does not pursue; indeed, the technology efficiency of the average product available on the market has hardly changed in the last years, as confirmed by most stakeholders, by the researches performed for the preparatory and impact assessment studies, and the slow diffusion of energy-savings technologies (See Section 3.2 and Annex V for more details). The problem tree in Diagram 1 represents graphically the situation, with the addition of the objectives (Described in Chapter 4) of the envisaged regulation that would tackle them.

Diagram 1: Problem Tree



Grounds for a possible implementing measure

According to Article 15(1) of the Ecodesign Directive, a product shall be covered by an implementing measure or self-regulation if the criteria listed in Article 15(2) are met, namely:

(a) the energy using product shall "represent a significant volume of sales and trade, indicatively more than 200 000 units a year";

(b) it shall "have a significant environmental impact within the EU";

(c) it shall "present significant potential for improvement in terms of its environmental impact without entailing excessive costs, taking into account in particular:

  (i) the absence of other relevant EU legislation or failure of market forces to address the issue properly;

  (ii) a wide disparity in the environmental performance of energy using products available on the market with equivalent functionality."

The following paragraphs will verify if and how the criteria listed above are met.

3.1. Baseline scenario

3.1.1. Sales and stock (Article 15(2)(a))

Storage cabinets

The baseline scenario is developed on the basis of the technical definition of the product and the scope of the envisaged regulation reported in Annex II. In less technical terms, storage cabinets are used in commercial kitchens[5] and can be either chilled or freezer cabinets; furthermore, they can be either vertical or counter cabinets. This results in four broad categories. It is important to note that performances can be compared only within them, because of obvious different temperature targets in the case of chilled vs. freezer cabinets, and of a different air infiltration pattern in the case of vertical vs. counter cabinets. Apart from this broad distinction, the consultation process has dealt extensively and effectively with the definition of the product scope of the regulation, the exclusions and exemptions from it, and the methods to deal with particular subcategories of the products. More information at this regard is to also be found in Annex II.

The majority of the market is served by 6 major European manufacturers, according to the research performed for the preparatory study[6], but a substantial minority is made by smaller companies. This situation has been confirmed throughout the consultation process, but precise numbers are regretfully not available. Almost all products are sold rather than leased, and 70% of sales are made directly to end users and 30% via independent distributors. As for all refrigeration products, many thousands of SMEs are involved in supply, installation and maintenance, while the producers of components and refrigerant gases tend to be large multinational companies. Germany, Spain, Italy and the UK account for the majority of EU production, with China, Turkey and South Korea accounting for significant imports according to the research of the preparatory study and supported by stakeholder comments. Regarding trade, it is impossible to separate statistics on import/export of storage cabinets from the much broader categories of refrigeration products included in European PRODCOM and similar statistics, but imports certainly account for at least a significant minority proportion of sales.

This report is based on data originating from the preparatory study (regarding sales and stock numbers, and their evolution) and the impact assessment study (regarding the efficiency profile of the products). Details about both sets of data are given in Annex III. All data used in the tables and the figures of this report are from these two sources, unless explicitly stated otherwise.

Table 1 below summarises the stock and sales of storage cabinets in 2012. It has been assumed that the proportion of stock is equal to the proportion of sales. The long-term trend of the market has been estimated as an annual 0.91% growth, on the basis of recent market trends and projected population growth. EU annual energy consumption was estimated by the impact assessment study through analysis and modeling (also detailed in Annex III) as 8.4 TWh in 2011 from a stock of 3.3 million units with an average life time of 8.5 years.

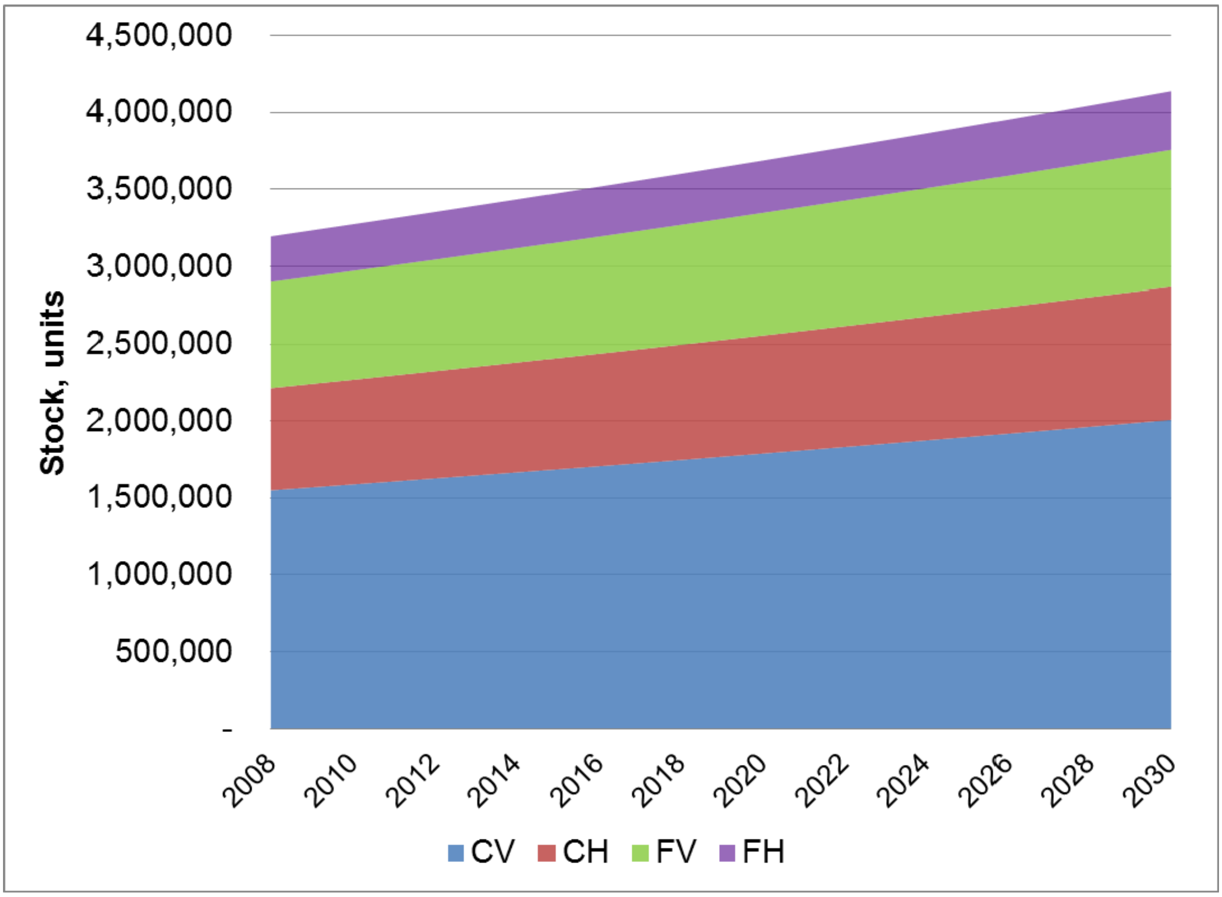
Table 1. Summary of storage cabinets stock, sales and energy consumption in 2012.

	Stock in 2012 (million units)	Stock as %	Annual sales in 2012 (million units)	Sales as %	Stock Annual Energy consumption in 2012 (TWh)	% of annual stock energy consumption
Chilled cabinets	2.32	70%	0.28	70%	4.43	52%
Freezer cabinets	1.03	30%	0.12	30%	4.08	48%
Total	3.35	100%	0.40	100%	8.51	100%

[5] For instance in restaurants, hospitals, canteens (i.e. locations not in direct contact with the public).
[6] Preparatory Study Task 2, Table 2-16, available at http://ecofreezercom.org/

Figure 1 represents the stock growth of each storage cabinet category.

Figure 1. Stock of storage cabinets (C=chilled; F=frozen; H=counter; V=vertical).



Source: based on data from the preparatory study and the IA study as reported in Annex III. All following figures and tables, unless stated otherwise, share these same two sources.

Blast cabinets

A blast cabinet is designed to rapidly cool a batch of cooked food down to chilled or frozen temperatures in a minimum amount of time (technical definitions of product and scope are again to be found in Annex II). They are similar in construction to refrigerated storage cabinets but have larger capacity refrigeration systems and additional fans which circulate cold air around the food to cool it rapidly.

Table 2 represents the EU market situation in 2012, and is based on data from the preparatory study (See Annex III). The sales figure was assumed in the study to grow constantly by 2% a year, which would mean that it would reach about 230,000 by 2020. The higher growth in comparison with storage cabinets is due to this market not being yet fully exploited in most countries, the strong correlation with some growing sectors such as catering, and the consideration of existing trends. However, it is important to note that the market is driven by the requirements set by national food safety regulations, with high sales in countries such as France where such regulations are in place and almost none in those where they are not. Therefore, it is reasonable to assume that the sales figures could increase greatly if additional countries decide to introduce stricter food safety rules that can be met only with a blast cabinet. However, in the absence of concrete plans to introduce such regulations, it is not possible to quantify this effect and therefore it is not included in the outlook.

Table 2. EU27 Blast cabinet market

Types of blast cabinet included	Estimated stock - Total (units, 2012)	Estimated sales (units, 2012)
All types:- Freezer and chilled; remote and integral; reach-in, trolley and pass-through.	1,479,000	198,000

Concluding, the criteria set by Article 15(2) (a) of the Ecodesign Directive are clearly met in the case of both products, since the sales numbers are clearly above the threshold for storage cabinets, and while they are very slightly below it for the blast cabinets, they are set to pass it already in 2013.

3.1.2. Environmental Impacts (Article 15(2)(b))

The IA analysis focuses on the use phase of the products because it is the dominant one in terms of impacts and other life cycle phases fall out of the scope of the proposed regulation. For instance, the end-of-life phase is generally addressed in the Waste of Electrical and Electronic Equipment Directive 2002/96/CE (WEEE Directive). Within the use phase, the main environmental impact of both products consists in their contribution to global warming caused by the leakage of refrigerant gases and above all the emissions caused by the production of the electricity used.

In the case of storage cabinets the energy consumption[7] has been foreseen to develop as shown in Figure 2. The baseline scenario is based on the assumption that without additional policies, efficiency levels remain constant despite the availability of better products. This has indeed been the case in the last years for the EU market as a whole, with energy-efficient improvements struggling to be widely adopted because competition focuses mostly on prices. The result is a noticeable increase in total energy consumption, which is set to surpass 10 TWh in 2030.

The contribution of the energy use by storage cabinets to global warming is depicted in Figure 3, where energy consumption is converted into TEWI (Total Equivalent Warming Impact), expressed in million tonnes CO_2 equivalent. The translation of electricity use into global warming effects is explained in Annex IV. Also the refrigerant gases used in storage and blast cabinets have a global warming effect when they are leaked into the atmosphere, which varies substantially among the different refrigerants. Figure 3 also presents the TEWI equivalent due to the refrigerant gases leakage in use and at end of life, assuming an average annual leakage rate of 1%, 25% end of life leakage and a refrigerant GWP assumed of 2.349[8]. Energy consumptions accounts for about 95% of the total TEWI emissions, but nevertheless the TEWI increase is less steep than the energy consumption increase, due to the changes foreseen in the energy source mix over the next years (see Annex IV).

In the case of blast cabinets, the consumption figures provided by the preparatory study have been considered to be unreliable, as it had to rely heavily on a limited amount of non-homogeneous data. Namely, manufacturers do not usually publish energy consumption data and when they do, they do so on the basis of an own methodology, so that the results are neither comparable nor possible to normalize (as done for storage cabinets). Therefore, it was neither possible to quantify the energy consumption of the existing blast cabinets stock with an acceptable degree of confidence, nor to project its evolution in the future. Given the similarities among the technical features and the market for blast cabinets and those of storage cabinets, it is reasonable to assume that the energy consumption trends would follow a similar pattern, but it would be very speculative to go beyond such a general assumption. This situation has been confirmed both by the research performed by the contractor for the impact assessment study and by the feedback collected during the stakeholder consultation.

[7] The data shown there are based on the analysis and the calculation performed by the impact assessment study contractor within a separate project (Ecodesign Standardization Project on Refrigerated Storage Cabinets). The data set consisted of about 1,100 products mostly from Italy (judged to be representative of the Southern European market), the UK and Denmark, plus data provided by two suppliers of widespread products. The data were produced through different test methodologies and it has been possible to normalize them and make them comparable. The baseline scenario is built on these normalized data. It is important to note that this data regard only energy performance, not the market (see Annex III)

[8] A GWP of 2.349 means that the amount of heat trapped by a certain mass of such a gas is 2.349 times the amount of heat trapped by a similar mass of carbon dioxide. See Annex VI for more information.

Figure 2. Total energy consumption for storage cabinets stock.

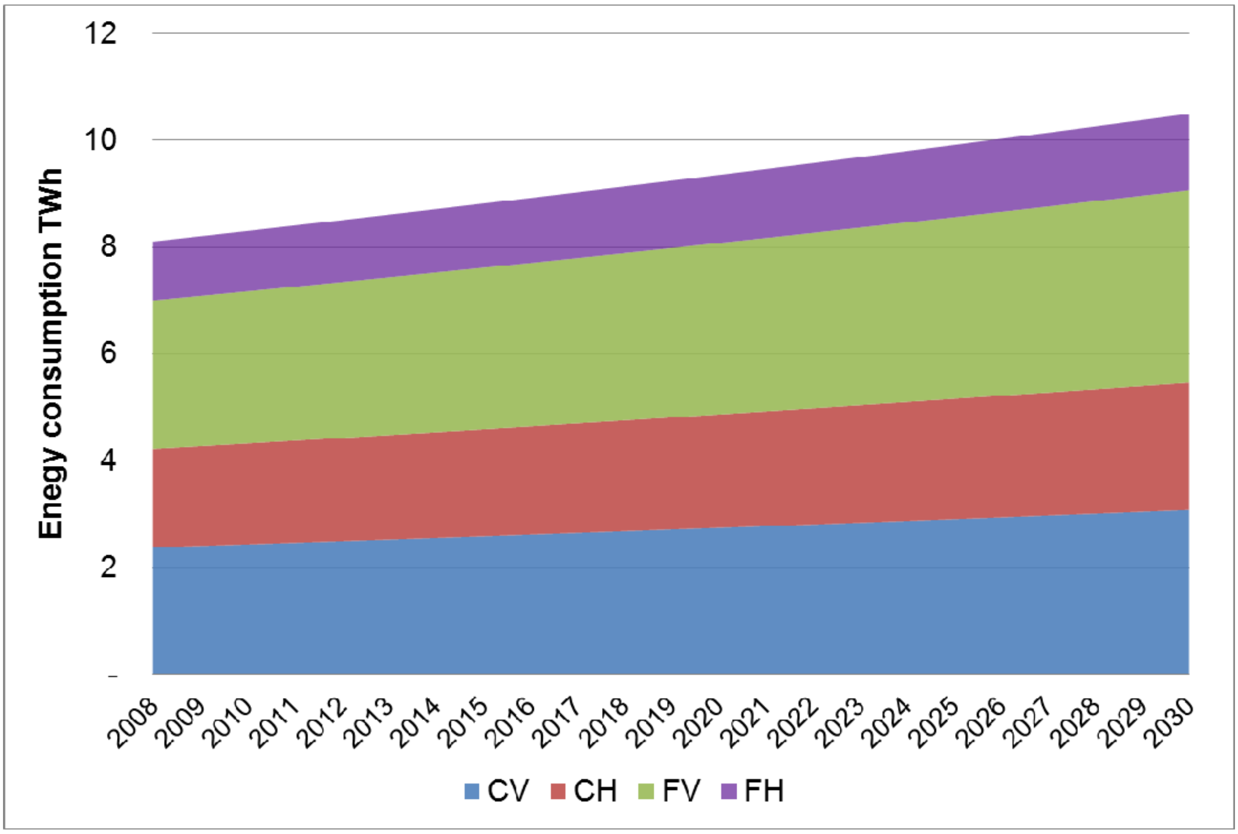
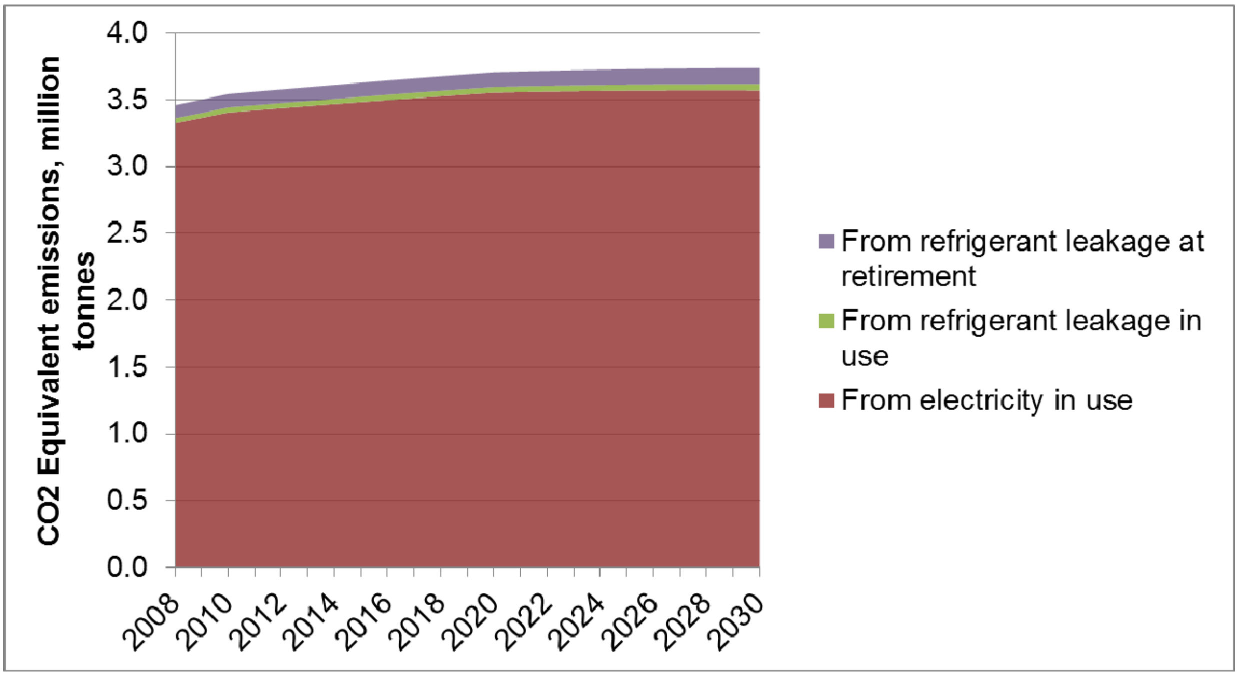


Figure 3. Total storage cabinets CO2 equivalent emissions from energy consumption and direct emissions (refrigerant leakage and end of life).



The global warming impact described and depicted in the figures above clearly indicates, also in comparison with those of other products already subject to ecodesign regulations, that the criteria set by Article 15(2) (b) of the Ecodesign Directive are met.

3.2. Improvement potential (Article 15 (2) (c))

Storage Cabinets

Competent design can significantly increase efficiency from a poor level at minimal cost. A mix of technology improvements (such as high efficiency compressor, electronically commutated fan motors, high-efficiency fan blades, or thicker insulation) which add about 16% to the cost have been estimated in the preparatory study to achieve 43% energy savings and pay back in as little as three months. Best available technology might cost just over double the base case price but pay back in 1 year. However, the very strong competitive focus on prices in the market (due to the market failures described at the beginning of Chapter 3) makes it difficult to achieve these savings.

Blast Cabinets

The situation is similar for blast cabinets**,** since the technologies that can be applied are closely related, and the same can be said of the market. The preparatory study estimated that energy savings of around 35% are cost- effective for all types of blast cabinets through improved features and design. During the consultation process, while the blast cabinet data regarding the average efficiency of the market and the distribution of the products among the different efficiency classes have been contested and sometimes proved wrong, there has been wide agreement that the improvement potential allowed for by the technical solutions described in the preparatory study is indeed realistic, and achievable at a limited cost.

Annex V gives more detailed information about the technological options to improve the energy efficiency of both products.

3.3. Existing legislation and failure of market forces to address the issue (point (i) of Article 15(2) (c)

3.3.1. Existing legislation

No direct regulatory approach to reduce the energy consumption of storage cabinets and blast cabinets has been identified in the EU to date.

Legislation on other environmental aspects

The use of (product related) hazardous substances during the production phase is dealt with by Directive 2002/95/CE on the Restriction of Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS Directive).

The end-of-life phase is addressed in the Waste of Electrical and Electronic Equipment Directive 2002/96/CE (WEEE Directive). The WEEE Directive states that entities responsible for bringing these products into the market are also responsible for adequate take-back and disposal.

These products are also subject to the F-Gas Regulation EC No 842/2006 which does not directly address energy efficiency. Options for directly addressing refrigerant and global warming potential (GWP) issues are discussed in option H and Annex VI.

3.3.2. Voluntary measures

Storage cabinets

Voluntary product endorsement and tax break schemes[9] covering also professional storage cabinets have been introduced in the UK and Denmark. According to the managers of the Danish scheme over 80% of products sold on the Danish market[10] fall now in the scheme, while the British experience is limited to endorsing the better products of certain types and sizes only. Therefore, low price and low efficiency products are still widely available also on the British market; this reduces greatly the impact of the scheme, since most energy savings are to be achieved by removing the worst performing products from the market, rather than by making those already efficient still a little more efficient, as the endorsement of the better products tends to do. More generally, the success of such schemes is due to substantial investments in the form of both effort and finance (in terms of lost revenues) by state authorities, and therefore cannot be easily replicated on a wider scale. The Italian industry association CECED Italia (Conseil Européen de la Construction d'appareils Domestiques, Italian branch) launched a voluntary energy labelling scheme for these cabinets in April 2012. The scheme is too recent to be properly valued, but it appears that only the better performing models tend to be labelled, as confirmed by a major Italian-based manufacturer. Here lies a significant flaw of a voluntary labelling scheme: it may be used as an effective marketing tool for the better performing models, but it does little to improve the overall situation of the market which is heavily influenced by the very low energy performance of the worst products.

Blast cabinets

No voluntary initiative that covers blast cabinets has been identified.

3.3.3. Market failures

As stated in the introduction to Chapter 3, the failure of the market to tackle the problem is due to a lack of functional information for the user and a short-sighted, but comprehensible, focus on the up-front price of the product.

Also the criteria set by Article 15(2) (c) (i) and (ii) of the Ecodesign Directive can thus be considered to be fully met.

3.4. Legal basis for EU action

Article 16 of the Ecodesign Directive provides the legal basis for the Commission to adopt an implementing measure for this product category. The scrutiny of criteria enshrined in Article 15(2) of the Ecodesign Directive performed above shows that storage and blast cabinets qualify for the adoption of an implementing measure setting new ecodesign requirements or self-regulation.

Furthermore, as is the case for all five products in the professional refrigeration group, the problem is undoubtedly transnational due to the significant EU and international trade in these products. Action at EU level is appropriate to ensure free circulation of goods and would also

[9] Under the scheme, the buyer of an energy-efficient cabinet can deduct part of its cost from his or her tax bill.

[10] This estimate was provided by the technical representative (from DTI) of the Danish delegation to the Ecodesign Consultation Forum.

reduce the burden of testing and product development on manufacturers compared with separate measures in various Member States.

The envisaged regulation is fully coherent with other EU policies, and in particular it is to be seen as a contribution to decoupling economic growth from the use of resources, an objective set out in the Europe 2020 strategy (COM(2010) 2020)[11] under the flagship initiative: ‘resource efficient Europe’.

3.5. Conclusion

The analysis performed above clearly indicates that there is a currently missed opportunity of significant energy savings (and consequently reductions in greenhouse gases emissions) to be achieved in this sector; at the same time users currently pay higher than necessary life-cycle costs for operating storage and blast cabinets. Market forces alone are not expected to achieve them due to the characteristics of the market. Therefore, action at EU level seems advisable, and it could give a noticeable contribution to the achievement of the Europe 2020 targets. The following chapters will investigate if and how a well-designed regulatory intervention could achieve this.

4. Objectives

The **general objective** is to develop a policy which corrects the market failures, and which:

– reduces energy consumption and related CO_2 and pollutant emissions.

– promotes energy efficiency hence encouraging innovation and reducing energy dependence and contributing to the EU objective of saving 20% of the EU's energy consumption by 2020.

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

The **specific objectives** are:

– to facilitate removal of the poorest performing products from the market, where their life cycle cost disadvantages have proven insufficient to drive this.

– to help purchasers to make an informed and rational choice based on performance information that reflects real life usage, thereby pushing the market to adopt improved technology solutions.

– To set incentives for producers to further develop and market energy efficient technology and products

– to generate cost savings for end-users.

The **operational objectives** are:

– to develop by 2013 an appropriate metric for energy performance that reflects real life usage.

– to make sure by 2015 that purchasers receive appropriate and understandable performance information and so foster an effective competitive market driven by competition on energy performance.

[11] Available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF

– to create, in the case of blast cabinets, a framework for gathering information about energy performance that can allow for possible subsequent (self-) regulation at a review four years after entry into force.

– to achieve the objectives listed above without 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.

Chapter 5 describes the policy options that have been considered to meet these objectives.

5. Policy options

This Chapter describes the policy options, both discarded and assessed in detail, that have been considered in the context of this impact assessment. It is important to state that the requirements foreseen in both the preparatory study and the working document presented at the Consultation Forum have been substantially changed in view of the reaction of the stakeholders and/or the new data they provided; however, this affected the stringency levels rather than the type of envisaged regulatory actions. Before describing the options, it is appropriate to introduce the important topic of test methodology.

Development of a harmonized test methodology

As explained in Chapter 3, the lack of a harmonized methodology to calculate the energy efficiency of each product is a major obstacle that impedes comparable energy consumption information and thereby the movement of the market for both products towards a more performance-based competition. Namely, even when the energy performance is declared, comparison among different products is difficult for the average informed buyer. The existence of such a methodology is a necessary prerequisite for all following options except A and B, and therefore the establishment of a fair and EU-wide means to measure energy efficiency of both products should be an immediate policy priority; both SME and adhoc consultation replies were unanimous at this regard. While standards can be developed by the standardization bodies at the request of the industry, in case of an Ecodesign regulation it would be the Commission to mandate their development to ensure consistency and clarity, as foreseen by the Ecodesign Directive. The process could be initiated through a CEN mandate in late 2012, with support from manufacturers and the relevant trade associations. In the case of storage cabinets, which allow to work on an existing methodology already applied such as the CECED Italia one, a new harmonized standard is already being developed by CEN TC44 WG2 with the aim of producing a published standard by the end of 2013. The standard will be based on EN ISO 23953-2:2006 with amendments similar to the CECED Italia methodology and a improved and simplified net volume calculation. In the case of blast cabinets[12], the test method can be developed from an existing French test standard. A CEN 'Technical Report'

[12] The creation of a harmonised test methodology will be made much easier by the contribution of the industry: the European Federation of Catering Equipment Manufacturers (EFCEM) has agreed that it will seek to establish through its national association members a blast cabinet energy efficiency working group, representing equipment manufacturers. This group would contribute to the CEN process, and then collect energy consumption data from companies across Europe once the test method is in place in order to generate evidence which will be submitted to the European Commission. It will also help to reduce the testing cost by considering how to use the test results obtained for "representative" models to calculate the energy consumption of other product variants, which are quite common in the blast cabinets market.

(as opposed to a full standard) could be an appropriate route to deliver a workable test methodology within 2 years, probably by early 2015, followed by up to 6 months for manufacturers to familiarise with the method, carry out tests and compare results. Consultation replies strongly favoured allowing 18 months to 2 years to establish the test methodology. Robust performance data can thus be expected to be available by the end of 2015 provided that testing and provision of performance information would become mandatory. The cost of developing such standards is very low, while the cost of testing the products according to their methodology is significant; it is quantified later on, together with other regulatory costs, for each retained option.

Option A: No new EU action

Currently there is no Ecodesign or energy efficiency related EU-level policy in force. If no EU action is taken the problems described in Chapter 3 will persist, and energy consumption is expected to increase as described under the baseline scenario in Section 3.1.2.

The "Business-As-Usual" scenario is based upon this option and provides the reference for the other proposed options and thus the basis on which savings and other impacts are calculated.

Option B: Adoption of existing foreign policy

No policies directly affecting **blast cabinets** are in operation anywhere in the world; consequently this option is not viable for this product.

In the case of **storage cabinets**, mandatory minimum requirements regulations apply in Canada and the USA, plus slightly different mandatory requirements in the state of California. These regulations are very similar in terms of content and aims to the EU Ecodesign regulations; consequently, they have been analysed with a great deal of attention. There are also other schemes in place for these products, such as the US ENERGY STAR program; but they limit themselves to endorse the best performing cabinets, like the UK scheme described in Section 3.3.2., and have therefore much less to offer in terms of content and experience and a much more limited capacity to achieve the objectives of this policy. Therefore, the analysis focused on the Canadian and US regulations based on mandatory requirements. It identified a number of significant differences which mean that they could not be simply adopted for the EU:

a) The US and Canadian regulations are based on test methodologies which are different in many respects from the EN (i.e., developed by the European standardization authorities) test methodologies. It would be difficult to change the methodologies in use just for these products.

b) The various schemes have different levels of stringency which were largely determined by the local markets and specific policy intent of each scheme.

c) Analysis of the relative internal volumes of the datasets shows significant differences with US and Canadian products, which have an average volume larger by an amount between 15% and 100% depending on the product subcategory. This implies that the nature of the markets in different countries is substantially different, thus criteria cannot be considered[13] appropriate for the EU market.

[13] Larger appliances tend, other things being equal, to be more efficient than smaller ones due to their more favourable surface to volume ratio. Setting the same requirements independently from size would encourage to buy larger appliances, which consume less per cubic centimetre, but more in absolute terms. This would defeat

d) Products are defined differently with different nomenclatures and grouping of product types. Whilst best efforts have been made to ensure comparability for this analysis, the US and Canadian schemes cover many more product types than the professional refrigerated storage cabinets that are subject to this EU regulatory proposal.

Hence it would be inappropriate to adopt regulations from the US and Canada for use in the EU market and this option is therefore not a viable possibility; in fact, no stakeholder favoured such an option. Nevertheless, important lessons can and have been learned from them, both on a technical level (for instance, about the correct slope of the functions setting the requirements that can be seen in Figure 10), and more generally about how to best design the regulation and time the entry into force of its requirements.

Option C: Self-Regulation

Storage cabinets

A self-regulation scheme could consist, as in the case of a regulatory one, in the setting of minimum requirements or in the creation of labels. In the first case, producers would commit themselves not to place on the market products below a given efficiency level; in the second, they would test their products and label them according to their performance, so that the users can choose in an easier and more informed way. These sub-options would not be mutually exclusive.

There is no precedent for the first sub-option, the creation of minimum requirements on a voluntary basis. The reason is simple: manufacturers voluntarily withdrawing products would risk losing market share to cheaper alternatives that do not respect the voluntary standards, in particular non-signatories and non-branded products. Furthermore, generating and managing the performance information is costly, which would put producers participating in the scheme at a disadvantage compared to non-participating ones.

The situation is different for the second sub-option, the setting of a voluntary energy labelling scheme. The Italian one by the Italian industry association (CECED Italia) (see Section 3.3.2) proves that this option is viable, since it is drawn from a dataset that is probably representative of the majority of EU products (if without the better performing products found in countries such as the UK and Denmark), and has the support of several major manufacturers at the heart of the European industry association EFCEM. However, a voluntary initiative is unlikely to achieve the objectives of an EU Ecodesign initiative for the following reasons:

i. As it has already been confirmed in discussions with manufacturers at the stakeholder meeting on 28 May 2012, the labelling is applied mainly to the better performing products. The lower price products from the major manufacturers would be much less likely[14] to be given labels under a voluntary initiative. Low cost products from both EU manufacturers and those based outside of Europe would be highly unlikely to carry any labels due to the additional costs. Users would therefore not benefit from a complete picture of the energy efficiency of products and a fully functioning competitive market on energy efficiency could not exist.

the purpose of the regulation. Consequently, formulas are developed to take this into account. These formulas cannot be applied indiscriminately to any market, independently of its characteristic.

[14] This assumption is confirmed by the experience of the CECED Italia labelling scheme, as reported in the development of Option F.

ii. A voluntary scheme could not be policed effectively by the trade association supervising it to ensure that labels in use are accurate. This is due not only to the limited powers and resources it would have in comparison with a public market surveillance authority, but also to the high cost of testing, as well as the proliferation of smaller suppliers and importers which are not members of EU industry associations. The credibility of the labels in the wider market could not be guaranteed which fundamentally undermines the case for reputable manufacturers to make the investment in labelling of all products.

iii. The stakeholder consultation from January to June 2012 highlighted a significant number of technical issues regarding exceptions, exclusions, special cases and other issues that would need to be resolved in order to have a scheme that is effective for the majority of this market. It is highly unlikely that a voluntary scheme would have the resources to address all of these issues in a manner acceptable to all participants such that they would willingly take part.

Significantly, CECED Italia itself supported a regulation at EU level, and made its data available for this purpose.

Blast cabinets

The same problems stated above for storage cabinets would affect also the market for blast cabinets, and they would be even more difficult to overcome since the industry associations are less experienced and influential than those active in the storage cabinets market. Therefore, it would be more difficult for them to plan and implement such a voluntary scheme. Furthermore, the lack of data and of an even limitedly shared methodology for this product means that the time required to start the scheme could be measured in decades rather than years.

The impact on the market of this option is likely to be very limited; only the producers of better performing products are to be expected to make use of the possibility to declare their performance to clients, while the rest of the market would continue to compete on price alone.

Option C is, concluding, unlikely to be effective for both products. Therefore it is not retained.

Option D: Mandatory Information Requirements

Under this option producers would be obliged to declare information about the energy performance of their products. This option is thus likely to improve the information failure described in Chapter 3, and could therefore contribute to the solution of the problem. Clearly, it would depend on the development of a shared methodology, since users could not assess the performance across the market if each producer could develop its own. Under this regard, it is similar to the labelling option, with the important difference that the information would be less user friendly and comparison among products would be much more time and effort-consuming.

Storage cabinets.

In terms of its effect on the market, the imposition of mandatory information requirements could reduce the lack of information on energy performance that is one of the causes of the market failure, as detailed in Chapter 3. However, there are reasons to doubt its capacity to tackle the problem in a significant way. First of all, it is very unlikely to affect buyers' choices noticeably: storage cabinets already report energy performance information usually, if in a non-harmonized manner, but this does not appear to have influenced the average user. This is most likely due to the fact that energy costs are far from being among the main ones for him or her. On the other hand, some buyers are able and willing to search and compare energy performance information but cannot currently do so because of the lack of either any or of comparable information. Under this option they would be in a better position to do so and their demand for efficient products should increase. However, the share of these 'sophisticated buyers' is estimated to be relatively small and they already now tend to buy more efficient equipment. Therefore the option would have a positive, though limited effect on the market, since non sophisticated users would continue to buy the least efficient products. In terms of its impact on the industry, this option would entail significant costs for manufacturers, arising in particular from testing; they can be assumed to be similar to those caused by Option E and detailed in Section 6.2.1.4. The consultation has made it clear that industry stakeholders do not believe this to be an effective option; the producers of more efficient products already experience great difficulties to market them, as proven by the existence of national schemes to support their purchase and the creation of a labelling scheme by CECED Italia as described in Section 3.3.2. Consequently, the industry would oppose the imposition of the testing and administrative costs caused by this option as disproportionate to the benefits to be achieved. Also most Member States would not support such an option on its own. As stated by a national delegate and reported in the minutes of the Consultation Forum, "information requirements generate administrative burden for manufacturers and market surveillance authorities. Such burden is justified only if sufficient energy savings are achieved through *combined* information and performance requirements". It should be noted that if there were information requirements only, the penalties to be imposed for an untruthful declaration are generally limited[15], while they can amount to a withdrawal from the market for a product whose performance is found to be below a minimum requirement. Consequently, manufacturers would have an incentive to control the performance of their competitors (self-

[15] The determination of the penalties, as market surveillance in general, falls within the responsibility of the Member States, and as foreseen by the Ecodesign Directive, it depends on the gravity of the non-compliance. Therefore, they can be different among countries; typically, in the case of an inaccurate declaration they consist in a fine and the order to declare the correct value in the future. Given that products are rarely tested, the risk of incurring into it can be accepted by the producer.

policing). This would not happen in the case of simple information requirements[16]. Concluding, Option D is not retained for storage cabinets.

Blast cabinets

The same limits highlighted for storage cabinets would apply in the case of blast cabinets. However, the present state of data does not allow to envisage the adoptions of any of the following options. Therefore, Option D is retained for further analysis, since the collection of data it foresees would contribute to the solution of this problem.

Option E: Information and Minimum Energy Performance Requirements (MEPS)[17]

This option builds on Option D but goes beyond it. Under this option, only products that perform above a given energy efficiency level would be granted placing on the market. It is a very common option in Ecodesign regulations, and the same in force in Canada and the US as described in option B. It would help to tackle the problem described in Chapter 3 by removing from the market the worst performing products.

Storage cabinets

This option has already been considered in the preparatory study and presented to the Consultation Forum While with the European Commission working document of January 2012; following stakeholders feedback, the results of the eco-design standardisation project[18] carried out between May and July 2012, and the July 2012 stakeholder consultation made it possible to set refined requirements for storage cabinets. The entry into force of the MEPS would be staged, with a first non-challenging tier in order to give the industry enough time to master the testing procedures and plan how to improve the performance of their products, followed by two more challenging tiers that would require a larger technological effort but achieve much greater energy savings. This option is therefore retained for further analysis. Details about stringency are explained in chapter 6.2 and Annex XII.

Blast cabinets

The preparatory study proposed minimum requirements, but it has been demonstrated that they were based on unrealistic assumptions[19]. In the absence of any agreed test methodology, the limited data gathered from the minority of producers who published it cannot be seen as comparable or a valid representation of market performance; furthermore, the impact assessment study revealed that even the data published by the most sophisticated producers does not reflect the energy consumption during a standard cycle, but rather just a broad performance indicator of maximum chilling capacity. Lastly, the products that declare performance tend generally to be the more efficient ones, so that MEPS based on them would probably be too stringent. Concluding, minimum requirements could not be set in a robust way yet, which forces to discard this option for the time being. Once reliable data becomes available, it should be reconsidered.

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[16] Producers indeed assured informally that they would test themselves and report to the authorities a product from a competitor that they suspect to be non-compliant and therefore under-pricing their own; they would not do it if the penalty would consist in just a fine instead of a withdrawal from the market.

[17] The abbreviation 'MEPS' refers to 'minimum energy performance standards', but it is now often used to refer to minimum energy efficiency requirements set by Ecodesign regulations.

[18] The aim of the project was to make the different data used in the IA study compatible through a process of standardization; this was needed in particular for allowing the use of the vast data provided by CECED Italia in February 2012.

[19] In particular, stakeholders noted that the energy performance data used in the preparatory study were extremely thin, not homogeneous, and often not expressed in an appropriate metric; the analysis by the impact assessment study contractor confirmed this situation.

Option F: Energy Labelling

Energy labelling represents a more user friendly way of giving information about the energy performance of the products; the latter would not only have to be accompanied by information, but also ranked according to their performance. Therefore, users would not have to go through the difficult and time-consuming process of comparing products themselves by collecting the necessary information: the labels convey it immediately. Such a system has already been introduced for many households products, including refrigerators, whose now familiar labels communicate this information through both colours and letters that define the different energy performance classes. In the case of this option, it has been assumed during the consultation process that the labels should be similar to the household products ones, in order to exploit their recognisability, but also slightly different in order to avoid confusion[20] among households and commercial products. The effect of this option on the market is quite different from the MEPS's: minimum requirements would improve the average performance by pushing the worst performing products out of the market, while labels would encourage the improvement of all products, including the efficient ones through an increased demand for good energy performance by better informed buyers.

Storage cabinets

The Italian voluntary labelling scheme by the Italian industry association (CECED Italia) described in Section 3.3.2 clearly indicated that this is a viable option for storage cabinets; the same conclusion can be drawn from the successful experience of the labelling of household refrigerators, which are not very different from a purely technical point of view (they do differ in terms of usage pattern and requirements, which makes it impossible to use the experience gathered through their regulation directly in terms of data and testing methodology). Therefore, this option is retained fur further analysis.

Blast cabinets

The same data availability and reliability problems cited in the previous option apply here, forcing to discard it until they become available. Once they are, this option should be further investigated, since there are no technical reasons to consider it not viable.

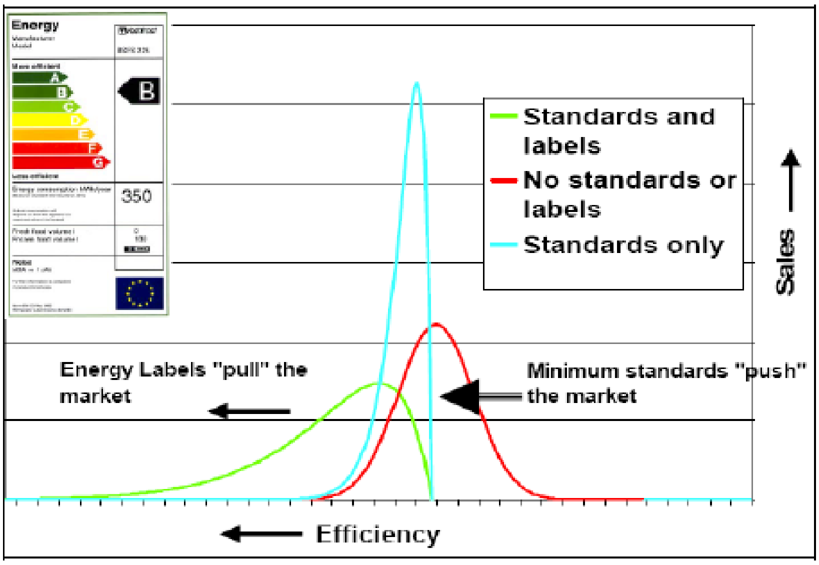
Option G: MEPS and Energy Labelling

Combining both options for storage cabinets could achieve the effect of removing the worst products[21] from the market in a way that is fair to all manufacturers together with the motivating effect of transparency on efficiency information that will drive competition and innovation on energy efficiency issues. The simultaneous introduction of both measures (MEPS and labelling) could combine the pushing effect of the eco-design specific requirements and the pulling effect of the new labelling energy efficiency scale, according to the pattern illustrated in Figure 4. This pattern is at the base of all Ecodesign regulations which foresee both MEPS and labelling, and is therefore not only widely accepted in theory, but also well experienced in practice.

[20] This risk is real but limited, since the distribution channels are generally distinct.

[21] The percentage of very inefficient products on the total is substantial, according to both the EU data set used in this IA and described in Annex III and stakeholders' feedback; indeed, even a very unambitious requirement as the one foreseen by Tier 1 in the development of option E would remove a quarter of the products from the market. However such non-compliant products can be improved so as to meet Tier 1 requirements at virtually zero cost; the fact they are not testify the little attention paid to energy efficiency in the market.

Figure 4: Cumulative impact of ecodesign and labelling



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

Therefore, the option is retained for further analysis.

Blast cabinets

The same data availability and reliability problems cited in the previous options apply here, forcing to discard it until they become available. Once they are, this option should be further investigated.

Option H: Malus/bonus and/or other measures regarding GWP of refrigerants

The rationale of this option would be to strongly promote the use of refrigerants with a low Global Warming Potential (GWP) in order to reduce the global warming effect from leaked refrigerants (see also Figure 3). The most common way of promoting the use of low GWP refrigerants would be to give them a bonus so that it would be easier for products using them to meet possible minimum requirements, which would then become effectively lower for them (or, conversely, to impose a malus on high GWP gases). Therefore, this option would be an addition to other options, rather than one standing on its own. With regard to storage[22] cabinets, such an option seems to offer only a limited potential impact. First, the other options (MEPS, labelling, or both) already contain a very strong incentive to use low GWP gases, in particular hydrocarbon refrigerants, that offer significant energy-saving potential. Hydrocarbon refrigerants do not appear to need any support once the market starts to focus on energy efficiency: they took over the household refrigerator market following its regulation (which foresees both MEPS and labelling). Furthermore, as Figure 3 shows, the global warming effect caused by refrigeration gases leakages is very small (about 5%); almost all comes from energy consumption. It is also set to decrease further as the use of hydrocarbons spreads, a process that is already ongoing. The principle of proportionality would be infringed if the regulation were to be made more burdensome to achieve results bound to be very

[22] It is not possible for the time being to envisage such an option for blast cabinets, since the lack of data does not allow for the setting of its prerequisites such as the setting of MEPS or labels. This situation should however change in time for the regulatory review.

limited, also considering the EU policy to simplify legislation and the risk of double regulation (these products, and all other refrigeration products, are already covered by the F-Gas regulations). It should also be kept in mind that a malus or bonus for refrigerants affecting labels rather than MEPS would distort the buyers' perceptions of energy consumption of the products as it implies that products with different performances would receive the same label. A detailed summary of the policy options regarding the promotion of low GWP refrigerants and related issues is provided in Annex V. Some northern Member States as well as environmental NGOs proposed such an option while industry representatives were against because of its limited impact and the fact that hydrocarbon refrigerants are so superior in terms of energy efficiency that they do not need support.

Consequently, this option is not retained for further analysis; however, it is recommended that it will be considered again at the time of the review, given that technology is changing quickly in the field of refrigerant gases, and the need to coordinate the envisaged professional refrigeration regulation with the other EU regulatory measures, the F-gas regulation in particular.

Overview of the options

The following tables present an overview of the options, first for storage cabinets, then for blast cabinets. The options which can be retained at this moment are very limited for blast cabinets because of the data availability issue already described. However, most of them will become perfectly viable options at the time of the review, after the collection of sufficient data.

Table 3. Summary of options for storage cabinets

	Not Retained	Retained	Earmarked for review
Option A: No new EU action		✓ (as baseline)	
Option B: Adoption of existing foreign policy	✓		
Option C: Self-Regulation	✓		
Option D: Mandatory information requirements	✓		
Option E: Minimum Energy Performance Requirements (MEPS)		✓	
Option F: Energy Labelling		✓	
Option G: MEPS and Energy Labelling combined		✓	
Option H: Malus/bonus and/or other measures regarding GWP of refrigerants			✓

Table 4. Summary of options for blast cabinets

	Not Retained	Retained	Earmarked for review
Option A: No new EU action		✓ (as baseline)	
Option B: Adoption of existing foreign policy	✓		
Option C: Self-Regulation	✓		
Option D: Mandatory information requirements		✓	
Option E: Minimum Energy Performance Requirements (MEPS)			✓
Option F: Energy Labelling			✓
Option G: MEPS and Energy Labelling combined			✓
Option H: Malus/bonus and/or other measures regarding GWP of refrigerants			✓

6. Impact Analysis of the retained options

This section looks into the impacts of the retained policy options. They are assessed against the baseline scenario described in Chapter 3 which describes the impacts in case the Commission decides not to put forward any measures.

The assessment is done with a view to the criteria set out in Article 15 (5) of the Ecodesign Directive. The aim is to find a balance between the quick realization of the appropriate level of ambition 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.

6.1 Option D: Mandatory information requirements

This option is retained only for blast cabinets

Below are listed the envisaged parameters that should be publicly accessible and reported in the product documentation accompanying blast cabinets falling within the scope of the Regulation. They are based on those contained in the May 2012 consultation document, which have been slightly changed and expanded following the feedback from the consultation. Namely, stakeholders generally agreed with the list, with some, especially SMEs, suggesting to add more information.

- Energy consumption, in kWh per kg of foodstuff per temperature cycle
- Full load capacity of the cabinet expressed in kg of foodstuff
- Temperature cycle (from which temperature in °C down to which temperature in °C the foodstuff is intended to be cooled and in how many minutes)
- In the case of integral equipment, the refrigerant charge (kg) and refrigerant fluid. In the case of equipment designed to be used with a remote condensing unit (not supplied

with the blast cabinet itself), the intended refrigerant charge when used with a recommended condensing unit and the intended refrigerant fluid

If the disclosed data are to be comparable, a standardized method would be necessary, as confirmed unanimously by both SME and adhoc consultation returns; the process of developing it is detailed in Chapter 5.

A conservative approach dictates that only small energy savings can be assumed to arise simply from publication of product performance information. They would be higher than in the case of storage cabinets, since currently in the case of blast cabinets often no information about energy performance is published at all; therefore, the sophisticated users who now cannot make a proper and informed decision would find it much easier to do so. Regretfully, the impact of the option cannot be quantified, since the baseline data to base it upon is completely lacking. Consequently, also the environmental impact (driven by energy consumption) could not be quantified. However, both the energy and the environmental impact are bound to be limited by the same problems described in Chapter 5 in case of the adoption of Option D for storage cabinets.

The costs falling on the producer in order to comply with the information requirements have been estimated by the IA study through specific enquiries and the consultation process. Administrative costs are estimated at between €3.000 and €6.000 per product range to implement the information requirements (according to consultation returns). An average of 7 product ranges is assumed per manufacturer (half that estimated for professional storage cabinets as these are less varied products) from 50 suppliers (same number as assumed for professional storage cabinets). It is also assumed that manufacturers will have ongoing communication with their customers and that the additional technical information will be developed within the cost of 2 days of engineering time per product, costed at €300 per day. To this must be added the administrative and changes to marketing materials which therefore make an estimated €5.000 per product range appear reasonable. This implies a total of (7 x 5.000) = €35.000 per manufacturer and total of (50 x 35.000) = €1.750.000 for all manufacturers across the EU. The cost of testing each cabinet has been estimated at €6.000 but extensive use can be made of representative models and some calculated extrapolation of results to cover other products in a range.

Furthermore, the impact of testing on manufacturers of blast cabinets who also produce storage cabinets, a common case according to stakeholders' feedback, can be increased by the need to test also the different storage cabinets' categories following the introduction of minimum requirements or labels on them (Option E and F).

Given that this option has limited value in terms of energy and emissions savings, and imposes costs to producers, it can be justified only if used to prepare the ground for a more effective regulation later on. This should indeed be the case, given that the technology and the market for blast cabinets are very similar to those of storage cabinets; once data are made available by the adoption of mandatory information requirements, all of the following policy options would become feasible also for blast cabinets, and their energy efficiency[23] could be improved in a similar way.

[23]The IA study has quantified, on the basis of the limited data available and therefore with a consistent margin of error, the maximum energy savings to be achieved through the setting of minimum requirements as 1.4 TWh per year in 2020 and 2.1 TWh per year in 2025.

6.2 Option E: Information and Minimum Energy Performance Requirements (MEPS)

This option can be developed, at the present state and with the data currently available, only for storage cabinets.

The envisaged information requirements to be reported in the product documentation are:

- The energy consumption of the cabinet, measured according to the standard currently being developed by CEN TC44 WG2; it is most likely to be expressed as the Annual Energy Consumption calculated by annualizing the results of the testing methods, which differ in terms of door opening protocols and climate class (There climate classes at which a product can be tested differ in terms of temperature and humidity)
- The intended use for storage (not display) of foodstuff; this is to avoid overlaps with the commercial refrigeration regulation being developed by DG ENER
- The declared category of the appliance according to the definitions of this regulation (e.g. counter chilled cabinet, roll-in freezer cabinet, static air cabinet, semi-professional, heavy duty etc.)
- Indication of any restriction on the product's intended usage (e.g. semi-professional cabinets are not appropriate for use in hot kitchens)
- Net storage volume in litres
- Explanation for users of how to minimise the energy consumption of the cabinet

The setting of adequate levels of performance would build on the same methodology used to measure the energy performance data which would have to be published under Option D; however, in this case there would be a fundamental addition to the regulation: products performing below a certain level would not be allowed to enter the marketplace. This level would be set in the following way. The Annual Energy Consumption (AEC) of a given product would be calculated through testing; then, its performance would be set against the so called Standard Annual Energy Consumption (SAEC) of its specific model category, which represents the market average. If the product performs exactly as the average, the ratio of the AEC and the SAEC would be 100. If it consumes more energy, it would be higher; if less, lower. This ratio is called the Energy Efficiency Index (EEI), and is expressed in hundreds, i.e. as a percentage.

The proposed minimum requirements would be based on the EEI. They would enter into force in stages, so called tiers, of increasing stringency; for instance, they would amount to 125 for Tier 1, meaning that from the entry into force of the first minimum requirements thresholds a product consuming more than 25% energy than the market average would be banned from the market. The envisaged MEPS are shown in Table 5, while the effect of the introduction of the different tiers on the market is shown in Table 6.

Table 5. Proposed minimum energy performance requirements for storage cabinets.

Requirement	Date of entry into application	ENERGY EFFICIENCY INDEX (EEI)
Tier 1	1 year after legal entry into force	EEI < 125
Tier 2	2 years after legal entry into force	EEI < 110
Tier 3	4 years after legal entry into force	EEI < 100

Table 6. Statistics to assess relative stringency of Tiers by type.

Product types	% of original products remaining after Tier 1	% of original products remaining after Tiers 1 and 2	% of original products remaining after Tiers 1, 2 and 3
Chilled vertical (CV)	78%	71%	67%
Chilled counter (CH)	62%	42%	40%
Frozen vertical (FV)	87%	67%	54%
Frozen counter (FC)	73%	63%	42%
Sales weighted average for all types	76%	63%	56%

Feedback from the stakeholder consultation indicated remarkably similar estimates for the proportion of market removed by each tier to those indicated in Table 6. Therefore, it can be safely assumed that the introduction of such minimum requirements would remove substantial proportions of the market as shown above. It should be noted that the stringency of the requirements is not proportional to the percentage of products that would fail them: already Tier 1 would remove a substantial part of the market, but it would not be very challenging, given the availability of low-cost ways of improving energy performance up to that level (See Section 3.2). The following sections will describe the economic, social, and environmental consequences of Option E.

6.2.1 Economic impacts

6.2.1.1 Energy savings

A conservative assessment has been made of the impact of the minimum requirements using distinct and logical steps: based on the harmonized all EU data set (see Annex III**)** an initial average consumption figure was calculated, then products performing worse than the proposed minimum requirements were deleted from the list and a new average calculated. The same procedure was repeated for Tier 2 and Tier 3. Figure 5 shows the BAU annual energy consumption, and a second line showing the combined effect of Tiers 1, 2 and 3 on total consumption. Growth over the period 2025 to 2030 is driven by the increase in stock. Figure 6 shows how the energy savings develop for Tiers 1, 2 and 3 and for chilled and frozen cabinets combined. Overall, as summarised in Table 7, the combined effect of all Tiers results in a saving of 1,8 TWh per year compared to base case in 2020, and 3 TWh per year by 2030. Tier

3 clearly achieves the vast majority of savings in the medium term. The translation of energy savings in monetary terms is performed in section 6.2.1.3., since they would be reaped by the users.

Table 7. Energy use and savings summary in 2012, 2020 and 2030 under Option E (Tiers 1, 2 and 3 combined).

	Base case energy use TWh	Energy use Tiers 1, 2 and 3 (TWh)	Energy saving (TWh)	CO2 equiv saving (TEWI, million tonnes)
2012	8,5	8,5	0,0	0,0
2020	9,4	7,6	1,8	0,7
2030	10,5	7,5	3,0	1,0

Figure 5. Annual electricity consumption for storage cabinets for base case and under Option E (Tiers 1, 2 and 3 combined).

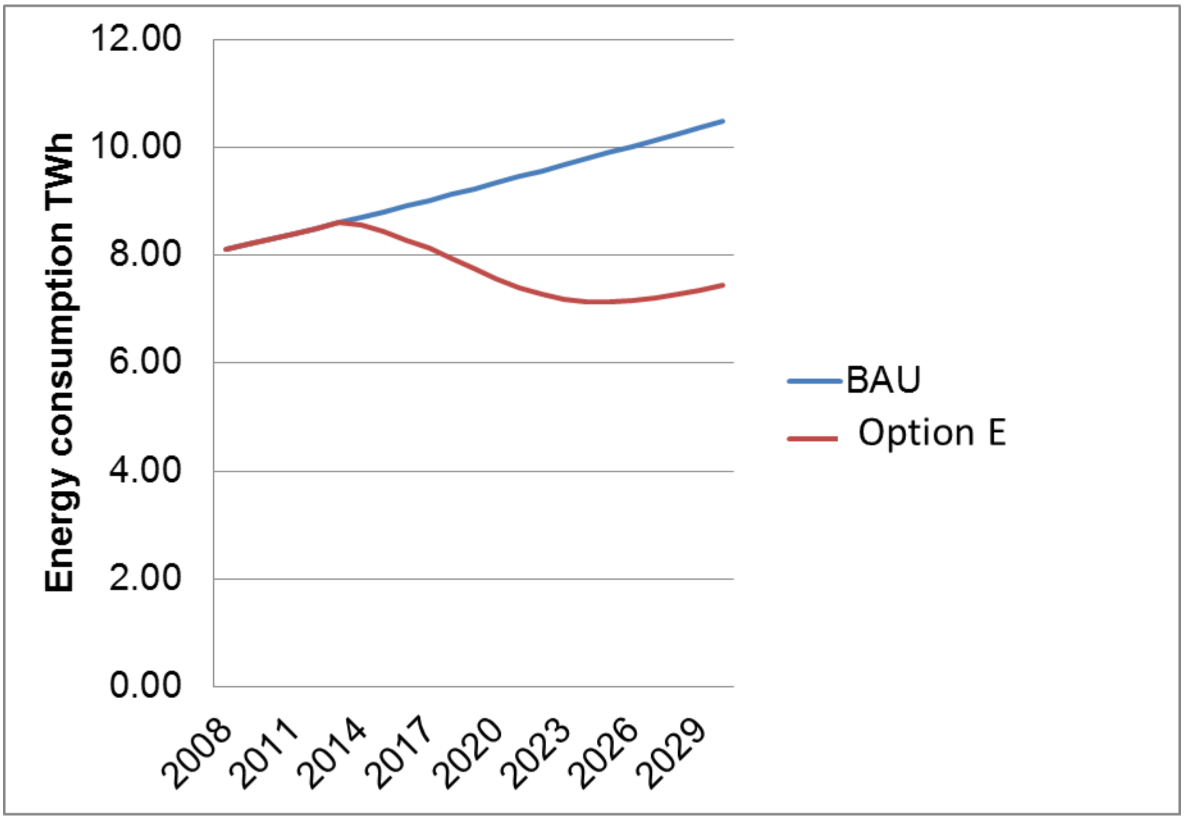
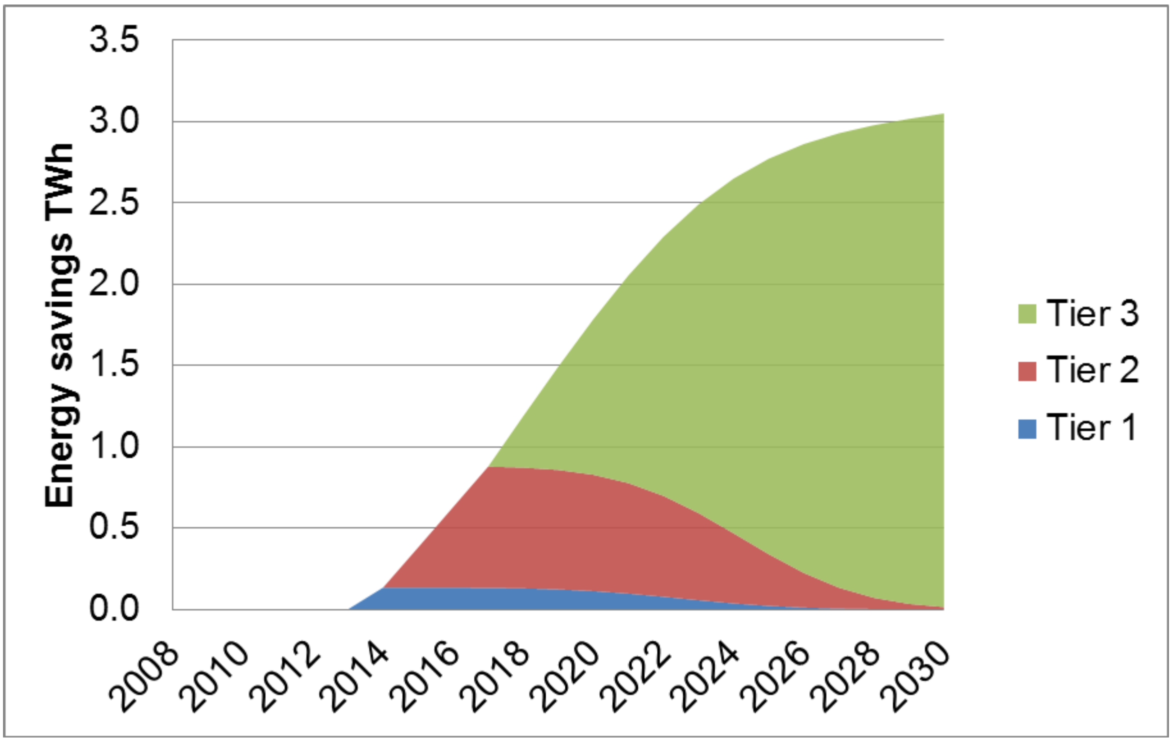


Figure 6. Energy savings from Tier 1, Tier 2 and Tier 3 of Option E for storage cabinets



6.2.1.2 Product price increases

The product cost to the manufacturer is set to increase due to the addition of improved technologies such as higher efficiency compressors, high-efficiency fans, larger heat exchanges, improved insulation and so on. The impact assessment study has assumed that increased costs would be passed on to buyers, an assumption that has been confirmed by a majority of respondents to the stakeholder questionnaire (17 out of 25); this does not mean that all costs would be immediately transferred to buyers, but rather that this would tend to happen over time. Indeed in the experience of Ecodesign regulations there has not been a general reduction of the profitability of a sector after its regulation; furthermore, the effect on prices tends to be overestimated[24] beforehand. This might indeed be the case in this IA as well, but it has been preferred to estimate it in a conservative way, and taking in due consideration the views of producers, who typically predict strong price increases. The effect on prices has been quantified based on the following assumptions:

- Tier 1 would not result in a general price rise (manufacturers would simply drop the very worst products from their catalogues).
- Tier 2 would result in price rises of around 10%.
- Tier 3 may raise prices by 20% compared to 2012 prices (see Annex III for details about the typical unit prices).

6.2.1.3 Impact on users

[24] The experience of the US household refrigerator market indicates that prices did not increase significantly after the introduction of the regulation, as emerged from the evidence (known from private communication) gathered by the US Department Of Energy (R. Van Buskirk) for the analysis of US household refrigerator policy impacts; paper due to be published late 2012; the same appears to be the case in the Australian market: see http://www.eedal.dk/Conference/~/media/EEDAL/Sessions/Session%205/How_much_did_we_actually_save_Lane_Harrington_Ryan_Lane.ashx. The main reason seems to be that over time the increased demand for more efficient components creates economies of scale, so that their price decreases.

There are two kinds of costs connected to the use of a storage cabinet: the purchase price described above (other possibilities such as leasing are very rare in this market) and the running electricity costs. The Figures 7 and 8 below, together with Table 8, show the net effect of the proposed requirements on the user. The data is based on the following assumptions: all costs are discounted at 4% per year, electricity price assumed to rise at 4%[25] above inflation every year, product cost increases are passed on to users and no cost inflation is assumed for product purchases. The expenditure on products sold in each year combined with energy costs to users is shown in Figure 7, with the costs split between frozen and chilled storage cabinets in Figure 8. Please note that the spikes in net costs in 2014, 2015 and 2018 are a consequence of the simplified calculation methodology whereby additional costs are incurred at the introduction of each Tier, while energy savings do not show until the following year.

[25] This assumption derives from the common Methodology for the Ecodesign of Energy-using Products (MEEuP) used for all Ecodesign regulations, which have to be based on it in order to be consistent. DG ENER has confirmed that this assumption is not going to be changed in the near future. Nevertheless, a sensitivity analysis is possible by changing this assumption in the model. An Energy price increase of just 2% would decrease the annual end-user cost savings in 2030 from 277 million Euro to about 160, and a stable energy price to just below 100.

Figure 7. Total annual end-user net costs (purchase and energy) under Option E.

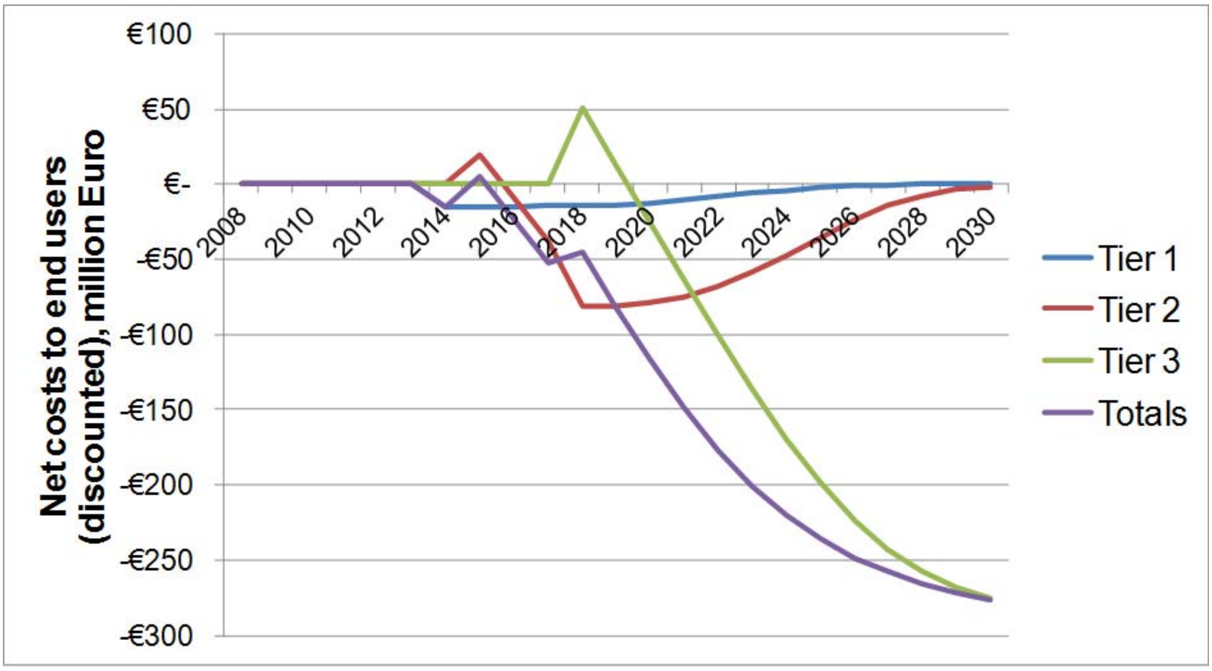


Figure 8. Annual end-user cost savings under Option E (product sales and stock energy costs) broken down into frozen and chilled cabinets

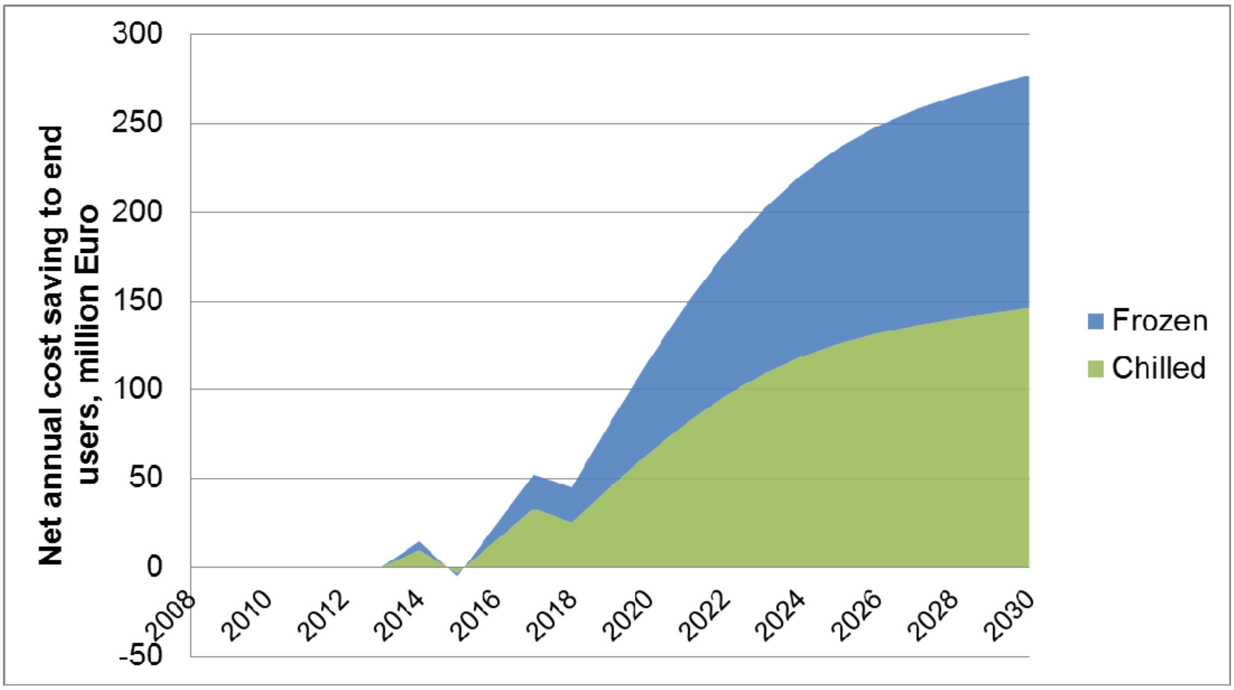


Table 8. Total costs and savings to end users for purchases and energy under Option E*.

	Base case cost of purchases (Million Euro)	Additional product costs (million Euro)	Base case cost of energy use, (Million Euro)	Energy cost savings (million Euro)	Total Net gains (million Euro)
2012	518	-	936	-	-

2020	401	80	1.029	196	116
2030	292	58	1.155	335	277

* All figures are discounted at 4 % annually.

It is obvious that the product cost increases would be more than compensated for users by significant energy savings.

6.2.1.4 Impact on manufacturer

Cost of testing

The cost of testing will be analysed again for the options involving energy labelling (F and G), since it is significantly higher in that case, as shown in Section 6.4.2.3. In fact, under Option E producers could focus their testing on the products they know to be below or close to the minimum requirement threshold while relying on slightly less accurate but much less costly methods to assess the performance of other products, in particular by calculation/extrapolation from other products that are tested. It is estimated that around 20% as much testing would be required for minimum requirements as compared with energy labelling (Options F and G). This means a cost of 20% of € 161.000 or € 32.200 per manufacturer (see Table 9); € 1,6 million per year for all EU manufacturers, or 0,3% of total sales value in 2012.

Other compliance costs

In addition to the cost of testing, other administrative burdens associated with this option would fall on manufacturers. A technical analysis would be needed to review product range, select products that will require testing and ensure that minimum requirements are met. Changes to CE marking and other information requirements would be needed, and companies would be subject to the cost of undergoing compliance inspection and monitoring by public authorities. A detailed explanation about how these costs have been valued is available in Annex VII and Annex X. A summary of the costs caused to manufacturers by the adoption of minimum requirements is shown in Table 9; the costs are estimated for 2014, and they are likely to decrease sensibly afterwards, as testing (the main cost driver) will be required only when additional products will be placed on the market. The administrative costs have been estimated using the Standard Cost Model.

Table 9. Summary of testing and compliance costs to manufacturers under Option E.

Type of cost	Indicative cost per manufacturer (Euro)	Indicative cost for all EU manufacturers (Euro)	Comments
Product testing	€32.200	€ 1,6 million	Assumptions detailed in Annexes VII and X. Equates to about 0,3% of the value of EU sales in 2012.
CE marking	€1.500 + €0,5 per sale c. €5.400 per manufacturer average	€ 75.000 + €195.000 = € 0,27 million	Assumes €1.500 of additional CE marking costs per manufacturer as a result of regulation, 50 manufacturers.

			Sales of 389.000 per year.
Technical documentation and assessment	€10.200	€ 0,51 million	Assumes 20% of model variants require different technical documentation costing 2 days per product at €300 per day.
Inspection and enforcement costs	€300	€ 0,015 million	Assumes inspection once every 5 years involving 5 days at €300 per day.
Total	**€ 48.100**	**€ 2,39 million**	Equates to 0,5% of estimated € 517 million annual sales for these products in 2012

6.2.1.5 Impact on competitiveness, innovation and trade

Option E should not, according to the IA study and the consultations, influence the cost competitiveness of companies active on the EU market, since the regulation falls equally on all producers and importers: the increased costs for testing and conformity assessment would affect them equally. There is no indication that these costs will be different for producers outside the EU. The increased demand for higher quality inputs, such as more efficient compressors, should decrease their price over time, thereby improving their cost competitiveness also in higher segments of the markets.

The regulation will encourage investment in product development and innovation, thereby having a significant positive effect on the innovative capacity of the industry and its ability to compete through innovation. Such innovative focus has previously been constrained by the focus on price and not by any lack of technological solutions, hence rapid improvements could be achieved. The more stringent second and third tiers will guarantee much wider deployment of better compressors, more efficient fans and fan motors, electronic expansion valves and other improved controls. Suppliers of these components could see a significant increase in market size, providing a further boost to capacity for innovation and the price of these components should then fall. There was widespread agreement during the stakeholder consultation that the measures would encourage investment in product development and innovation.

Regarding the competitiveness of users, the proposals will drive the adoption of very cost-effective technologies which result in medium term net cost savings to the end users through reduced energy costs. This could lead to a small net increase of their competitiveness. The proportion of end-user costs that are spent on energy varies enormously across end-user sectors. For some, such as cold storage and food processing, refrigeration energy costs can be a significant share of the total costs and these end-users will experience notable benefits. For most others, cooling costs may be an extremely small component of overall operating costs and so have negligible overall effect on competitiveness.

In terms of international competitiveness, minimum requirements on these products are in place in the USA and Canada, and other markets are likely to follow suit given the growing political will to achieve higher energy efficiency. Without the regulation, EU manufacturers would be at a distinct disadvantage for competing on energy efficiency issues. With it, a short to medium-term effect should be to reduce imports and internal production of very cheap storage cabinets with low efficiency, slightly boosting sales of efficient EU-made products (assuming reasonably effective market surveillance and enforcement). This is likely to be one of the main reasons why some EU manufacturers support the introduction of performance requirements. The harmonised test methodology and efficiency calculations have significant aspects that are specific to the EU in terms of ambient temperature classes and door openings for tests. This might be a disadvantage for exporters to the EU, but the same applies to EU producers who export to countries where other testing methodologies are in place. Manufacturers have not previously had to provide performance information for the EU; US manufacturers could have a slight advantage in this (having experienced similar minimum requirements for several years) but imports from the USA are low compared to Asia and Eastern Europe. Regarding exports, a few stakeholder consultation respondents commented that they may have to produce different (cheaper and less efficient) products for export once efficiency requirements for the EU market are established. However, this effect will be compensated by parallel decrease of the marginal cost of producing the better equipment as its sales numbers increase. Manufacturers will have more costs for testing and conformity but that this applies equally to EU suppliers and importers.

Concluding, the effect on the competitiveness of the sector as a whole will be positive for manufacturers and component suppliers due to increased ability to differentiate higher quality products and a clear need for wider deployment of improved technologies. The EU market manufacturers will be better positioned to compete as energy efficiency requirements become more widespread in other economies. Manufacturers will face increased costs for testing and conformity assessment, but the overall competitiveness will not be affected by it since this will fall on the sector as a whole, including imported products. This might however not be the case for all SMEs, as analysed in the following section.

6.2.1.6 Impact on SMEs

The majority of SMEs active in this sector focus on installation and maintenance work, which will not be significantly affected. However, the sector has also many SMEs, particularly in the UK and Nordic markets, which produce many types of tailored products in small numbers. Also some large suppliers tailor their products, but they are likely to be more resilient to the impact of the regulation thanks to their greater financial means, wider sources of revenue, and above all the more common availability among them of in-house test rooms, while SMEs will mostly have to pay per test for external testing. SME producers affected may have to focus on a smaller range of products for which sales numbers can justify the increased costs of testing. This could result in reduced production by SMEs, and some small suppliers could be forced to withdraw from this market.

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 (also with regards to the other professional refrigeration products as many SMEs are also involved in supply of blast cabinets and sometimes walk in cold rooms) of the entry into force of the MEPS and the publication of good practice guidelines on how to appropriately reduce the burden testing through use of calculation, extrapolation and representative models, and about the information requirements and the technical documentation that has to be kept by manufacturers. Such guidance could be provided by manufacturers' industry association(s) and checked and published by the European Commission.

Regarding the competitiveness of the users (mostly SMEs), the regulation is estimated to have a small positive effect. There will continue to be plentiful supply of products that meet the requirements, although perhaps fewer at the lowest price levels; but the increase in purchase costs would be quickly offset by lower energy costs (see Section 6.2.1.3.). However, these savings are significant in aggregate but make up a small percentage of the total costs of the typical user.

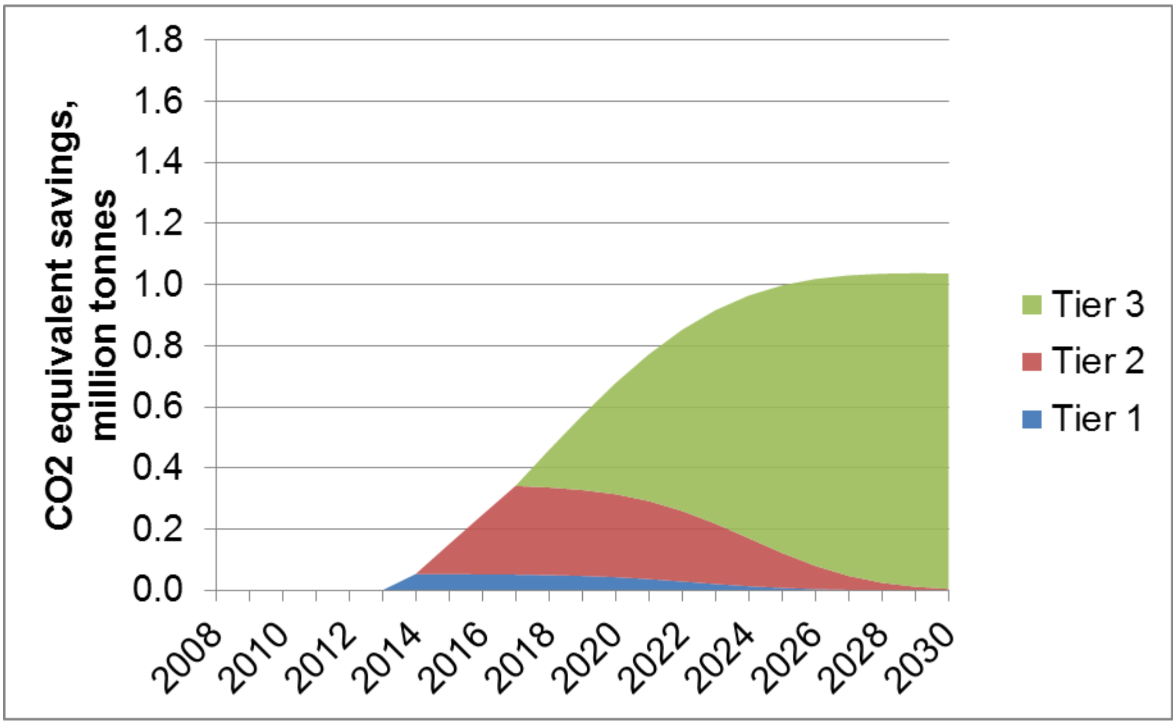
6.2.3. Social impact

The regulation is not set to have significant social impacts other than the eventual negative effect on the employment of SME producers, which could be mitigated in the ways described above.

6.2.4 Environmental impact

As stated in Section 2.1.2, the main environmental impact related to this product that falls within the scope of the envisaged regulation is its contribution to global warming. The main consequence of the regulation is represented in Figure 9, which can be compared with the baseline scenario of Figure 1. The net result is a significant reduction in TEWI emissions due to energy savings, measured in CO2 equivalent savings; the methodology for translating the one into the other is explained in Annex IV. There might be an additional, but very small, positive effect driven by the encouragement of the adoption of more energy efficient, low GWP refrigerant gases, thereby also reducing the global warming effect due to leakages. As already shown in Table 5, the savings would amount to about 1,0 million tonnes CO2 equivalent in 2030. This achieves a CO2 reduction of 28% compared to the base case in 2020 and 37% in 2030. By using the EU forecasts[26] for 2030, which foresee a carbon price of 36 Euro per tonne, this could be translated into a saving equal to 36 million Euros.

Figure 9. TEWI savings for storage cabinets for Tiers 1, 2 and 3 of Option E



6.3 Option F: Mandatory Energy Labelling

This option can be developed, at the present state and with the current availability of data, only for storage cabinets. In the following sections, only the impacts that differ significantly from those of the minimum requirements option will be explicitly analysed. The others can be assumed to be unchanged.

[26] http://ec.europa.eu/clima/policies/roadmap/index_en.htm

The principle behind setting mandatory labels is to help address the information failures in this market and enable manufacturers to secure recognition for the better performance of premium products and so support sales and justify a higher price. This is the intention behind the voluntary energy label scheme that the CECED Italia industry association has developed (See Section 3.3.2.). The main difference and added value compared to mere information requirements as in Option D is that through a label the relative energy performance of a product is easier to interpret and therefore useful also for 'non-sophisticated' buyers. A mandatory energy label would greatly assist the market to move ahead towards more efficient products. It would also clearly mark the poorest performing products so that many manufacturers would not wish to have them in their catalogues. Some suppliers would be likely to retain poorer performing products if they were cheaper, but several technical improvement options are low or zero cost (e.g. better design for refrigerant flow, sizing of capillary tubing) and so some poor performing products are likely to disappear from the market fairly quickly.

6.3.1 Methodology for establishing energy efficiency classes

In order to establish energy classes, it is necessary to place the products in different groups according to their energy efficiency. In Figure 10 each point represents a product, in this case a chilled vertical cabinet (the most common type), placed on the graph according to its size (horizontal axis) and its energy consumption (vertical axis). A simple way to divide them into groups would be to draw horizontal lines (called reference lines) in the graph, and consider all products placed between two lines as belonging to the same group. However, this would be unfair to smaller cabinets because of their unfavourable volume to surface ratio, as explained in footnote 13. Therefore, the lines are sloped to compensate for this factor. The slope of the lines is based on the formulas shown in Table 10. The methodology to derive the reference lines is explained in Annex VIII. The proposed energy label thresholds in terms of EEI are shown in Table 11. The thresholds have been established after extensive consultation with stakeholders, and with the contribution of ENEA, the Italian energy agency, whose proposals are shown in Table 11 as well.

Table 10. Equations for the reference lines to be used as the basis of energy labelling thresholds, V is the product internal volume in litres.

Cabinet Type	Proposed ref line (kWh/24 hrs)	Equivalent ref line (AEC, kWh/year)
CV, chilled vertical	0,0045.V + 1,6695	1.6425.V + 609,3675
CH, chilled counter	0,007.V + 4,905	2.555.V + 1.790,325
FV, freezer vertical	0,0135.V + 4,0327	4.9275.V + 1.471,9355
FH, freezer counter	0,016.V + 6,52	5,84.V + 2.379,8
FFV, fridge-freezer vertical	N/A	N/A

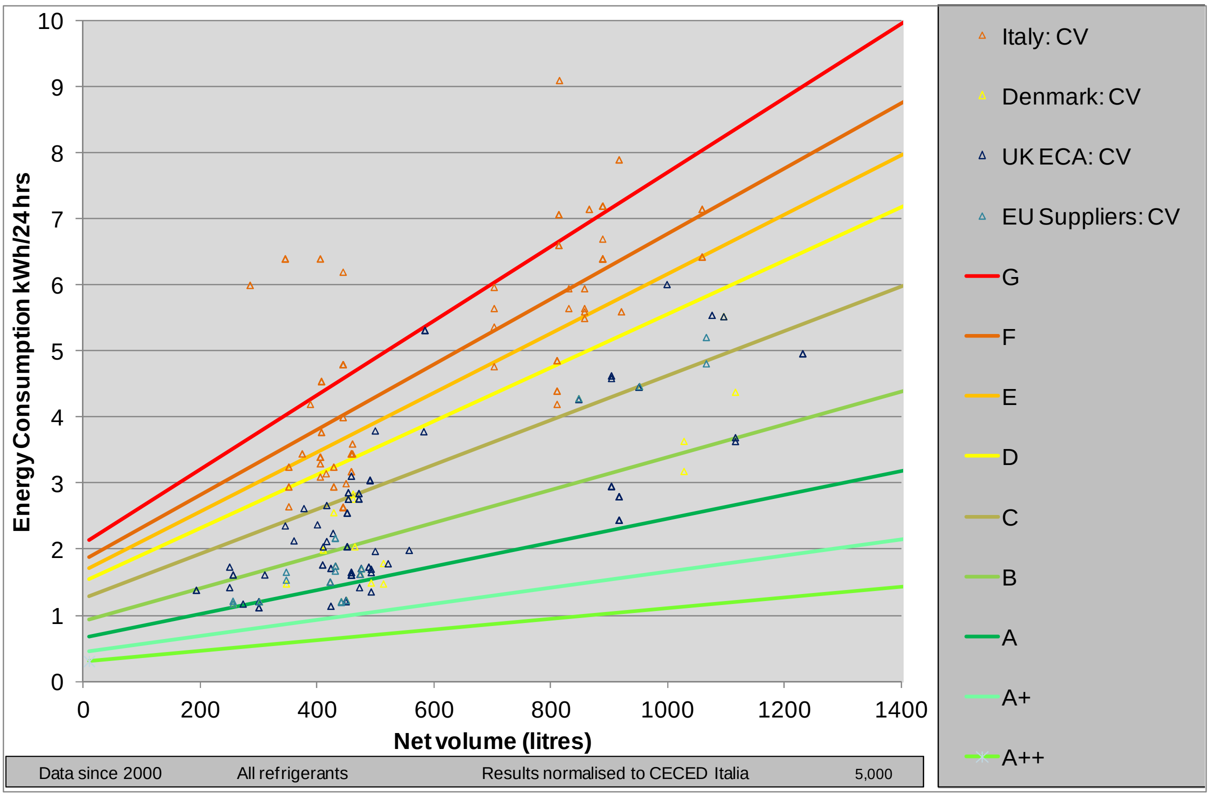
Table 11. Proposed EEI thresholds for energy label classes.

Label class	Proposed EU EEI threshold - upper boundary	ENEA proposed EEI threshold - upper boundary
A+++	(none)	(none)
A++	18	20

A+	27	30
A	40	42
B	55	55
C	75	75
D	90	90
E	100	100
F	110	110
G	125	125

The thresholds have been set so that products are spread throughout the categories. This way, a significant proportion of the labelling spectrum should be used. It has also been aimed at having very few or no cabinets in the A+ or A++ categories, suggesting reasonable scope for differentiating the performance of future high performing products. Figure 10 shows as an example how the available product data are spread across the labels for one of the product categories, chilled vertical cabinets. Similar Figures about all product categories are available in Annex VIII.

Figure 10. Proposed energy label thresholds of Option F for chilled vertical cabinets showing Italian data (orange), UK ECA (dark blue), Danish Go Energi (yellow), other EU suppliers (light blue).



6.3.2 Economic impacts

6.3.2.1 Energy savings

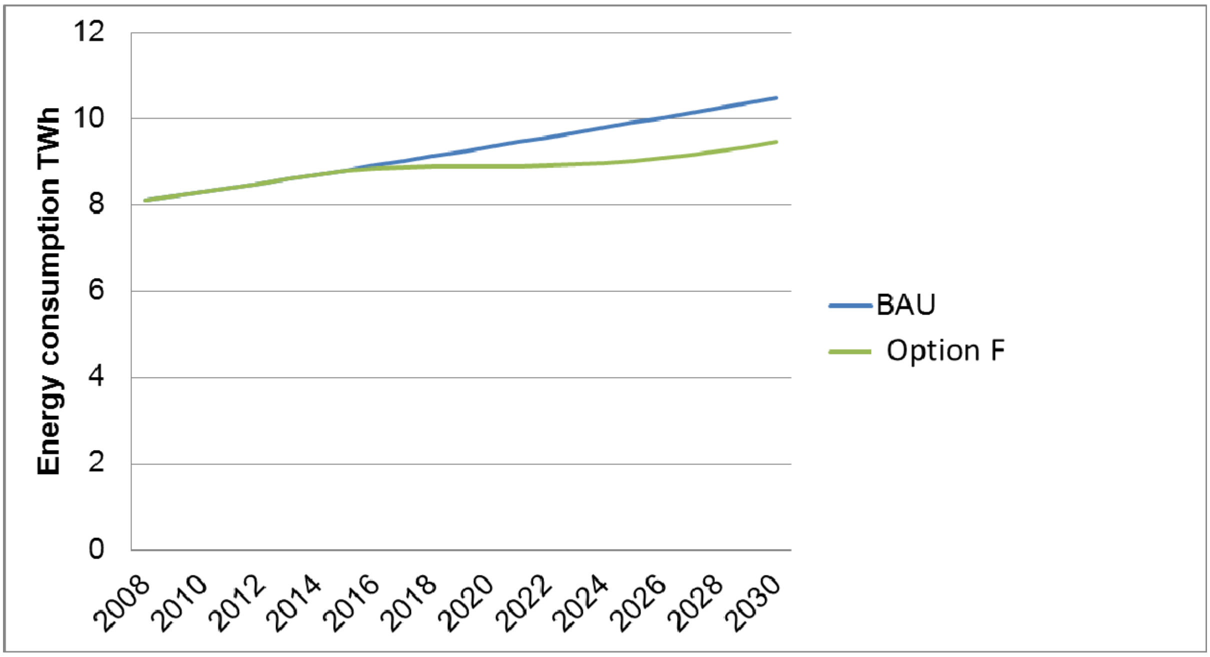
The generic impacts of energy labelling on the efficiency level of any given product market are illustrated in Figure 4: the distribution is shifted towards improved efficiency because the purchase of highly efficient products is incentivised. The fact that a major European trade association (CECED Italia) backed by several major EU manufacturers has developed its own voluntary energy labelling scheme (see Section 3.3.2) is proof that labelling is indeed a commercially attractive proposition to help differentiate better performing products. Such a voluntary energy label would probably not be applied by manufacturers to poor performing products, and would hence have a limited impact on the bottom of the market. A mandatory energy label can influence the market more deeply, mainly in the following ways. First, the presence of labels throughout the efficiency range enables a functioning competitive market based on energy efficiency since buyers can thus make informed choices and will have energy performance information made available for the purchase decision. Second, clear marking of poor performing products would discourage many (but not all) manufacturers from having such products in their range. Its effect could achieve some of the impacts of a minimum requirement. This will encourage (and fund) innovation.

The proposed labelling scheme is estimated to impact the energy use as shown in Table 12 and Figure 11. Estimates are derived on the base of assumptions about the effect of labelling in comparison with the effect of MEPS on the less efficient part of the market, and the consideration of the outcomes of other labelling schemes, in particular those of household refrigerators. Concretely, for the scale of impacts an energy use reduction of 2% has been assumed in the first year following start of labelling; a further 3% reduction in year 2 as the competitive market for energy issues takes hold; a further 2% for each of the next 2 years and 1% after the fifth year, thereafter level. For details about these assumptions and the underlying experience with household refrigerators labelling see Annex IX.

Table 12. Energy use and savings summary of Option F.

	Base case energy use TWh	Energy use from labels alone (TWh)	Energy saving (TWh)	CO_2 equiv saving (TEWI, million tonnes)
2012	8,51	8,5	0,0	0,0
2020	9,35	8,9	0,4	0,2
2030	10,50	9,5	1,0	0,4

Figure 11. Annual electricity consumption of storage cabinets for baseline and Option F.



6.3.2.2 Product price increases

The effect on the market of energy labels alone is assumed to be a more incremental process than that achieved through minimum requirements. Product improvement is at a pace set by individual manufacturers according to their established business priorities and development cycles. The effect on the product prices is therefore assumed to be so low, that it would likely be difficult to measure and it has been deemed disproportionate to be quantified here.

6.3.2.3 Impact on users

Table 13 shows how users will be impacted; since no product price increases are foreseen, the only effect is due to the reduced energy costs.

Table 13. Purchase costs and energy savings for end users under Option F*.

	Base case cost of purchases (Million Euro)	Additional product costs (Million Euro)	Base case cost of energy use (Million Euro)	Energy cost saving (Million Euro)	Net cost saving (Million Euro)
2012	518	-	936	-	-
2020	401	-	1.029	49	49
2030	292	-	1.155	114	114

* All figures are discounted at 4 % annually.

6.3.2.4 Impact on manufacturers

The total cost to manufacturers is summarised in Table 14. The labelling option imposes a much higher burden on them than Option E, in good part because of the much higher testing costs. This is because of the need to extend product testing over the full range of performance levels, instead of focusing it on those at risk of failing the requirement. Other additional costs, such as those required to add the label to the products, have to be added. The costs are estimated for 2014, and they are likely to decrease sensibly afterwards, as testing (the main cost driver) will be required only when additional products will be placed on the market. Annex X details how the figures were calculated.

Table 14. Summary of testing and compliance costs to manufacturers under Option F

Type of cost	Indicative cost per manufacturer (Euro)	Indicative cost for all EU manufacturers (Euro)	Comments
Product testing	€161.000	€ 8,1 million	Assumes that four times as much testing will be required compared to the current (voluntary) level (see Annex X). Equates to about 1.6% of the value of EU sales.
CE marking	€1.500 + €0,5 per sale c. €5.400 per manufacturer average	€ 75.000 + €195.000 = € 270.000	Assumes €1.500 of additional CE marking costs per manufacturer as a result of regulation, 50 manufacturers. Sales of 389.000 per year.
Energy labelling	€ 2 per sale c. €15.600 per manufacturer on average	€ 778.000	Assumes € 2 per fiche, sales of 389.000 per year.
Technical documentation	€37.800	€ 1,89 million	Assumes 75% of model variants require different technical documentation costing 2 days per product at €300 per day.
Inspection and enforcement costs	€300	€ 15.000	Assumes inspection once every 5 years involving 5 days at €300 per day.
Total	**€ 220.100**	**€ 11,1 million**	Equates to 2.1% of estimated € 520 million annual sales for these products and

6.3.2.5 Impact on SMEs

Energy labelling is likely to have a more significant impact on producers than the impact of minimum requirements due to the cost of testing a significant proportion of their product range. Many manufacturers of storage cabinets are large companies well equipped to deal with the additional testing and technical analysis required, but the situation is different for the significant number of SME producers. They may have to focus on a smaller range of products for which sales numbers can justify the increased testing and administrative costs. This could result in reduced production by SMEs overall; it is possible that some SMEs for which these product types represent a high proportion of their market may withdraw from the market. However, the impact on SMEs could be mitigated through the means described in Section 6.2.1.6. In addition, the scheduling of the introduction of labels on the various sub-types of professional storage cabinet could focus first on the most important and biggest selling sub-types (vertical chilled, vertical frozen) and delaying the introduction of labels on the smaller selling but clearly identifiable types (for example chest freezers or cabinets with transparent doors).

Installation and maintenance work will not be significantly affected, which is where the majority of SMEs are focused on in this sector. Finally, SME users are most likely to be the ones profiting from an easy way to get informed about energy performance; it is therefore very likely that the energy savings quantified above in Table 11 would be reaped by them.

6.3.2.6 Impact on competitiveness and innovation

The impact on cost competitiveness of labelling alone will be very similar to the one described for Option E, i.e. very limited. However, labels are likely to encourage innovation more thoroughly by facilitating the functioning of a competitive market on energy efficiency issues thanks to the availability of reliable product performance information that buyers can take into account in purchase decisions. The presence of labels will therefore more effectively drive innovation due to market recognition of better performing products, some of which could then command a higher price; also the components for these products would find a greater market, and would be likely to decrease in price as a consequence. At the same time at the opposite side of the market low-performing products will continue to be offered in a low-tech, low price niche, producing a noticeable split in the market. In terms of international competitiveness, the broad effect is likely to be similar to the one of Option E, with the difference that also low performing products would still be allowed to enter the EU market, even if with a bad label.

6.3.3 Environmental impact

The environmental impact is calculated by translating into the CO_2 equivalent (TEWI) the energy savings; both are shown in Table 12.

6.3.4 Social impact

Some reduction in employment is possible if some smaller manufacturers were to withdraw from the market. There is no data to quantify this, but the risk could be substantially reduced in the ways described in the SMEs sections.

6.4 Option G: MEPS and Energy Labelling

This option can be developed, at the present state and with the current availability of data, only for storage cabinets.

The combination of both MEPS and labelling would have the dual effect of removing the worst products from the market in a way that is fair to all manufacturers with the motivating effect of transparency and efficient information that will drive competition and innovation on energy efficiency issues.

6.4.1 Economic impact

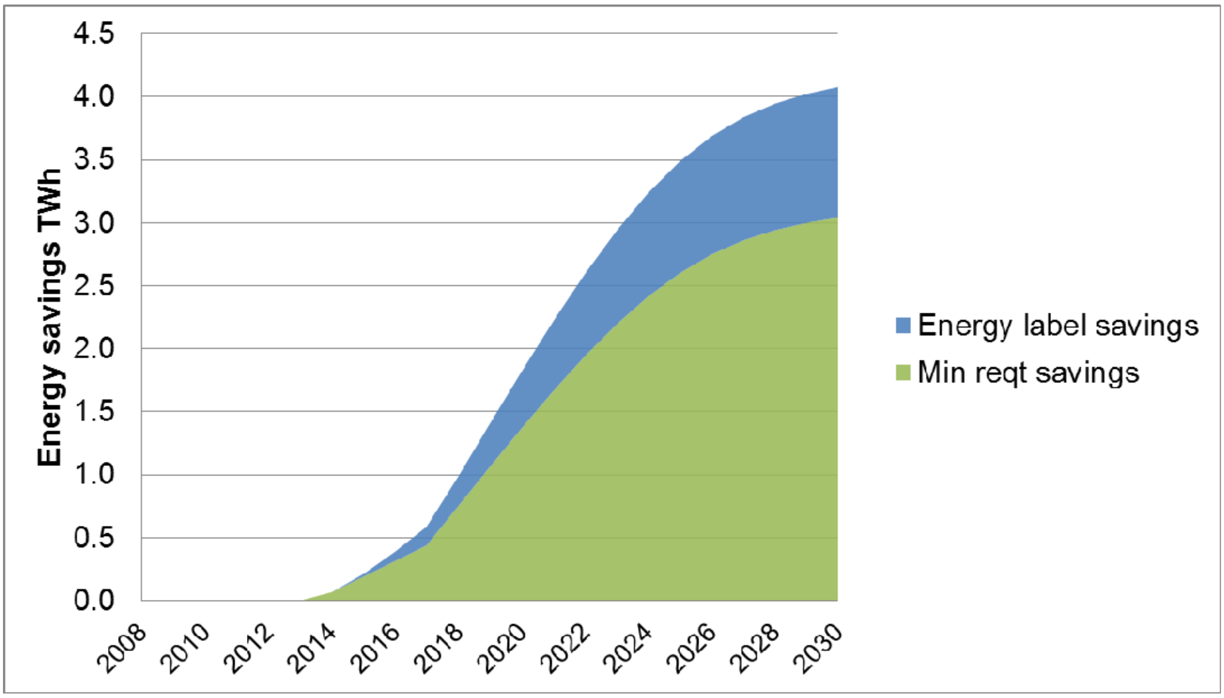
6.4.1.1 Energy savings

The energy consumption impacts of combining both options is estimated to achieve energy savings as proposed under minimum requirements (Option E), combined with energy savings arising from labelling alone (Option F) minus the overlap savings, i.e. those that would be double counted (see Annex IX). The combined total is summarised in Table 15 and the achieved savings are shown in Figure 12.

Table 15. Energy use and savings summary as a result of Option G.

	Base case energy use TWh	Energy use from labels and minimum requirements (TWh)	Energy saving (TWh)	CO_2 equiv saving (TEWI, million tonnes)
2012	8,51	8,5	0,0	0,0
2020	9,35	7,5	1,8	0,7
2030	10,50	6,4	4,1	1,4

Figure 12. Energy saving impact accruing from energy labels and from minimum requirements (Option G).



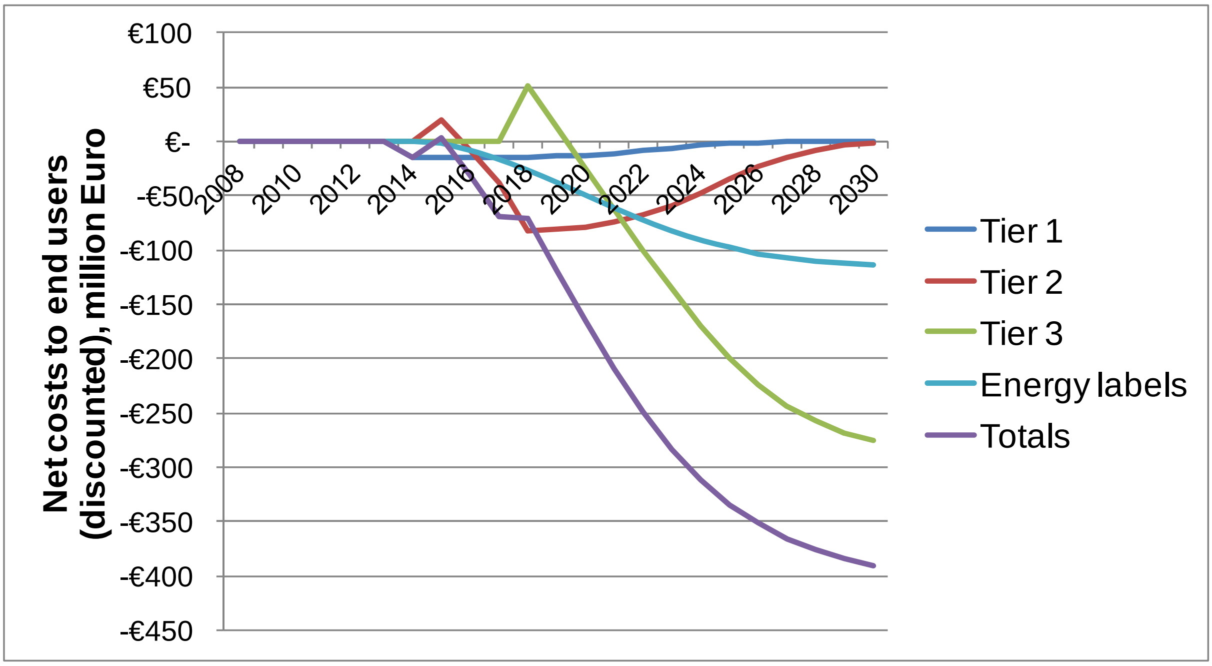
6.4.1.2 Impact on users

Product price increases are assumed to occur exactly as under Option E. Cost savings to end-users combine the benefits of minimum requirements with the benefits of the improvement in energy efficiency arising due to labelling, but offset to an extent by the product price increases that arise due to the minimum requirements. Costs to end-users are summarised in Table 16 and shown in Figure 13.

Table 16. Summary of costs and savings of end users under Option G.

	Base case cost of purchases discounted (Million Euro)	Additional product costs discounted (million Euro)	Base case cost of energy use discounted, (Million Euro)	Energy cost saving discounted (million Euro)	Net cost saving discounted (million Euro)
2012	€518	€ -	€ 936	€ -	€ -
2020	€401	€ 80	€ 1.029	€ 246	€ 165
2030	€292	€ 58	€ 1.155	€ 450	€ 391

Figure 13. Total annual end-user costs (purchase and energy).



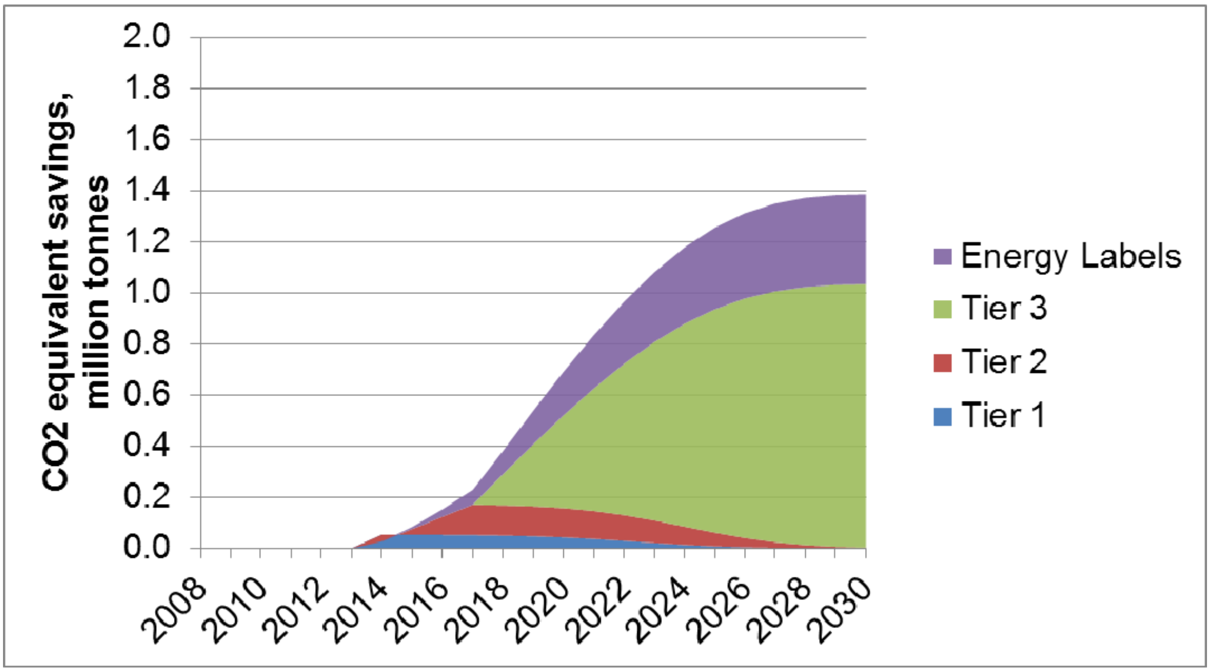
6.4.1.3 Impact on producers

Costs to manufacturers are identical to those that would be incurred under the energy labelling only scenario (Option F) since energy labelling already requires testing of products across the whole range of performance levels and the addition of minimum requirements would not add to the testing burden. Similarly, the other compliance burdens would be identical to those incurred under energy labelling.

6.5.2 Environmental impacts

The TEWI impacts are shown in Table 15 and savings are illustrated in Figure 14.

Figure 14. Relative CO_2 equivalent savings from Option G.



6.5 Risks and uncertainties, expected compliance patterns

The sources of uncertainty arising from the uncertainty in stock and sales data and estimates of average performance levels are detailed in Annex III.

Compliance with MEPS is anticipated to be good for all major EU manufacturers, many of which have actively participated in the development of the options. Compliance amongst smaller suppliers could not be high until enforcement takes hold, and allowance will have to be made for an economically viable schedule of testing and update of technical documentation. Authorities can also choose to check the technical files, which is a much cheaper option than testing.

It is unlikely that significant monitoring and enforcement resources will be directed at product testing in the short-term and so compliance will be heavily reliant on the accuracy of data declared by manufacturers. Given the fact that manufacturers would have to invest considerable resources in performance information and product development, manufacturer vigilance will be high (as indicated at manufacturer consultation meetings in May 2012). It is therefore likely that products suspected of not complying will be reported to the authorities if it is in the economic interests of competitors, as it will almost certainly be.

If compliance was seen to be poor, the benefits described in this impact assessment would rapidly deteriorate, particularly with regards to differentiating better performing products and so attracting and justifying the investment into them.

6.6 Timing of implementation

In the case of storage cabinets, it was originally planned to start to enforce the regulation in January 2014, and the quantification of the impact performed for this IA still uses that date as a starting point. However, following discussion with manufacturers the following dates could be considered, given that the new harmonised test method is planned to be published by the end of 2013:

- Eco-design information requirements from January 2015
- Tier 1 requirements and energy labelling from January 2015
- Tier 2 requirements from January 2016
- Tier 3 requirements from January 2018
- Review of the regulation in January 2018

Regarding blast cabinets, the envisaged starting date for the mandatory information requirements could be postponed to January 2016, in order to reduce the testing work-load on producers, in particular SMEs. At this regard, also the timing of some storage-cabinets sub-category could be delayed, in particular for the less common sub-categories, so that the energy savings would not be greatly reduced. Furthermore, also the timing of all professional refrigeration products could be coordinated; see Table 26 in Annex XI.

7. Comparing the options

Storage cabinets

Table 17 shows how the different options score in reference to the three criteria of effectiveness, efficiency and coherence, while Table 18 shows their concrete impacts. Option F (Labelling only) appears clearly to be inferior to the others, despite its positive effect on innovation. Namely, it achieves the lowest energy consumption reduction and the lowest savings for users, while imposing the same burden on producers as Option G (MEPS and Labelling). The reason behind this limited performance is that the market push (the removal of least efficient appliances) is diminished because poor efficiency models continue to exist on the market. In terms of coherence, it imposes a burden on companies and SMEs in particular without being very effective (as shown by the saving figures in the second table), thereby going against the spirit of both the Small Business Act and the Ecodesign Directive itself, while at the same time outperforming Option E in terms of being aligned with the focus on innovation of the Europe 2020 Agenda.

Table 17. Summary of policy option comparison

Option	Effectiveness to deliver on objectives	Efficiency	Coherence
Option A: No New EU action	0	0	0
Option E: Minimum Energy Performance Requirements (MEPS)	✓✓	✓✓	✓
Option F: Energy Labelling	✓	✓	✓
Option G: MEPS and Energy Labelling	✓✓✓	✓✓	✓

Scoring key: ✓✓✓ = large positive, ✓✓ = sizable positive ✓ = small positive, 0 = neutral, × = small negative, ×× = large negative.

Table 18. Summary of quantified impacts

Option	Total energy savings (until 2030, TWh)	Total TEWI savings (until 2030, Million tonnes)	Total savings to users (until 2030, million Euro)	Total costs to manufacturers (until 2014, million euro)
Option A: No New EU action	0	0	0	0
Option E: Minimum Energy Performance Requirements (MEPS)	3	1	277	2.39
Option F: Energy Labelling	1	0.4	114	11.1
Option G: MEPS and Energy Labelling	4.1	1.4	391	11.1

The comparison between Options E and G gives a less clear-cut picture. In terms of efficacy, Option G is clearly superior: it achieves more energy savings and more value added for users. Furthermore, also its effect on innovation and competitiveness is estimated to be more positive. On the other hand, the compliance burden it causes on producers, and SMEs in particular, is also greater, mostly because of the connected heavy testing burden. This might lead also to a more negative social impact. From the point of view of coherence, the two options seem to be equivalent, Option E scoring better in terms of the principles of the Small Business Act, Option G being closer to the goals of Europe 2020 and more coherent with the regulations of household refrigerators, which foresee both MEPS and energy labelling.

Nevertheless, Option G can still be deemed superior if the testing burden is reduced through the methods highlighted in Section 6.3.2.5: a scheduled entry into force of requirements for different storage cabinet categories and also for blast cabinets, and extensive use of agreed calculation methodologies that reduce the number of tests necessary to comply. Since such methods are clearly applicable, **Option G** can be considered the **preferred option**.

Blast cabinets

The limited market and performance data available for this product makes it extremely risky to go beyond the simple option of making the disclosure of harmonized performance data mandatory: the likelihood to set requirements at a wrong level is high. Furthermore, self-regulation is clearly not feasible, at least for the foreseeable future, because of the absence of a strong industry association that could coordinate it. The imposition of mandatory information requirements (Option D) imposes a cost on producers without contributing substantially to achieving the objectives of the Ecodesign Directive; therefore, it can be accepted only as a preliminary step for further policy measures. This is indeed the case: given the similarities between this product and its market and storage cabinets and their own market, it is clear that once data is made available by the mandatory information requirements the same policy options will become viable. Therefore, **Option D** is the **preferred option**.

Without the setting of mandatory information requirements foreseen by Option D, the situation is most likely to remain the same for a very long time: energy performance data would continue not to be published, the market would continue not to focus on energy efficiency, and no effective regulatory intervention would be made possible.

8. Monitoring and Evaluation

The main monitoring element will be the tests carried out to verify correct energy efficiency and labelling. This monitoring should be done by market surveillance carried out by Member State authorities ensuring that requirements are met. An effective market shift towards upper labelling classes will be the main indicator of progress towards market take-up of more efficient storage cabinets.

Specific indicators to monitor the evolution of the policy will be:

1. Availability of the necessary harmonised test methodology by end of 2013.

2. Availability of energy label information on manufacturer websites and in technical documentation in line with the mandatory requirements. This can easily be assessed with a survey and could be expressed as a percentage of models for which the mandatory information is found. Assessment of this should begin in mid 2015 in order to allow time for corrective action before review of the regulation must start, which will require a reasonable product performance data set.

3. Accuracy of reported performance information. There are 2 levels at which this can be assessed. Firstly, through the correlation of declared label class with performance data in the manufacturer's technical file, including test reports or other calculation methods. Such inspections could be carried out by independent experts with refrigeration engineering knowledge and familiarity with the test requirements. Secondly, through practical testing of products which should be selected as mainstream products with significant sales, with testing targeted at products for which data has been notified as potentially misleading. It is suggested that the first enforcement testing should begin in mid 2015, allowing time for manufacturers to adopt and bed in the new test and calculation methodology.

4. Absence of products not meeting the minimum requirements. This can be achieved through a simple survey of manufacturer performance data, carried out with the survey on data availability. A baseline survey would be valuable during 2014, with follow-up surveys required in 2015 to ensure Tier 1 compliance, followed by another survey in late 2016 for Tier 2 which would also feed into the regulatory review.

Coordination with member states' enforcement authorities would be useful, particularly once a testing programme is initiated. It is possible that the European industry associations could facilitate the public accessibility of product performance information. This possibility is worth exploring to reduce the cost and increase the accuracy of monitoring of product performance and compliance.

As previously mentioned a regulatory review is foreseen in 2017.

9. Annexes

Annex I: Consultations and Consultation Forum Minutes

Stakeholders consultations

In addition to the main consultations listed in Section 2.3, the following more specific ones were held:

- A meeting with manufacturers of blast cabinets and storage cabinets was held on 2 March 2012 in Brussels to identify key issues of concern.
- Additional meetings with manufacturers to discuss data analysis process, label thresholds and options to address concerns regarding storage cabinets were hosted on 15 May 2012 by the European industry association EFCEM and on 28 May by CECED Italia.

- An additional meeting was held for storage cabinets by the contractor to the Commission on 3 July 2012 to review the energy label thresholds and minimum requirements and finalize the proposals to address concerns.

The following table summarises the information about the consultations, their participants and their topics.

Table 19. Consultation events and numbers of participants / respondents

Consultation event	No. of manufacturer and industry participants / respondents	No. of government, NGO or other participants / respondents	Topics and Aims
Consultation forum 19 January 2012	c. 10 for both storage and blast cabinets	c. 45	Open meeting for all 5 Lot 1 product groups
Meeting with manufacturers 2nd of March 2012, Brussels	16 manufacturers, 4 industry associations represented	1 (European Commission)	Identified key issues of concern both storage and blast cabinets
Meeting with 3 UK manufacturers, 3rd of May 2012, Peterborough, UK.	3	None	Reviewed possible options for addressing identified concerns for storage cabinets, preparation for 15th of May
Meeting with manufacturers on 15th of May 2012, Brussels	11 manufacturers, 4 industry associations represented	1 (European Commission)	Hosted by the European industry Association EFCEM; data analysis process discussed and options to address concerns for storage cabinets.
Meeting with manufacturers on 28th of May 2012, Milan	20 manufacturers, 3 industry associations represented	2 (JRC, Italian Government delegate)	Hosted by CECED Italia; Review of interim data analysis, proposed label thresholds and proposals to address concerns for storage cabinets.
SME consultation via European Enterprise Network, 30 March to 21 May for blast cabinets, 4 June to 16	2 respondents for storage cabinets, 7 for blast cabinets	None	The consultation was based on a questionnaire detailing the main aspects of the proposed regulation, and inquiring about its impact on the market and SMES active in it.

July 2012 for storage cabinets.			
Consultation with stakeholders 4 April to 10 May for blast cabinets, 21 June to 20 July 2012	21 manufacturers (9 SMEs), 3 industry associations, 2 independent technical experts for storage cabinets; 7 manufacturers, 1 industry association, 1 technical expert for blast cabinets	4 Member States, 2 NGOs for storage cabinets, 4 member States, 1 market surveillance authority for blast cabinets	The consultation was based on a questionnaire detailing the main aspects of the proposed regulation, and inquiring about its impact on the market and the companies active in it.
Open informal consultation forum on 3rd of July 2012, Brussels for storage cabinets	18 manufacturers, 4 industry associations represented	9	Detailed review of energy label thresholds and minimum requirements, final review of proposals to address concerns.

Consultation Forum Minutes

MEETING OF THE CONSULTATION FORUM UNDER ARTICLE 18 OF THE ECODESIGN OF ENERGY-RELATED PRODUCTS DIRECTIVE (2009/125/EC)

POSSIBLE ECODESIGN IMPLEMENTING MEASURES AND ENERGY LABELLING REQUIREMENTS FOR PROFESSIONAL REFRIGERATION PRODUCTS

Held on 19 January 2012 (09:30 – 17:30)
Centre A. Borschette, Rue Froissart 36, 1040 Brussels

Chair: Kirsi Ekroth-Manssila
Assistants: Laure Baillargeon, Tobias Biermann, Ugo Miretti

1. Welcome, introduction, approval of the agenda

THE CHAIR welcomed the participants and recalled that the objective of this meeting was to get feedback and a clear 'mandate' from CF members on the appropriateness of Ecodesign and Energy Labelling requirements for professional refrigeration products. The vote in the Regulatory Committee was expected to take place in the first quarter of 2013.
THE COMMISSION presented the introduction working document (EDCF-2012-02-19-Doc01). Professional refrigeration products were primarily intended for the storage of foodstuff whereas commercial refrigeration was intended for the display and selling of foodstuff. This distinction was mainly useful for distinguishing between professional storage cabinets (ENTR Lot 1) and commercial display cabinets (ENER Lot 12). The Commission insisted on the role of food hygiene rules, installation and maintenance for these products, as well as the significant share of SMEs in this sector. The aggregated energy consumption of professional refrigeration products was 295 TWh in 2008 and estimated to grow up to 344

TWh in 2020. The saving potential from the envisaged Ecodesign requirements was estimated at 29 TWh in 2020 (including 21 TWh from condensing units). However, estimates needed refinement during impact assessment.
GERMANY, THE NETHERLANDS, THE UNITED KINGDOM, ITALY asked for good coordination in the process for adopting Energy labelling and Ecodesign requirements, to avoid, in particular, that delegated acts under the Energy labelling Directive would be finalised before the vote in the Regulatory Committee on corresponding Ecodesign implementing regulations. **ITALY AND THE NETHERLANDS** suggested putting a priority on some professional refrigeration products, taking into account criteria of Article 15 of the Ecodesign Directive (in particular, saving potential and sales), in order to avoid that the preparation of some Regulations could delay the swift adoption of others. **THE COMMISSION** explained that running parallel processes with different timings would be very complicated to manage, but that it would aim at avoiding delays.

2. Possible Ecodesign requirements for condensing units

THE COMMISSION presented the working document on condensing units (EDCF-2012-02-19-Doc06 to 06.2 and EDCF-2012-02-19-PPT05).
AUSTRIA stated that the adoption of a new standard on measurement of seasonal efficiency of condensing units should not delay the adoption of Ecodesign requirements. **CEN CENELEC** considered that no distinction should be made between professional and commercial condensing units. However, an update of EN13771 should be envisaged to allow for higher variability of test results as this test protocol was initially created for air-conditioning units also used in B2C markets. **THE NETHERLANDS** agreed that standards made for products sold in large numbers were not necessarily suitable for professional equipments, and asked why noise was covered by Ecodesign requirements for air-conditioners but not for condensing units. The impact assessment should demonstrate how Ecodesign requirements would promote more efficient technologies, including through benchmarks. **THE NETHERLANDS, ITALY, ECOS, GERMANY** supported a formula linking COP/ SEPR to cooling capacity rather than fixed COP or SEPR values by segment (whether linear or curved). **SWEDEN** underlined that the Commission should not be afraid of high market cut-off through Ecodesign requirements (as shown by the example of circulators, with a market cut-off of 95%). Tier-3 requirements could also be envisaged to anticipate on a future review which might turn to be more complicated than expected, except if a solution could be found to allow easier update of the Regulation. The use of CO2 as refrigerant (R744) was very efficient in indirect systems; it could be promoted through legal requirements (e.g. bonus or ban). **THE UNITED KINGDOM** suggested using the ambitious recommendations from the preparatory study as benchmark levels. The use of low GWP refrigerants could at least be supported by information requirements. **AUSTRIA** asked whether energy labelling of chillers and condensing units was envisaged. Any trade-off between energy efficiency and alternative refrigerants such as CO2 should be identified by the impact assessment. **ECOS** supported the introduction of Tier-3 requirements, voluntary benchmarks and legal provisions promoting the use of low GWP refrigerants. **DENMARK** indicated that CO2 was also used in direct systems in supermarkets, but underlined that the market for condensing units also included smaller users. **GERMANY AND INFORSE** supported more ambitious Tier-2 requirements. **ITALY** underlined that Tier-3 requirements, if erroneous or excessively ambitious, could also create undue market shocks.
ASERCOM indicated that the use of CO2 as refrigerant was suitable in colder climates and reminded that condensing units were tested with ambient temperature +32°c. In addition, condensing units were sold as incomplete systems, and therefore tested according to a pre-set evaporating temperature (-10°c or -35°c). Once installed, the evaporating temperature might

actually be higher. Besides, suitable compressors for CO2 condensing units were not available yet. The market for refrigeration systems in supermarkets could hardly be compared with the market for condensing units. **EUROVENT** suggested that COP or SEPR could be calculated and not necessarily tested in order to decrease testing costs. **THE NETHERLANDS** opposed to this suggestion, and asked that refrigerants would be addressed at least through information requirements.

THE COMMISSION summarised and concluded that the draft Regulation would not distinguish between "professional" and "commercial" condensing units. Noise was not relevant at first sight (Machinery Directive, no data) but this should be confirmed after impact assessment; information requirements could be envisaged if relevant. The impact assessment would need to further investigate the impacts on costs, technologies and energy savings of the envisaged requirements, so as to adjust the stringency of Tier-1 and Tier-2 requirements if necessary, taking into account, in particular, the best available technology (or product) and the least life cycle cost. Voluntary benchmarks, Tier-3 requirements and labelling would have to be considered among possible policy options. A more in-depth technical analysis of the refrigerants issue was still necessary, including availability and market penetration of technologies, their costs, related safety issues, other technical constrains and any trade-off with energy efficiency. This was necessary to properly impact assess the various policy options (ban, bonus, information requirements). The impact assessment would also consider the appropriateness of a formula linking COP/ SEPR to cooling capacity. The Commission indicated that COP and SEPR could be calculated when basing on "representative models" (in that case, the representative model would have to be tested but COP and SEPR values for "equivalent" models could be derived from these test results).

3. Possible Ecodesign requirements for refrigeration process chillers

THE COMMISSION presented the working document on refrigeration process chillers (EDCF-2012-02-19-Doc05 to 05.2 and EDCF-2012-02-19-PPT04).
THE NETHERLANDS, BELGIUM, ITALY, SWEDEN stated that the data presented was not sufficient to substantiate the proposed Ecodesign requirements. **THE NETHERLANDS** recommended that the Commission envisaged the adoption of information requirements only, in case the lack of data for chillers would risk delaying the decision-making process. **ITALY** underlined that information requirements generated administrative burden for manufacturers and market surveillance authorities. Such burden was justified only if sufficient energy savings were achieved through combined information and performance requirements. **THE NETHERLANDS** replied that providing information on energy performance was usually a contractual obligation on B2B markets anyway, and that a harmonised standard was already available for chillers. The Commission should confirm whether information requirements implied product testing by market surveillance authorities or merely a check that required information was provided in product technical documentation. **SWEDEN** indicated that the burden of the proof was on manufacturers to demonstrate the accuracy of the information contained in product documentation. Information requirements were useful to allow designers and manufacturers to compare and thus optimise their products. The existing measurement standard was suitable, provided tolerances would be clearly specified. In Sweden, chillers were used as an alternative to condensing units to reduce refrigerants charges. **BELGIUM** added that data was only available for HFC models, whereas HC models were already being used in Nordic countries. More data should be provided on the energy efficiency of models placed on the market today, but also on the link between refrigerants and energy consumption. **NORWAY** recalled that the base case was using R134a and R404a, but that the use of low GWP refrigerant such as R290 allowed higher energy efficiency. **DENMARK** recommended

that envisaged requirements would be compared to existing minimum requirements in Australia and New Zealand. **ASERCOM, EUROVENT** explained that the lack of data had been the very reason for establishing a joint expert group, and that industry was supportive of minimum performance requirements. Performance data was not available, but the group had assessed the feasibility of minimum requirements on the basis of a detailed thermodynamic analysis. **ECOS** underlined the risk of adopting not very ambitious minimum performance requirements due to lack of data. These requirements would stay in place until the review in 4 years. This would constitute a missed opportunity for energy savings. **CEN CENELEC** stated that chillers for air-conditioning and for refrigeration at high operating temperature (+6°c) had identical technical features and that manufacturers did not know which application their products were intended for. Additional testing for refrigeration chillers was not useful and, besides, SEPR rating conditions were not suitable for air-conditioning chillers. Verification tolerances for air-conditioning chillers were 5%. **ASERCOM** replied that a single measurement standard could not be applied to air-conditioning and refrigeration chillers due to different load profiles and cooling demand over the year.

THE COMMISSION summarised and concluded that the impact assessment would look for additional data on energy consumption of models currently sold on the EU market, and/or that the thermodynamic and technical analysis would be beefed up. Additional background on low GWP refrigerants would be sought, in particular on the link between refrigerants and energy consumption. The intention remained to adopt minimum performance requirements for chillers, on the basis of a specific measurement standard for refrigeration applications[27]. The impact assessment would include some international benchmarking. Administrative burden would be investigated through a specific SME consultation. High temperature chillers for air-conditioning would fall in the scope of ENTR Lot 6 whereas high temperature chillers for refrigeration fell in the scope of ENTR Lot 1.

4. Possible Ecodesign and Energy labelling requirements for professional refrigerated cabinets

THE COMMISSION presented the working document on professional refrigerated cabinets (EDCF-2012-02-19-Doc02 and EDCF-2012-02-19-PPT01).

AUSTRIA recommended using a single measurement standard (EN 23953) for commercial display cabinets and professional storage cabinets with transparent doors. The Option 2 formula needed refinement but was preferable to Option 1.
EFCEM suggested paying special attention to testing costs due to the significant proportion of SME assemblers and because of the high degree of customisation of products. Besides, manufacturers had to ensure that their products deliver the expected functionality also in extreme ambient conditions. The product data from the English and Danish voluntary schemes (measured with EN441) was not representative of the market. EFCEM was going to submit additional data and an alternative proposal of measurement method. **EUROVENT** estimated that testing results under EN441 and EN23953 were equivalent. But the door opening protocol in EN23953 was not suitable for professional cabinets. Option 1 seemed more convenient for users and more in line with the English scheme. Option 2 included inconsistencies. **THE NETHERLANDS** supported Option 2. International benchmarking should be beefed up. Article 4(2) of the Ecodesign Regulation on household washing machines could serve as an example how to deal with 'equivalent' models to reduce testing

[27] In case a model is intended for use in both air-conditioning and refrigeration applications, this model should therefore be tested both with EN14511/EN 14825 (SEER) and with the specific refrigeration standard (SEPR).

costs to manufacturers. According to data presented by **ITALY** (EDCF-2012-02-19-PPT01.2), the base case was overestimated. Data showed that it was appropriate to differentiate products according to design and operating temperature, but not to volume. Therefore, Option 2 could be acceptable if refined with 4 sub-categories. The proposed requirements were not realistic when compared to market reality, in particular for under-counter models and chest freezers. The case of chest freezers deserved special attention to avoid inconsistencies or loopholes in legislation. The technical features of domestic and professional models were almost identical, but these would be covered by different Ecodesign requirements and measurement standards. **BELGIUM** supported Option 2. Besides, meters displaying energy consumption in real time should be required on all models. **DENMARK** acknowledged that data from the Danish voluntary scheme was not representative of the market. Minimum performance requirements and energy labelling requirements should be made more stringent. The energy consumption measured with EN23953 was ~10% lower than with EN441, and results of comparative tests would be submitted to the Commission. However, these comparative results were available for energy efficient models only, and might not be valid for other models. The Option 2 formula could be linear or curved against volume, and this should be elaborated on the basis of product data. The method for net volume measurement and calculation was not sufficiently clear. **SWEDEN, ECOS** supported the adoption of minimum performance requirements and energy labelling requirements, but these should be made more stringent. **ECOS** requested that the use of low GWP refrigerants would be incentivised and asked why noise was submitted to information requirements for domestic fridges and not for professional fridges. **EFCEM** replied that noise was not problematic in professional environments and that testing noise performance was excessively costly.

THE COMMISSION summarised and concluded that minimum performance requirements and labelling classes would be refined during impact assessment, taking into account new data submitted in the next few weeks –data should first be made comparable. Based on the discussion, the intention was to refine Option 2 to eliminate inconsistencies, and elaborate a formula against volume and with 4 sub-categories according to design and operating temperature. Energy consumption would be measured according to a standard specific to professional refrigerated cabinets. Additional evidence should be sought on low GWP refrigerants. It was intended to beef up international benchmarking. The calculation and measurement of net volume, the special case of chest freezers and the possible general requirement on energy meters would also be analysed in more details. Professional storage cabinets with transparent doors could be distinguished from commercial display cabinets according to intended use. It was not intended to exclude these from the scope of the future Regulation. However, noise did not seem to deserve further consideration.

5. Possible Ecodesign requirements for blast cabinets

THE COMMISSION presented the working document on blast cabinets (EDCF-2012-02-19-Doc03 and EDCF-2012-02-19-PPT02).

ECOS considered that the data presented was not sufficient to substantiate the proposed Tier-1 requirements. In addition, no benchmark and no Tier-2 requirements were proposed. A mid-term target was at least necessary. **DENMARK** broadly supported the proposed approach and the introduction of minimum performance requirements. However, the proposed test material (smashed potatoes) should be changed. **THE UNITED KINGDOM** suggested distinguishing between “pass-through” models and “conveyer belt” models, and to set an upper threshold in terms of capacity to better define the scope of the Regulation. The Commission selected the

English temperature cycle as a reference for testing. However, many models were designed for use in other EU countries where less stringent temperature settings were tolerated. These models might not be able to reach the English temperature requirements. **ECOS** insisted that the future harmonised standard should be uniform and reproducible. The French standard AC D40-003 was a suitable hygiene standard but might need adaptation for energy consumption measurement. **SWEDEN** indicated that models placed on the market in Sweden and Finland were designed to comply with local food safety rules, with much lower temperature requirements compared to the English cycle. These might not be able to comply with requirements based on the English cycle, or would be put at a disadvantage. The Commission could propose information requirements only as a first step. **EFCEM** indicated that the English cycle was defined by Health Guidelines and was not mandatory in the UK. The Regulation could base on another cycle, as a compromise. However, the difference between plug-in blast cabinets (integral condenser) and remote blast cabinets (attached to a remote condensing unit) should be carefully taken into account in the test protocol and in terms of measured energy consumption. The proposed minimum performance requirements were too stringent. **BELGIUM** asked how new data could be obtained, and whether energy labelling was envisaged. **AUSTRIA, THE NETHERLANDS** suggested not proposing any Ecodesign Regulation for blast cabinets. **EFCEM** indicated that some test results with the French standard could be made available. **ECOS** supported the adoption of Ecodesign requirements. Sales of blast cabinets followed a growing trend and would increase in the future. **SWEDEN** indicated that national regulations should be further analysed. Ecodesign requirements might not be adequate if national regulations were too diverging. However, Sweden supported the introduction of Ecodesign requirements in principle if a proper harmonised standard could be elaborated. **BELGIUM** supported the adoption of an Ecodesign regulation.

THE COMMISSION summarised and concluded that new data would be looked for during impact assessment. If no data was available, mandatory information requirements on the basis of a proper harmonised standard could be an acceptable first step, before a review in maximum 4 years, or the Commission could consider "no action" as the preferred policy option. The French standard seemed acceptable for the bulk of the test protocol, but some further discussion would be held on the adequate temperature cycle and on the test material. In addition, national regulations on food hygiene would be further analysed.

6 Possible Ecodesign requirements for walk-in cold rooms

THE COMMISSION presented the working document on walk-in cold rooms (EDCF-2012-02-19-Doc04 and EDCF-2012-02-19-PPT03).

EFCEM did support the introduction of insulation requirements (U values). **EUROVENT** supported the introduction of insulation requirements. However, the U values associated with various thicknesses as presented in the working document needed to be corrected. **NORWAY, DENMARK, ECOS** supported more stringent U values. **GERMANY** supported more stringent U values for doors and windows. **SWEDEN, ECOS** supported the introduction of Ecodesign requirements for cold rooms in general. Sweden, in particular, recommended more stringent U values in low temperature cold rooms – these should correspond to at least 160-mm thickness. Besides, consistency between proposed U values and national building regulations should be checked. **DENMARK** offered to share data on insulation in the residential sector. **ECOS** stated that the overall level of ambition of the working document was not sufficient, with no Tier-2 requirements and no benchmarks, despite the availability of some highly performing technologies such as vacuum insulation panels. The cost of insulation much depended on the considered lifetime (much longer for

vacuum insulation panels than for polyurethane). **GERMANY** stated that voluntary benchmarks should be considered. **NORWAY** indicated that many cold rooms were renovated rather than replaced and wondered to which extent this could be considered under the Ecodesign Directive. **THE UNITED KINGDOM** supported the use of gross storage volume (rather than net storage volume) and 1% tolerances for all thermal bridges values. The recent US test protocol on walk-in cold rooms should also be considered as a valuable precedent. Beer cellars, hence any cold room operating above 8°c, should be excluded from the scope of the Regulation. **EUROVENT** supported the use of gross storage volume and suggested to differentiate between several categories of cold rooms according to volume. Proposed U values were slightly too stringent and alternative proposals would be submitted to the Commission. Besides, U values should refer to initial lambda values (as opposed to aged lambda values). **PAN AND PRO EUROPE** offered to provide additional data on U values of insulating panels. The aged lambda value was already dealt with under EN14509. Vacuum insulated panels were not covered by existing standards.
ITALY, THE UNITED KINGDOM, HUNGARY, ECOS wondered how market surveillance could work in practice, notably for checking the proper construction of a kit or the proper installation of a customised cold room. **ECOS** observed that installers would be in charge of placing on the market and CE-marking for customised cold rooms. **ITALY** underlined that cold rooms could not be withdrawn from the market if not compliant, especially if forming part of the building.

THE COMMISSION summarised and concluded that it would be checked whether walk-in cold rooms usually form part of the building and whether and how these products were addressed by national building regulations. The intention was to go ahead with mandatory requirements on insulation (U values), installation requirements and information requirements. However, additional data would be looked for during impact assessment in order to ensure that U-value requirements were adequate. Depending on data availability, benchmarks and Tier-2 requirements could be envisaged. The Commission agreed to use gross storage volume as a basis. Significant standardisation work was necessary (including for example to cover vacuum panels with existing standards). An informal meeting with standardisers and representatives of industry would be organised soon to discuss standardisation needs on insulation and refrigeration efficiency.

Annex II: Scope of the regulation

Storage cabinets

The proposed definition for the regulation, taking on board feedback from the stakeholder consultation in July 2012 is:

An insulated cabinet integrating at least one energy-consuming condensing unit and one or more compartments accessible via one or more doors and/or drawers, intended for the refrigeration and/or freezing of foodstuff or the storage of refrigerated or frozen foodstuffs for use by food service professionals but not for display and sale to customers.

Considered as excluded from the scope are:

- Cabinets operating with a remote condensing unit
- Open cabinets
- Open top preparation tables and saladettes
- Cabinets that carry out food processing and not just storage function (e.g. bakery cabinets that chill, heat and humidify)
- Serve-over counters and any other form of cabinet primarily intended for display and sale of foodstuff.
- Cabinets specifically designed for the purpose of thawing frozen foods in a controlled manner.
- Cabinets specifically designed for the storage of medicines and scientific samples.
- Cabinets that do not use a vapour compression refrigeration cycle (including absorption and thermoelectric based systems)

Exempted from requirements, at least until regulatory review are:

- Built in cabinets
- Roll in and roll through cabinets
- Static air cabinets
- Fridge-freezer cabinets: these constitute around 1% of all sales and inadequate performance data is available to set robust requirements. Requirements could be included at a conservative level and reviewed at the first opportunity, but given the testing burden already imposed on manufacturers, the energy savings could be forfeited at little overall loss of impact but appreciable reduction of testing burden. These are recommended for inclusion in scope but exemption from requirements until regulatory review.

Special requirements are to be included for some subcategories, which have been individuated through the consultation process described in Section 2.3; in some cases it will be delegated to the standardization bodies to find a way to account for them in a proper and fair manner. It should be noted that the envisaged context of use plays an important role for the characteristics of the product; in particular, the cabinet has to be able to perform at different temperature and climate classes. For instance, heavy duty cabinets are designed to operate in very demanding conditions (e.g., a busy kitchen), and therefore tend to have larger components and consume more energy, while the opposite is true for light duty ones, designed to operate in less demanding environment such as the cafeteria of a hospital. Here is a list of the envisaged special requirements:

- **Professional chest freezers**. These are to be made subject to the same mandatory energy requirements as household chest freezers and also carry and energy label that is directly comparable to the household label. To be decided whether the label needs to be made specifically different to the household label to distinguish it from household products.
- **Light duty or semi-professional cabinets**: to be tested at climate class 3 and an adjustment factor to be provided to render the results directly comparable with cabinets tested at climate class 4. Through that adjustment of results, these cabinets

would be required to meet the same requirements and carried the same energy label as standard cabinets. The label is to make clear the intended purpose of the cabinet.

- **Heavy duty cabinets**: cabinets that are proven capable of meeting temperature requirements under climate class 5 to be exempted from Tier 2 and Tier 3 minimum requirements. These cabinets to be tested in climate class 4 conditions for the purposes of meeting Tier 1 requirements and allocating and appropriate energy label.

- **Multi use cabinets**: cabinets which can be set to perform at frozen or chilled temperatures depending on user settings shall be tested and qualified at the coldest temperature.

- Cabinets with **transparent doors**: cabinets for which the door is over 75% glazed (precise the definition to be developed) are to be subject to the requirements for retail display cabinets under DG ENTR Lot 12, requirements yet to be developed. Cabinets for which the door area is less than 75% glazed are to be subject to the requirements of this professional storage cabinet regulation. No special allowances are to be given and the energy label should reflect the generally poorer energy efficiency performance of such cabinets; transparent door cabinets have to meet the same minimum requirements as solid door cabinets.

- CEN TC44 Working group 2 will be requested to review whether cabinets with **very small internal volume** (potentially using a threshold value of less than 100 L) should be able to make use of an adjusted volume in their calculation to ensure that they are not unjustifiably forced off the market where they actually present an option consuming less energy than a larger but more *efficient* cabinet.

- **Under counter cabinets** should be treated identically to other counter cabinets with no special allowance. It is unlikely that they would achieve as high energy efficiency but buyers should be able to decide based on fair relative energy consumption information.

- The issue of **counter frozen cabinets** was discussed in some detail at 3 July open consultation meeting. It is apparent that these cabinets would struggle to achieve energy level classes of D or C for an internal volume above 250 L – see Figure 19. This could result in there being no products on the market with a 'good' energy label and much of the market being eliminated at Tier 3. It may be appropriate to split the frozen counter cabinet category into 2 size segments, above and below 250 L. The current reference line and labelling scheme should apply to the smaller segment and a new reference line and thresholds developed for the larger segment. This is not an urgent requirement and could probably be addressed at the 1st review when more data should be available.

- A request was received at 3 July consultation forum to include **water cooled cabinets** within the scope of the regulation (i.e. those making use of a water loop to take heat from the condenser, instead of an air cooled condenser). Such products would achieve a significantly better energy efficiency but may not come within the scope of the harmonised standard and so may not be possible to include. CEN TC44 WG 2 will be asked to investigate.

Blast cabinets

A 'blast cabinet' is defined as a refrigerated enclosure primarily intended to rapidly cool hot foodstuff down to below +10°C in the case of chilling and below -18°C in the case of freezing. The scope of the envisaged regulation includes cabinets designed only for chilling, only for freezing and combination cabinets designed for both processes. It includes both integral cabinets and cabinets designed for use with a separate condensing unit. To load foodstuff into the cabinet, trays can be used ('reach-in' designs) or trolleys ('roll-in' or 'pass-through' designs).

This covers a wide range of foodstuff capacity: typical capacities can vary from 3 kg to 100 kg in the case of reach-in equipment or from 30 kg to 240 kg in the case of trolley equipment. Available evidence indicates that 85% of sold blast cabinets the EU market are integral cabinets and 15% are remote. But remotes tend to be larger (often trolley equipment) and so account for higher than 15% of energy.)

Considered as excluded from the scope are

- walk-in blast rooms (for which the doorway and internal space is large enough for a person to step inside)
- continuous-process blast equipment (for example equipment with a conveyor belt to feed product through).

Annex III: Data Sources and Modelling

Storage cabinets

The data used in this IA can be divided into two categories: those about the efficiency profile of the products, and those about their stock and sales numbers.

From the point of view of the efficiency profile of the products, the data used in the preparatory study and consequently the regulatory proposals based on them have been considered insufficient (both by stakeholders and the IA study contractor) for a number of reasons:

a) They were based only in the UK and Danish data set detailed below.

b) The fixed threshold failed to set requirements proportional to the internal volume and so larger cabinets would find it much easier to meet the requirements.

c) They were based upon a dataset that consisted of only the UK and Danish endorsement schemes (see Section 3.3.2) and so represented only the better performing products on the UK and Danish markets.

d) They did not refer to any sub-types of product such as semi-professional, heavy duty, product variants etc.

e) They were not based on a harmonized test methodology and thus results are not necessarily comparable with other data.

This situation has emerged during the consultation process, in particular in the Consultation Forum. Therefore, a new data set was collated for the Ecodesign Standardisation Project[28] with the aim of increasing the amount of data and making it homogenous through a standardization process that considered the different methodologies behind each data source and accounted for them. The EU part of the data set consisted of some 1.100 products and was obtained from the following sources:

[28] Final report, AEA/R/ED57346, Issue Number 1, Date 06/07/2012, Contract number SI2.624689, AEA Technology plc and Tait Consulting Limited, author Jeremy Tait.

a) CECED Italia data set [29]. Claimed to be representative of the Italian market. Supplied directly by CECED Italia.

b) UK Enhanced Capital Allowance (ECA) scheme database. Only better performing models of certain types of product. Downloaded from ECA scheme web site[30] using 'compare details' settings to yield maximum data fields.

c) Danish energy-saving scheme[31] database. Better performing models of certain types of product, but which are estimated to account for 80% of Danish sales of these types of cabinet.

d) EU manufacturer data set. This represents some mainstream products from two suppliers.

The data in these sets consisted of figures derived from several different test methodologies, these were normalised to be comparable based on adjustments calculated from a spreadsheet model of a chilled and a frozen cabinet. CECED Italia has provided assurances that the Italian models in the database represent about 70% of the Italian market and represent quite fairly also other markets (e.g. France, Spain and Greece). This assumption has been accepted in the consultation process. Unfortunately no indications could be provided about the Polish market (probably the biggest market missing in the database). The data is probably less representative of products imported from the Far East, Turkey and other significant minority supplying nations. It is important to note that no data were available for sales weighted efficiency profile, but only on the efficiency of single products, regardless of the numbers produced of each. Figure 10 and all Figures in Annex VIII give a graphic representation of how the products are spread in terms of their efficiency. The following table reports how distant the performance of the average product on the market is from the one attainable using the best available technology. The source is the EU data set described above.

Table 20. Market average and best available performance levels for storage cabinets with energy saving %, by type.

	Indicative average volume (litres)	Typical (market average) efficiency 2011, kWh/24hrs	Best available consumption 2011. BAT, irrespective of price. kWh/24 hrs
Chilled vertical (CV)	600	4.20	1.3
Chilled counter (CH), including under-counter	300	7.60	1.5
Frozen vertical (FV)	600	11.10	5
Frozen counter (FH), including under-counter	200	10.30	4

[29] Available at http://www.ceceditalia.it
[30] See http://etl.decc.gov.uk/etl/find/
[31] See http://www.savingtrust.dk/public-and-commerce/products/professional-white-goods

Source / rationale	Rounded value from average in EU data set	Figures derived from the All EU data ref. line; modification of CV average from stakeholder feedback	Taking figures based on judgement for the all EU data set

From the point of view of the stock and sales numbers of the products, the data are taken from the preparatory study (Table 2-6) which were extrapolated up to the EU 27 from UK and French statistics published by the UK Market Transformation Programme MTP[32] and BSRIA[33]. This is undoubtedly the most significant source of uncertainty in the estimates of energy consumption and savings potential for this product impact assessment. It is unknown whether this would result in an over or under-estimate, nor of the magnitude of uncertainty.

Regarding the modelling, the following table gives an overview of the assumptions and the source of the data that underpinned it.

Table 21. Assumptions underlying the main baseline model inputs

Aspect	Assumption	Comments	Source
Total sales	Data from Prep study for 2008 taken as accurate, removing remote cabinets from the total.	Extrapolated to EU from a survey of French industry. Fridge freezers and chest freezers ignored (only 1.4% and 1% of total)	Prep study Table 2-6
Sales growth over time	0.91% per year growth	Quoted as CAGR (compound annual growth rate)	Prep study Table 2-2, with Figure 2-4 showing continuation of this rate to 2025
Sales and stock breakdown by type	Same breakdown assumed for stock and sales. 70% vertical; 30% counter; 69.3% chilled; 30.7% frozen.		Prep study table 2-6.
Total stock	Data from Prep study for 2008 taken as accurate, removing remote cabinets from the total.	Extrapolated to EU from a survey of French industry. Fridge freezers and chest freezers ignored (only 1.4% and 1% of total)	Prep study Table 2-6
Stock growth over time	Stock calculated from stock model based on sales, product lifetime (and standard deviation of 2)		
Lifetime	Adopted from Preparatory study, assumes 8.5 years		Prep study Task 4, Table 4-24
Usage	8,760 hrs per year from Prep study	Based on 24 hrs per day.	Prep study Task 4 report page 64.
Average efficiency	Based on the reference line for energy labels calculated from the data set of all EU products. Chilled vertical consumption modified slightly for this IA analysis following stakeholder feedback		Report *Ecodesign Standardisation project on Refrigerated Storage Cabinets*
Change in efficiency over time	Only MEPS impact efficiency change (ie no underlying improvement). Calculated as the average of the products in the dataset that meet the MEPS levels	This gives a conservative scenario	Assumption

[32] UK Defra statistics available at http://whatif.mtprog.com/
[33] BSRIA "French Market for Refrigeration" 2009

Annual consumption (kWh per year)	Calculated for each product type as average kWh/24 hrs x 365.		(calculated)

Selling price

The data used at this regards is taken from the preparatory study, which performed an accurate study of the catalogues of storage cabinets. The average selling prices had been estimated there to range between € 850 and over € 3,000; depending on the size, operating temperature, and the exterior of the cabinet (i.e. stainless steel or white). Typically, a stainless steel exterior will be € 100 - € 300 more expensive than an equivalent model with a white exterior. For comparison, a US study[34] estimated the price of a freezer service cabinet at around US$ 2,200 (approx. € 1,620) for a volume of 24ft^3 (approx. 680 litres), and the price of a refrigerated service cabinet at US$ 2,500 (approx. € 1,835) for a volume of 48ft^3 (approx. 1,360 litres).

Table 22 details the price ranges to buyers according to the type of storage cabinet.

Table 22: Average prices for storage cabinets

Net storage volume, V (litres)	Description	Average selling price (€)
V <400	Refrigerator	850 – 1,300
	Freezer	1,000 – 1,400
400< V <600	Refrigerator	1,000 – 2,000
	Freezer	1,400 – 2,500
V >600	Refrigerator	1,500 – 3,000
	Freezer	1,500 – 3,000

Blast cabinets

In terms of the efficiency profile of the products, the data is extremely scant and, when available, not reliable nor comparable. As explained in Chapter 3, very often the energy performance data is not published at all, and when available, in the absence of a common testing method, it does not permit comparison and ranking of products.

In terms of numbers of sales and stock, the figures for blast cabinets are taken from the preparatory study, and are based both on data from the BSRIA report on French Market for Refrigeration and consultation with stakeholders. The BSRIA report considers that blast

[34] Arthur D. Little, Inc. *Energy Savings Potential for Commercial Refrigeration Equipment, Final Report Prepared for US Department of Energy*. 1996

equipment sales and installed base were similar to that of the storage cabinets for year 2007. This could be explained by the French law that encourages establishments to pull down the temperature of foodstuffs in a certain period of time (French law of 29/09/1997) after being cooked. As result of this law, France is a very significant consumer of blast equipment. Also, France's use of blast equipment is expected to be one of the highest in Europe when considering that the country has 15% of hotel and restaurant establishments in Europe, after Spain and Italy only. Furthermore, according to Eurostat figures, France accounted for 26% of new hotel and restaurant establishments from 2003 to 2007. In particular, for the same years studied by the BSRIA report, France had the third highest growth in this sector. Catering is considered an increasing consumer of large blast cabinets, leading to a slight increase in sales. However, these companies are likely to purchase fewer larger units than restaurants. Considering these aspects, the sales for France are estimated to represent 25% of the total European market. According to stakeholders, figures for blast cabinets might represent around 10% of sales for service cabinets in average in Europe. France presents an extreme ratio between blast and service cabinets (1:4). By contrast, Northern European markets seem to have only 1 blast cabinet per every 20 service cabinets. Considering the 5 top countries (66% of the total figure) with new establishments (which are suppose to drive the growth in blast cabinets sales) between 2003 and 2007, the approximate trend of growth if 2.15% per year. This trend is considered applicable for the EU for the coming years. Importantly, stricter food safety requirements could greatly impact the number of sales, as it has happened in France, also in other countries. However, since no such new regulation has been found to be either introduced soon or in the pipeline, this eventuality has not been quantified. Consequently, the estimation of the sales stock of blast cabinets in the future could have to be revised substantially upwards if such regulations were to be introduced.

Annex IV Electricity Emissions factors

To estimate the impact of energy consumption (or savings) on the atmosphere one has to consider the greenhouse gases emissions connected with the production of energy. Clearly, they vary a lot according to the energy source used (coal, wind, gas, etc). While we know the energy mix currently in use, we have to assume the energy mix in the future to estimate the potential future emissions. The energy mix is then translated into emission factors, which one multiplies by the energy consumption to have the corresponding emissions, expressed in TEWI. In the case of this IA, as in all Ecodesign regulations, the emission factors are from the MEErP 2011 Methodology, final report, part 1[35]. The downward trend visible in Table 23 is due to the expected rise of renewable energy sources within the energy mix.

Table 23: Electricity emission factors used

[35] Methodology for Ecodesign of Energy---related Products (MEErP 2011), Methodology Report Part 1: Methods, COWI / Van Holsteijn en Kemna B.V. (VHK), prepared for DG ENTR under contract SI2.581529, Delft, 28 November 2011. page 142.

Year	Electricity emissions factor kg CO_2/kWh
2010	0.41
2011	0.407
2012	0.404
2013	0.401
2014	0.398
2015	0.395
2016	0.392
2017	0.389
2018	0.386
2019	0.383
2020	0.38
2021	0.376
2022	0.372
2023	0.368
2024	0.364
2025	0.36
2026	0.356
2027	0.352
2028	0.348
2029	0.344
2030	0.34

Annex V: Technology

The tables below, originating from the preparatory study, present the energy efficiency improvement options, estimates of their current market penetration, their energy saving potential and cost. First are listed those already available (BAT, or best available technology), then those that are not yet (BNAT). It should be noted that the IA does not foresee the endorsement of any specific technological solution, since the envisaged implementing measures of the Ecodesign Directive would be designed in such a way that only performance levels would be targeted, while the industry would be free to find a way to reach them, in order to respect the principle of technology neutrality.

Table 24: Technological options to improve storage cabinets' energy efficiency

BAT	Applicability (years)	Market penetration (%)	Savings for HT (% TEC)	Savings for LT (% TEC)	Increase in price of HT product (€)	Increase in price of product LT (€)
High efficiency compressor*	Now	40	7	10	20	40
ECM evaporator fan	Now	20	12	7	18	18
ECM condenser fan	Now	20	8	3	20	20
High efficiency fan blades	Now	20	3	3	5	5
Sealing door face frame	Now	N.A.	19	26	0	0
Insulation thickness	Now	35	4	5	100	110
R290 (Gas)	Now	10 to 20	5**	5**	40	40
Zeolite filter cassettes	Now	N.A.	0.5	2	90	90
Bubble expansion valve	Now	NA	10 to 20	10 to 20	N.A.	N.A.
Defrost control	Now	30	-	3	-	50
Anti-condensation control	Now	N.A.	2 to 20	-	N.A.	-
Insulation material	Now	N.A.	2	2	330	1115
BNAT						
VSD compressor	2 to 3	N.A.	10	10	80	168
Hot gas anti-condensation	2 to 3	N.A.	18	9	94	94
ECM compressor	2 to 3	N.A.	12	12	108	122
Hot gas defrost	2 to 3	N.A.	N.A.	8	N.A.	129
R744	2 to 3	N.A.	N.A.**	N.A.**	N.A.	N.A.

**Selected from technologies related to the component*
***The benefit of this improvement is also the lower GWP of the refrigerant and reduced refrigerant charge – although it could provide high energy savings at no extra cost, it has flammability issues.*
N.A.: Data not available
Note: Savings are not additive.

Table 25: Technological options to improve blast cabinets' energy efficiency

BAT	Applicability	Market penetration (%)	Savings (% TEC)	Increase in price of product (€)
High Efficiency Fan Blades	Now	0%	9%	10
Electronic expansion valve	Now	5%	15%	100
Variable speed drive (VSD) compressor	Now	2%	10%	400

BAT	Applicability	Market penetration (%)	Savings (% TEC)	Increase in price of product (€)
Insulation thickness	Now	5%	4%	100
ECM Fan for evaporator	Now	<5%	7%	40
Defrost Control	Now	5%	3%	10
Electronic Expansion Valve (EEV) when integrated with floating head pressure	Now	2%	20%	100
Remote condensing	Now	<1%	15%	1200
Full baffling	Now	99%	6%	Negligible
R290	N.A.	N.A.	5%	200
CO2	Now*	N.A.	N.A.	N.A.
BNAT				
ECM compressor	2 to 3 years	0%	10%	100
Improved heat exchanger**	Now***	5%	5%	60
Unsaturated HFC blends	3 to 4 years	0%	0****	300

Applicable only for remote condensing units
***Selected from technologies related to the component*
****Tested in prototypes, but there is no evidence of current application in the market*
*****The benefit of this improvement is also the lower GWP of the refrigerant and reduced refrigerant charge – although it could provide high energy savings at no extra cost, it has flammability issues. No evidence of currently available equipment has been found*
N.A.: Data not available
Note: Savings are not additive.

Annex VI: Refrigerant gases

The key points for storage cabinets are:

1. Hydrocarbon refrigerants, with low GWP, are available for professional storage cabinets from a selection of major manufacturers. The market share of these professional products is not well documented but probably, according to the IA study research, between 1% and 10% of the whole EU market (0% in France and over 70% in Denmark). The growth of hydrocarbon refrigerants in the household refrigerator market sets a precedent that this sector could follow in many respects, especially if a current regulatory limit of 150 g maximum charge size in some MSs were to be reviewed.

2. Hydrocarbon refrigerants offer significant energy-saving potential for these products (supported by the vast majority of stakeholder respondents on this issue) and so the existence of MEPS and an energy label will in itself provide a driver for the more widespread deployment of low GWP refrigerants.
3. The existence of a malus or bonus for low GWP refrigerants would distort the buyers' perceptions of the energy consumption of the products if it allowed to declare a better or worse energy performance than the real one.
4. These products, and all other refrigeration products, are already covered by the F-Gas regulations to address GWP of refrigerants. Manufacturers strongly support the principle that GWP should be left to the F-Gas regulations and energy efficiency should be dealt with separately under Ecodesign/energy labelling.
5. F-Gas Regulations already require that the refrigerant and charge weight are declared on the product, but this could be made more prominent in literature and on the product itself.

A bonus could be given for products that use hydrocarbon or other low GWP refrigerants in the form of an additional fixed amount to subtract from the EEI which could push the cabinet into a better energy label class. The size of this bonus could be set in some way commensurate to the net environmental impact benefit in kilograms CO_2 terms. One possibility is that the direct emissions impact over the product lifetime should be calculated, assuming a given leakage rate and end of life emissions; and the EEI is credited to a level that gives the same net kg CO_2 impact.

As an example calculation, a chilled vertical cabinet using the estimated overall sales-weighted average GWP of 2349 with 1% leakage per year, 0.5 kg charge, 8.5 year life and 0.125 kg end of life emissions would result in 394 kg CO2 equivalent direct emissions over its life. The same cabinet with hydrocarbon R290 (GWP 3) would result in <1 kg CO2 equivalent direct emissions. The difference in direct emissions of 393 kg is equivalent to 990 kWh electricity consumption over the product lifetime (assuming an emissions factor of 0.392 kg CO2/kWh, the approximate figure for 2016 halfway through the cabinet's life if sold today). An average cabinet has annual energy consumption of 1.533 kWh/year (Table 24) and so this direct emissions benefit is equivalent to around 8% of lifetime energy related emissions (8.5 x 1.533 = 13.030 kWh). The statistics of this would have to be properly investigated and justified in terms of different cabinet types, refrigerants, leakage rates, end of life emissions and energy consumption but a reasonable overall figure could be derived.

Overall assumptions: for the estimation of the direct refrigerant related TEWI emissions in Figure 3, as well as for as for the example above, the overall sales-weighted and refrigerant charge-weighted average GWP of 2.349 has been used. This weighted average GWP is based on the conservative assumption that the only refrigerant used are R134a (GWP: 1430) for chilled cabinets and R404A (GWP: 3922) for frozen cabinets; the average reflects their market shares. A leakage of 1% and end of life emissions of 25% are foreseen. The 25% figure is a simplification of the higher emissions at the present time and the growing rate of recovery[36] to be expected in the next year as a consequence of the F-gas regulation coming into force. If the growing use of refrigerant R290 (hydrocarbon with a GWP of 3) in these products had been taken into account, the average GWP would be have been reduced substantially.

[36] It should be considered that the average life of this products amounts to 8.5 years. Therefore, the proposed regulation would affect end of life emissions by storage cabinets no sooner than in 2023.

For completeness, consultation feedback on refrigerants for storage cabinets is provided below:

- 22 respondents said that hydrocarbon refrigerants would result in lower energy consumption; 7 thought efficiency would be about the same; none believed hydrocarbons would result in higher energy consumption. 6 said that hydrocarbon refrigerants were not practical for use in their products.
- Regarding CO_2 as a refrigerant: 8 believed that this would result in higher energy consumption, 5 thought about the same; none believed that use of CO_2 would result in lower energy consumption; 9 said that it was not practical for use in their products, 11 did not know.
- 18 respondents stated that there were barriers that prevent use of low GWP refrigerants; 4 said there were no such barriers. The barriers identified, in descending order of mention were:
    - Maintenance of product (15)
    - safety of product[37] (12, plus several additional comments)
    - Lack of training for staff (9)
    - Cost of refrigerant (4)
    - Other (13)
    - ('Higher energy consumption' was offered as an option but nobody selected this)
- Other barriers mentioned were: the 150 g regulatory limit for maximum charge size (3 mentions); capabilities of service engineers (1); customer concerns (2); Compressor availability and cost (1);
- Estimates of the proportion of storage cabinet sales that use low GWP refrigerants varied greatly from 0% in France to around 75% in Denmark. The majority of estimates were in the region of 1% to 10%.
- One stated that the market is moving towards hydrocarbons quickly and does not require any malus/bonus to encourage this.
- One respondent provided some detailed evidence from the US and other places regarding reviews of safety requirements to allow wider deployment of hydrocarbons.

It is recommended that Option F, bonus/malus for products with specific refrigerant GWP values should be considered at the time of regulation review along with evidence of the feasibility of such measures. A requirement to publish the refrigerant used and its GWP should be included in the regulation but the impact assessment does not analyse any impact or costs associated with this further, as they are considered to be negligible.

Annex VII: Estimation of compliance costs of Option E

The estimation of the cost of testing is detailed in Annex X, where it is quantified for Option F, energy labelling, because it is much more significant in that case. It is assumed that for option E the additional testing costs would be 20% of those caused by Option F, since

[37] The main low GWP refrigerant option for these products would be hydrocarbons which are highly flammable but widely used for domestic products of similar sizes.

products close to the thresholds would be tested, while for others less precise but also less expensive methods are more likely to be used.

Here are analysed the potential compliance costs to manufacturers associated with Option E, which comprise:

- Technical analysis to review product range, select products that will require testing and ensure that minimum requirements are met
- Costs of changes to CE marking and other mandatory information requirements
- Costs of undergoing compliance inspection and monitoring by public authorities

CE marking is not a new requirement although an update is required for the new regulation. The additional costs outlined below are therefore a worst case estimate of the additional administrative burden.

a) **Technical analysis of product range:** Technical analysis in checking product performance data for products that might not comply with the minimum requirement is assumed to be required on around 20% of products (manufacturers will have or soon develop rationales of which products are marginal):

- Number of products to be analysed is 20% of 6 variants for 14 families or 17 products
- Allowing 2 days per product at €300 per day
- Details must be established over a period of 1 year from availability of the test method (early 2013) to start of information requirements (January 2014).

This implies a one-off cost for companies of 17 x 2 x 300 = **€10.200 per manufacturer.** Costs of preparation of technical literature are therefore 50 x 10.200 = €0,51 million in total for 50 companies for the EU as a whole.

b) **Additional CE marking** costs are incurred to update and provide the mandatory information and edit the data associated with each product:

i. Since the same changes occur to all products, there would be a one-off fixed cost for preparing a new metal label stamp to label products, plus associated documentation, suggested at **€1.500 per manufacturer** (author's estimate) and so €75.000 across the EU (50 manufacturers).

ii. There would then be a cost of €0,5 per product sold to affix the amended CE label (author's estimate); total product sales are approximately 389.000 per year giving a total cost of around €195.000 for all manufacturers across the EU, equating to 195.000 / 50 = **€ 3.900 per manufacturer** on average. This cost would only apply to products requiring re-labelling. New products manufactured after the label had been revised would not incur additional costs.

c) **Inspection and enforcement costs**: As the information requirements and minimum performance requirements are now mandatory, we assume that there will be additional inspection and enforcement by the regulatory authorities to ensure compliance. This will result in costs for manufacturers in preparing for and undergoing inspections. Assuming that:

i. each manufacturer will be inspected once every five years

ii. preparation for and undergoing inspection will require 5 days at €300 per day (€1.500)

This implies an annual cost of 50 x 0.2 x 1500 = c. € 15.000 across the EU, or **€ 300 per manufacturer.**

Annex VIII: Energy Efficiency Classes

Notwithstanding some detailed feedback from 3 July meeting regarding frozen counter and small internal volume cabinets, stakeholders were very supportive of the proposed energy labelling requirements. Very few cabinets would exist in the A+ or A++ categories suggesting reasonable scope for differentiating the performance of future high performing products, and products are spread throughout the other categories so a significant proportion of the labelling spectrum should be used.

The rationale used to derive the reference lines for the energy labels is reported in the eco-design standardisation project report, and in particular in the document entitled *Derivation of reference lines and energy label thresholds from EU data, plus taking into account some reference to US/Canadian data*, which appears as appendix 12 of the project report.

Example graphs are given below showing how the proposed energy label thresholds subdivide the available EU product data. Figure 15 shows the proposed labels for chilled vertical cabinets; Figure 16 shows the label thresholds suggested by ENEA for this category. Note that the proposed thresholds have fewer products in the top classes and are generally slightly more stringent. The subsequent Figures 17, 18, and 19 show the proposed thresholds for chilled counter, frozen vertical and frozen counter cabinets. Note in Figure 19 for frozen counter how no products with a volume of 250 L achieve higher than the energy label class D - the implications of this and possible remedies are mentioned in Annex II.

Some product types, such as very small cabinets, frozen counter cabinets and possibly chilled counter cabinets may find the requirements particularly challenging and less high label class products will exist for those types. It is, however, unlikely that these product types would be entirely driven from the market especially given that a possible reclassification of frozen counter cabinets is feasible.

Due to the existence of several fairly low-cost energy efficiency improvement options, combined with optimising designs at low or zero cost, it is likely that the majority of the market will move rapidly up through the energy label classes during the 1st and 2nd years of the regulation.

Figure 15. Proposed energy label thresholds for chilled vertical cabinets showing Italian data (orange), UK ECA (dark blue), Danish Go Energi (yellow), other EU suppliers (light blue).

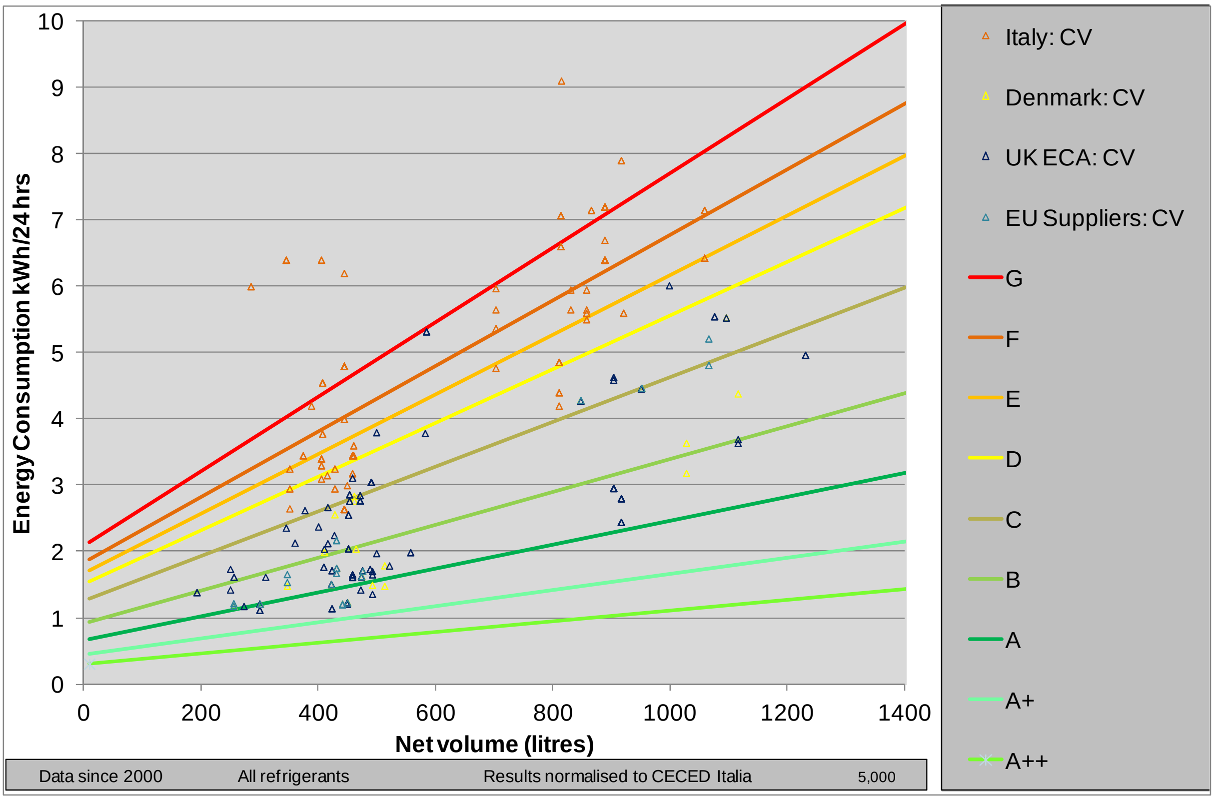


Figure 16. Energy label thresholds as proposed by ENEA (data: same as in Figure 15)

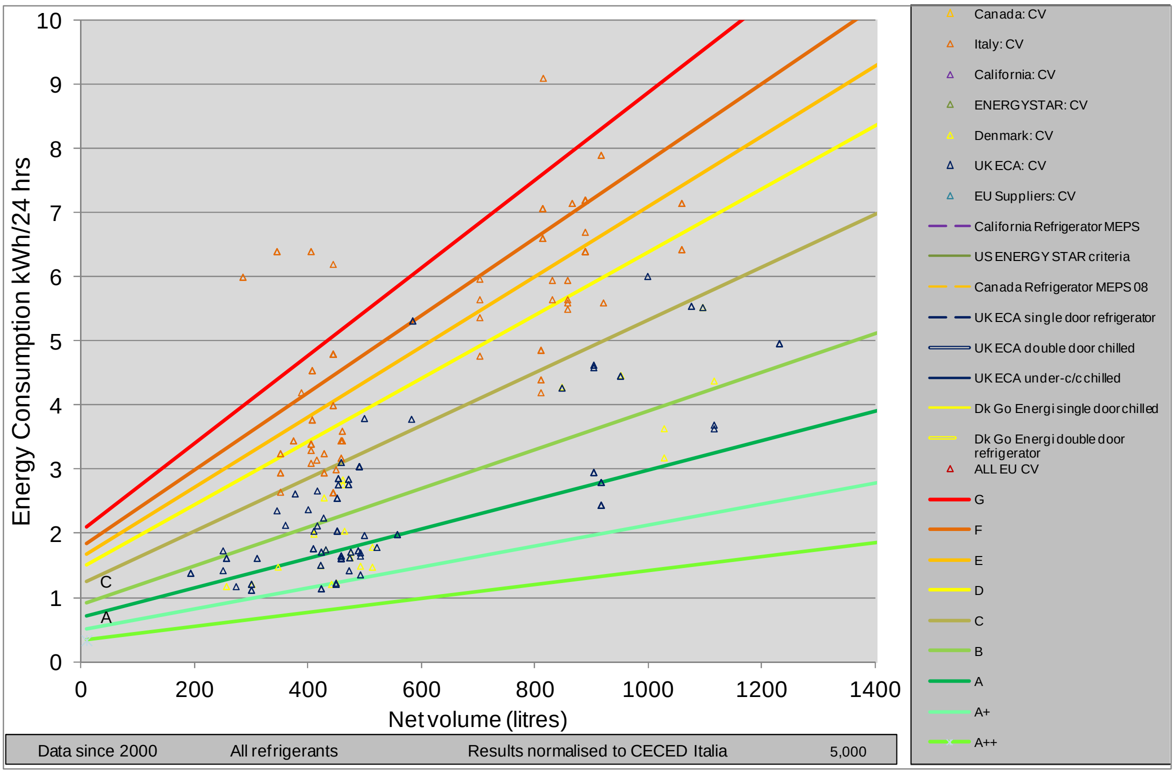


Figure 17. Proposed energy label thresholds for chilled counter cabinets (data: same as in Figure 15)

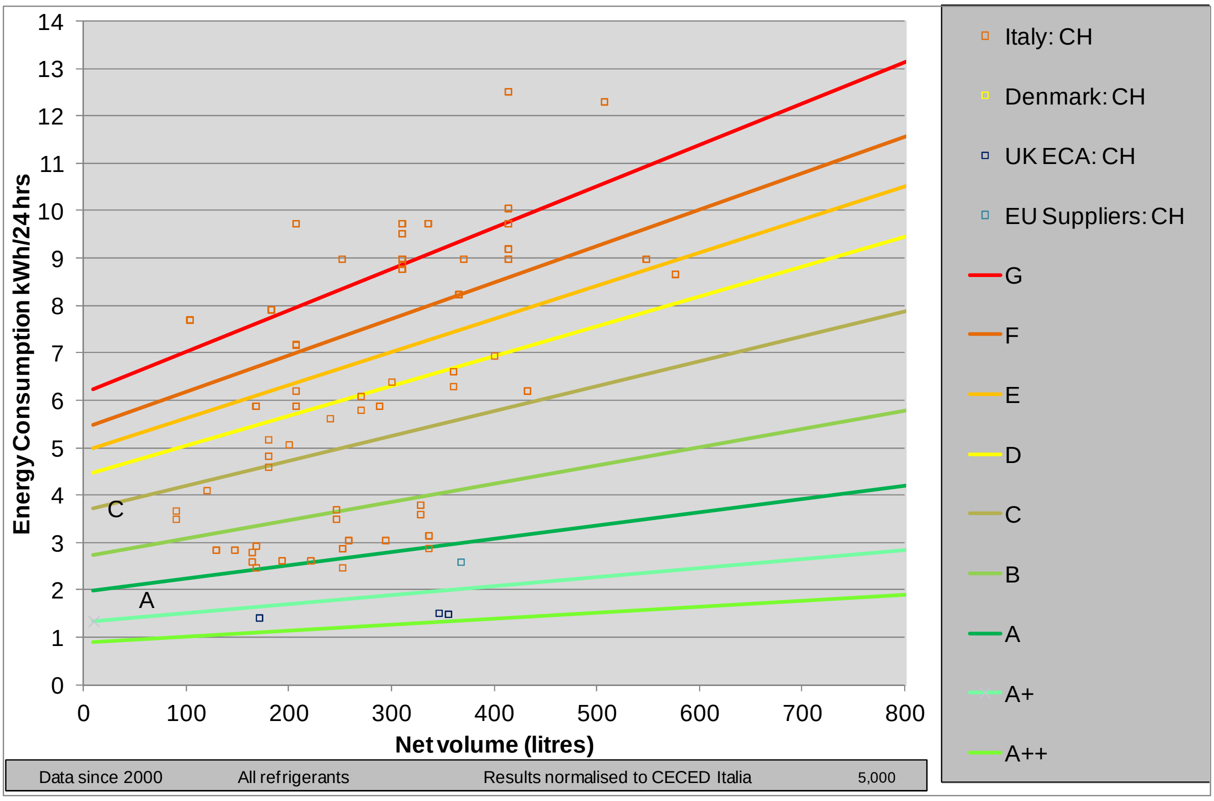


Figure 18. Proposed energy label thresholds for frozen vertical cabinets (data: same as in Figure 15)

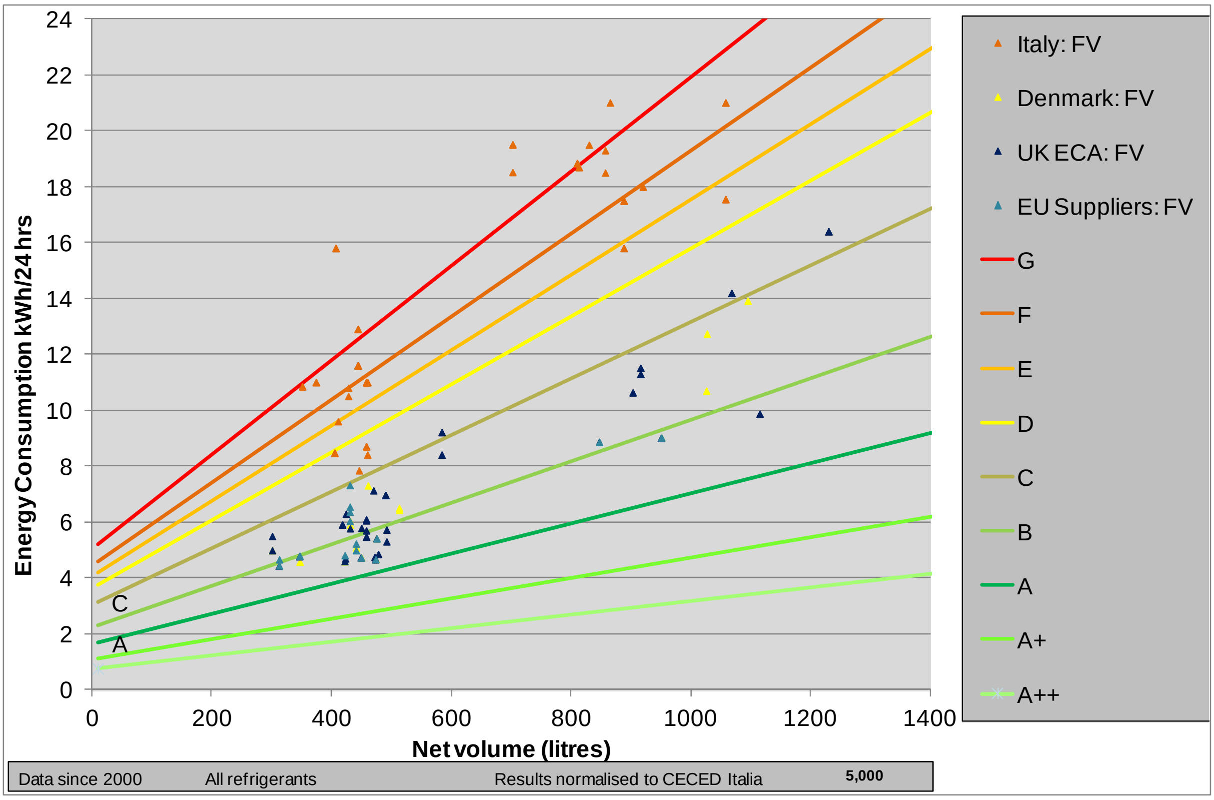
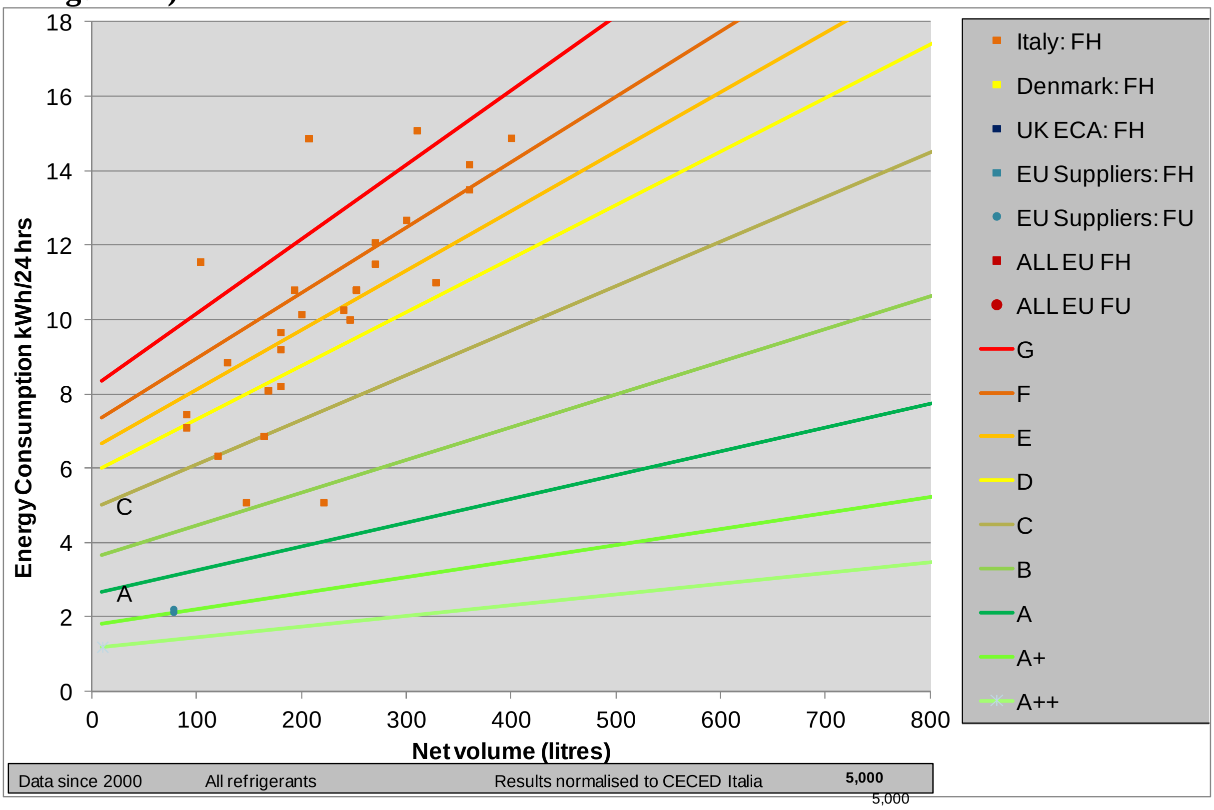


Figure 19. Proposed energy label thresholds for frozen counter cabinets (data: same as in Figure 15)



Annex IX: Quantifying the impact of labelling

The generic impacts of energy labelling on the distribution of sales by efficiency for any given product are illustrated in Figure 4, showing how the distribution is generally shifted towards improved efficiency including encouraging the deployment of highly efficient products. This contrasts with the impact of only minimum requirements which simply cut off the poor performing products at the left of this diagram. There is plenty of evidence that this effect occurs for household appliances[38] but none that a similar effect would occur for commercial products as this would be the 1st such label. However, the fact that a major European trade association (CECED Italia) backed by several major EU manufacturers had developed its own voluntary energy labelling scheme is proof that it is a commercially attractive proposition to help differentiate better performing products. Feedback from the manufacturers involved at a meeting on 28th May 2012 confirmed that the label is being applied to better performing products for the involved manufacturers.

A voluntary energy label would probably not be applied by manufacturers to poor performing products. However, a mandatory energy label can influence the market in 3 distinct ways:

a) The presence of labels throughout the efficiency range enables a functioning competitive market based on energy efficiency since buyers can make informed choices and will have energy performance information made available for the purchase decision.
b) Clear marking of poor performing products would discourage many (but not all) manufacturers from having such products in their range. Its effect could achieve some of the impact of a minimum requirement.
c) Robust labelling of better performing products helps justify to buyers the investment in those premium products which may command a premium price. This will help encourage (and fund) innovation.

In order to estimate the impact of energy labelling alone, it is assumed that many manufacturers will be motivated to improve the performance of their products once mandatory labels are established. Some limited evidence shown in Figure 20 implies that energy labels alone for household refrigerators resulted in a 2% per year improvement in sales weighted average efficiency between 1994 and 1997, followed by a 5% improvement to 1998.

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[38] For example that collected in the report: Impact assessment study on a possible extension, tightening or simplification of the framework directive 92/75 EEC on energy labelling of household appliances, Appendix 1 Literature review carried out by Europe Economics, 12 October 2007.

Awareness of energy labels is now much higher than in 1995 but moves toward more efficient products will be particularly constrained in this market by price pressures. Energy labels alone for professional storage cabinets are likely to achieve a reduction in the average daily energy consumption year on year for a period following introduction. Taking the household refrigerator evidence to indicate a scale of impact, a reduction has been assumed of 2% in the first year following start of labelling; a further 3% reduction in year 2 as the competitive market for energy issues takes hold; a further 2% for each of the next 2 years and 1% after the fifth year, thereafter level.

Some illustrative comparison between anticipated impact of energy labels and the proposed minimum requirements may be useful: manufacturers accounting for half of annual sales may be sufficiently motivated by the labels on those with the lowest label classes to voluntarily withdraw them from the market (author's estimate). This could achieve half of the impact of Tiers 1 and 2 (withdrawal of half of the energy label G products and half of the energy label F products). The requirements that could be introduced under Tier 3 are significantly more demanding and have a correspondingly significant (20%) increase in product prices. It is much less likely that manufacturers would voluntarily achieve the phase-out of these products under mandatory energy labels alone. Thus overall, mandatory labelling might create an impact on the poorer performing section of the market equivalent to around half of the savings achieved through mandatory minimum requirements from only Tier 1 and Tier 2 (which have been modelled for the MEPS option). It has not been attempted to model this impact on poorer products but its effect is included in the modelling described above affecting the whole market.

Results are shown in the main text. Growth over this period is driven by the increase in stock.

Figure 20. Improvement in sales weighted annual average efficiency for household refrigerators as a result of energy labelling, from EU literature review[39]

	EU	AU	Bel	Den	Fra	GB	Ger	Ita	NI	Por	Spa	Swe
1998	85.5	77.3	84.1	87.3	89.7	96.8	71.7	90.8	77.9	92.8	95.5	85.1
1997	90.0	82.6	88.8	88.8	95.0	100.5	77.9	95.2	81.4	102.0	94.6	89.8
1996	91.8	85.5	95.6	91.3	98.1	101.8	78.3	97.0	84.3	104.0	98.2	92.2
1995	93.9	87.9	97.0	93.1	101.6	103.4	80.6	99.3	88.2	106.3	100.5	95.0
1994	96.1	89.4	99.4	95.3	104.7	103.3	84.7	101.7	92.3	108.8	99.6	97.2
GEA	102.2	95.1	105.7	92.8	103.9	108.9	96.6	105.1	99.0	121.4	101.0	97.4

Source: Energy efficiency trends for refrigerators, freezers, washing machines, wash-dryers and household sold in EU, 2001

39 Impact assessment study on a possible extension, tightening or simplification of the framework directive 92/75 EEC on energy labelling of household appliances, Appendix 1 Literature review carried out by Europe Economics, 12 October 2007.

Annex X: Cost of testing to manufacturers for Labelling (Option F)

The cost of testing the manufacturers as a result of mandatory energy labelling is estimated to be significantly higher than the cost of testing under only minimum requirements. This is because of the need to test products over the full range of performance levels, not only those at risk of failing the requirement.

Questions were asked in the stakeholder consultation about the cost of testing. Initial estimates suggested that a single door cabinet test would cost around € 8.000; a test for a double door cabinet around € 10.000.

16 respondents said that the single door test estimate was about right; 11 disagreed and made suggestions ranging from €1.200 to € 20.000, and even € 40.000 for multiple tests on a single cabinet during redesign according to one respondent. The conclusion reached was to retain the € 8.000 estimate for the purposes of impact assessment estimates.

For double door cabinets, 17 respondents said this was about right; 9 disagreed and made suggestions ranging from €1.200 to € 25.000. Similarly, the original € 10.000 estimate will be retained for this impact assessment estimate.

As an example, one medium-sized manufacturer provided a detailed analysis of their potential testing programme as a result of mandatory energy labelling. This included the statement that

'Compliance testing is of a nominal duration of 2 weeks. The preparation and stabilisation period is usually a minimum of 72 hours with a test time of 48 hours. It routinely takes 2 [test] *cycles to deliver a test result. RD&T* [internal test department] *normally take 2 weeks per test'*.

Their product range that will be within scope of the proposed regulation includes 10 basic families of product which between them have 34 different types of product; 70% of those 34 have 2 temperature variants and 70% are available with a choice of 2 refrigerants. This gives a total number of product variants of 101 that could potentially require testing, excluding variants related to racking. 13 of these products types are potentially offered with glass doors.

The range of testing facilities available to manufacturers, and so the cost of testing, varies significantly between different manufacturers and so the accuracy of this analysis is further reduced.

The proposed requirements result in the following impacts to cost of testing:

- To date there has not been a harmonised test methodology specifically for these products although all major manufacturers and many of the smaller ones will have adopted testing according to one of several alternative test methodologies adapted for the purpose from tests designed for retail display cabinets. There was no previous requirement for testing and no particular customer interest in results, other than for reliability. Hence this regulatory requirement will significantly increase the amount of testing that has to be carried out across the sector, particularly for smaller manufacturers.
- The anticipated test methodology is based on existing methods with slightly reduced door opening regimes and is therefore no surprise for manufacturers already involved in testing. Existing test facilities can continue to be used where they complied with the requirements for testing of, for example, retail display cabinets.

- Many manufacturers have expressed concern at the potentially exorbitant cost of testing every variant cabinet, but this will not be required. Manufacturers will have to apply judgement as to the proportion of products that have to be tested. The regulation will not require every product to be tested and extrapolation and calculation will be allowable according to the judgement of the manufacturer to ensure robust results achieved at proportionate cost. For example, less testing would be required for products sold in low numbers and for these calculation based on the nearest similar product would probably be deemed adequate; performance under different refrigerants could be estimated by calculation once a reasonable body of evidence is established on the relative performance of refrigerants given the typical engineering of the manufacturer's cabinets.
- It is arguable that additional test facilities may be required in the sector to meet testing demand. The availability of calculation methods mean that manufacturers have a short term alternative whilst a test program proceeds and there should be no shock investment required.

The following assumptions are made about total tests required per year:

- The effort necessary to carry out a cabinet test in in-house facilities is around 7 man-days.
- Manufacturers have between 6 and 20 families of applicable product (small producers often have more variants so numbers may be similar) – assume average of 14
- Each family contains 2 to 10 product variants - assume 6 average
- Testing is required on 50% of variants within each family, with the remainder covered through extrapolation or calculation from the tested results
- In any given year, testing is required on 60% of the total cabinets to be tested in the range.
- 70% of cabinets are single door; 30% double door
- Number of manufacturers in EU assumed as 50: The preparatory study identified 6 major manufacturers in Europe (Table 2-16 in the preparatory study task 2 report); 22 manufacturers responded to the questionnaire, which covers all of the major ones engaged in the process and active in their industry associations – perhaps an equal number of smaller but still significant companies are not engaged.
- Half of manufacturers are already testing to a similar methodology and those are testing half of the product range that might be required under the regulation. I.e. four times as much testing will be required under the regulation.

Thus under the base case (prior to the proposed regulations), the average number of tests per year for a typical manufacturer might be:

(14 families x 50% of 6 variants) x 60% in each year = 25 tests per year

Total costs per manufacturer and for the sector for testing might be:

- Assuming a typical €8.000 per single door test and €10.000 per double door test, overall average per test is (70% x 8.000 + 30% x 10.000) = € 8.600.
- Total cost of 8.600 x 25 = €215.000 per year per manufacturer for all testing
- With 50 EU manufacturers, industry cost is 50 x 215.000 = € 10,75 million per year

- For context, this is equivalent to around 2% of the value of EU sales (value of €520 million).

If, as noted above, currently half of manufacturers are already testing to a similar methodology and are testing half of the product range that might be required under the regulation – meaning 25% of the total testing is currently incurred anyway. So 75% of it is newly stimulated by the regulation – 75% x 215.000 = € 161.000 per manufacturer in new testing as a result of this regulation. Or € 8,1 million per year for all EU, or 1,6% of total sales value at 2008.

This seems fairly high as a cost impact to the sector. Given these costs and the high pressure on manufacturers to carry out testing on a very wide range of products in a short time, options should be considered to delay implementation of requirements for some product types which constitute a relatively small proportion of overall sales. For example, cabinets with transparent doors, professional chest freezers, and possibly frozen counter cabinets (additional data would be desirable for these anyway). This concession could mitigate the impact on manufacturers, and particularly smaller manufacturers.

Other compliance costs

In addition to the cost of testing described above, the potential administrative burdens to manufacturers associated with Option F comprise:

- Costs of revising product information for users to include the mandatory information requirements;
- Cost of applying the energy label;
- Costs of changes to CE labels; and
- Costs of undergoing compliance inspection and monitoring by public authorities

The costs of providing the mandatory product information and applying the energy labels are calculated below. The costs of changes to CE labels and the costs of undergoing compliance inspection and monitoring are identical to those described under Option E.

a) **Technical analysis and performance information:** Technical analysis in developing claimed product performance data will be incurred on around 75% of products as some variations do not affect energy performance:

- Number of products to be analysed is 75% of 6 variants for 14 families or 63 products
- Allowing 2 days per product at €300 per day (author's estimate)
- Details must be established over a period of 1 year from availability of the test method (early 2013) to start of information requirements (January 2014).

This implies a one-off cost for companies of 63 x 2 x 300 = **€37.800 per manufacturer.** Costs of preparation of technical literature are therefore 50 x 37.800 = €1,89 million in total for 50 companies for the EU as a whole.

b) **Energy labelling costs:** there is a cost for producing the energy label fiche and ensuring it is supplied with the product. This has been estimated at € 2 per label (author's estimate), i.e. € 2 per product sold. This equates to 2 x 389.000 = 778.000 per year for all EU companies, or **€ 15.600 per manufacturer**.

a) **Additional CE marking** costs are identical to those for minimum requirements only, and incurred to update the information, and edit the data associated with each product are €1.500 per manufacturer for the stamp (author's estimate) and € 3.900 per manufacturer on average for marking products (only applies to products requiring re-labelling; new products manufactured after the label had been revised would not incur additional costs).

Inspection and enforcement costs: are identical to those for minimum requirements only, and amount to € 300 per manufacturer**.**

Annex XI: Envisaged timing for all professional refrigeration products

Table 26. Summary of implementation timing

Product	Information requirements	Tier 1	Tier 2	Tier 3
Condensing Units (Option E)	January 2014	January 2014	January 2017	TBD
Condensing Units (Option F)	January 2015	January 2015	January 2018	TBD
Chillers (LT and MT)	January 2014	January 2014	January 2017	TBD
Chillers (HT, Option G)	January 2014	January 2016	January 2017	TBD

Storage cabinets	January 2015	January 2015	January 2016	January 2018
Blast cabinets	January 2015	TBD	TBD	TBD
WICR	TBD	TBD	TBD	TBD

TBD: to be decided

The implementation timing can change, and probably will, according to the availability of testing methodologies, the positions emerged in both the ISC (Inter-service consultation) within the Commission and in the regulatory committee. Table 26 provides more a representation of how the timing could be scheduled rather than a fixed timetable.

Annex XII: MEPS Stringency and their effects on energy savings

Table 27. Market average and best available performance levels for storage cabinets with energy saving resulting from the introduction of Tiers 1, 2, and 3 by cabinet type[40].

	Indicative average volume (litres)	Typical (market average) efficiency 2011, kWh/24hrs	Base case AEC kWh per year (prior to Tier 1)	Best available consumption 2011. BAT, irrespective of price. kWh/24 hrs	Tier 1 MEPS for a cabinet of the average volume (maximum consumption)	% annual energy saving, base case to post Tier 1 as a result of MEPS alone	Tier 2 MEPS for a cabinet of the average volume	% annual energy saving, base case to post Tier 2 as a result of MEPS alone	Tier 3 MEPS for a cabinet of the average volume	% annual energy saving, base case to post Tier 3 as a result of MEPS alone
Chilled vertical (CV)	600	4.20	1,533	1.3	5.46	15.5%	4.81	24.4%	4.37	26.4%
Chilled counter (CH), including under-counter	300	7.60	2,774	1.5	8.76	17.3%	7.71	33.6%	7.01	36.2%
Frozen vertical (FV)	600	11.10	4.052	5	15.17	7.4%	13.35	17.8%	12.13	26.9%
Frozen counter (FH), including under-counter	200	10.30	3,760	4	12.15	13.1%	10.69	18.8%	9.72	29.5%
Source / rationale	Rounded value from average in EU data set	Figures derived from the All EU data ref. line; modification of CV average from stakeholder feedback	Average consumption for each type in kWh/24 hrs x 365 days per year	Taking figures based on judgement for the all EU data set	Calculated from ref line and proposed MEPS EEI ratio	Calculated from average consumption of All EU data set products that pass Tier 1	Calculated from ref line and proposed MEPS EEI ratio	Calculated from average consumption of All EU data set products that pass Tier 2	Calculated from ref line and proposed MEPS EEI ratio	Calculated from average consumption of All EU data set products that pass Tier 3

[40] Source data: preparatory study and impact assessment study as detailed in Annexes III and V.