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IMPACT ASSESSMENT

Accompanying the document

COMMISSION REGULATION (EU) …/… laying down ecodesign requirements for refrigerating appliances with a direct sales function pursuant to Directive 2009/125/EC of the European Parliament and of the Council

and

COMMISSION DELEGATED REGULATION (EU) …/… supplementing Regulation (EU) 2017/1369 of the European Parliament and of the Council with regard to energy labelling of refrigerating appliances with a direct sales function

{C(2019) 1815 final} - {C(2019) 2127 final} - {SEC(2019) 338 final} - {SWD(2019) 353 final}

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

1. INTRODUCTION

Directive 2009/125/EC of the European Parliament and of the Council establishes a framework for the Commission, assisted by a regulatory committee to set Ecodesign requirements for energy-related products. An energy-related product, or a group of energy-related products, shall be covered by Ecodesign implementing measures, or by self-regulation (cf. criteria in Article 17), if the energy-related product represents significant sales volumes, while having a significant environmental impact and significant improvement potential (Article 15). The structure and content of an Ecodesign implementing measure shall follow the provisions of the Ecodesign Directive (Annex VII).

This study assesses the impacts of different policy options for commercial refrigeration cabinets in the context of the Ecodesign Directive 2009/125/EC and the Energy Labelling Directive 2010/30/EU. The preparatory study for commercial refrigeration cabinets has concluded that these appliances comply with the criteria in Art. 15, sub 1, of the Ecodesign Directive and are therefore a candidate for measures.

This report presents the results of the Impact Assessment carried out on proposals of implementing measures on ecodesign and energy labelling of commercial refrigeration.

2. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

2.1. Organisation and timing of the IA and regulatory committee

Article 19 of the Directive 2009/125/EC foresees a regulatory procedure with scrutiny for the adoption of implementing measures. Subject to qualified majority support in the regulatory committee and after scrutiny of the European Parliament, the adoption of the measure by the Commission could take place by end 2015.

This policy initiative was launched in 2004-2005. The first preparatory study on ecodesign for commercial refrigeration started in 2005 and finalized in 2007. The subsequent implementing phase followed in 2008-2010, starting with an impact assessment (IA) study[1] carried out from October 2008 till July 2010. Further to Article 18 of the 2009/125/EC Directive, a formal consultation of MS and stakeholders was carried out through the Ecodesign Consultation Forum. The first Consultation Forum on commercial refrigerators and freezers took place on 23 April 2010.

However, the above-mentioned work did not conclude. The process was re-launched in 2012. Given the substantial delay between the earlier preparatory work (preparatory study in 2007, IA in 2010) and the expected adoption of the re-launched proposal of implementing measures (2015), an update of the preparatory work has been undertaken by the JRC in 2013-2014. A new meeting of the Consultation Forum took place on 2 July 2014, preceded by the distribution of updated working documents (explanatory notes, draft Regulation Ecodesign, draft Regulation energy label, draft transitional methods).

[1] Impact Assessment accompanying the Proposal for a Commission Regulation implementing Directive 2009/125/EC with regard to Ecodesign requirements for ENER Lot 12: Commercial Cold Appliances (ENER/D3/92-2007, Final report, 2010, Wuppertal Institute.

The Commission, in close collaboration with national experts and stakeholders, proposes to complete the preparatory work undertaken and regulate refrigerated commercial display cabinets. This policy would be complementary to the Commission Regulation for household refrigerating appliances[2] and the Commission Regulation for professional refrigeration products (ENTR Lot1)[3].

2.2. Consultation and expertise

The update of the preparatory work and the formulation of technical options for the implementing measures have been undertaken by the JRC by means of an intensive interaction process with stakeholders, in a structured Technical Working Group (TWG).

The Technical Working Group on commercial refrigeration is composed of experts from Member States' administration, industry, NGOs and academia. The experts of the group have voluntarily joined through the website of the project[4], and have contributed with data, information and/or written comments to interim draft versions of the preparatory study, and through participation in expert workshops organised by the JRC-IPTS. The first workshop was held on 23 April 2013 in Seville. The second workshop took place on 10 December 2013 in Brussels. Complementary, three questionnaires have been distributed to the TWG along the process, addressing information and data updates, and gathering opinions on scope, definitions, and energy consumption specificities. Furthermore, stakeholder communication has included numerous bilateral meetings, and site visits to manufacturing, testing and dismantling plants.

3. PROBLEM DEFINITION

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

Refrigerated commercial cabinets are fundamental appliances for ensuring food quality preservation in the food chain in the EU28, and in addition to provide to consumers other non-perishable foodstuff, *e.g.* beverages, that is customarily consumed at temperatures below the ambient temperature. However, in fulfilling this function, the cabinets are significant energy users and contributors to greenhouse gas emissions, with an annual consumption of over 60 TWh in the EU-28, equivalent to ca. 0.46% of the total final energy consumption of the Union[5]. In comparison to other appliances regulated by ecodesign and energy labelling measures, commercial refrigerating appliances consume about 25 % less than household and 22 % less than professional refrigerating appliances; but they consume 50 % more than washing machines, 96 % more than dishwashers, 84 % more than laundry dryers and 101 % more than vacuum cleaners.

Improving the energy efficiency, thus reducing the energy consumption, will increase the security of energy supply and allow a more efficient utilization of the limited energy resources in Europe. A more efficient use of energy in Europe is a key element to achieve renewable energy targets, greenhouse gas reduction targets and to improve the security of energy supply due to a reduced dependence on fossil fuel imports and the corresponding fuel costs.

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2 Commission Regulation (EC) No 643/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to Ecodesign requirements for household refrigerating appliances.

3 http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/product-groups/freezing/index_en.htm

4 http://susproc.jrc.ec.europa.eu/comrefrig/index.html

5 1103 Mtoe in 2012, Eurostat. 1Mtoe=11.63TWh

3.2. What is the scale of the problem?

As requested by Article 15 of the Ecodesign Directive[6], the preparatory study identified the relevant environmental aspects of refrigerated commercial cabinets, and analysed the legislative, technical, environmental, economic and behavioural aspects of commercial refrigeration. It has shown that in the product lifecycle the energy consumption during the use phase accounts for up to 80% of the product's total energy use. Many types of commercial refrigeration equipment are used 24 hours a day, 7 days per week. Using current best practice, there are many relatively simple design/operation steps that can be taken to reduce energy consumption of these refrigerating appliances, especially for appliances without doors. In most best-case scenarios of open cabinets, energy savings exceed 50% with a payback time of less than 18 months depending on the type and design of the equipment.

With more than 1.6 million units purchased in the EU-28 in 2012, this product group has a market volume largely exceeding 200 000 sales annually, which is the threshold for the Ecodesign Directive[7]. The EU-28 stock is expected to increase from about 14 million units in 2013 to 17 million units in 2030. In 2013 the EU stock had the following composition:

– 26.2 % supermarket segment cabinets
– 45.3 % beverage coolers
– 19.4% small ice-cream freezers
– 9.2% vending machines

Detailed descriptions of the main cabinet types, including pictures, are provided in Annex IV. Additional arguments for the inclusion and exclusion from the scope of specific cabinet subtypes are explained Annex 9.2.

[6] The Ecodesign Directive (Article 15) provides the legal basis for the Commission to adopt an implementing measure that would tackle the problem defined in this section. In Art. 15(2), products are eligible for measures if they meet the following criteria:
(a) the product shall represent a significant volume of sales and trade, indicatively more than 200 000 units a year within the Community according to the most recently available figures;
(b) the product shall, considering the quantities placed on the market and/or put into service, have a significant environmental impact within the Community, as specified in the Community strategic priorities as set out in Decision No 1600/2002/EC; and
(c) the product 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 Community legislation or failure of market forces to address the issue properly; and (ii) a wide disparity in the environmental performance of products available on the market with equivalent functionality.

[7] A more detailed evolution and estimation of sales figures is provided in Annex 9.6.

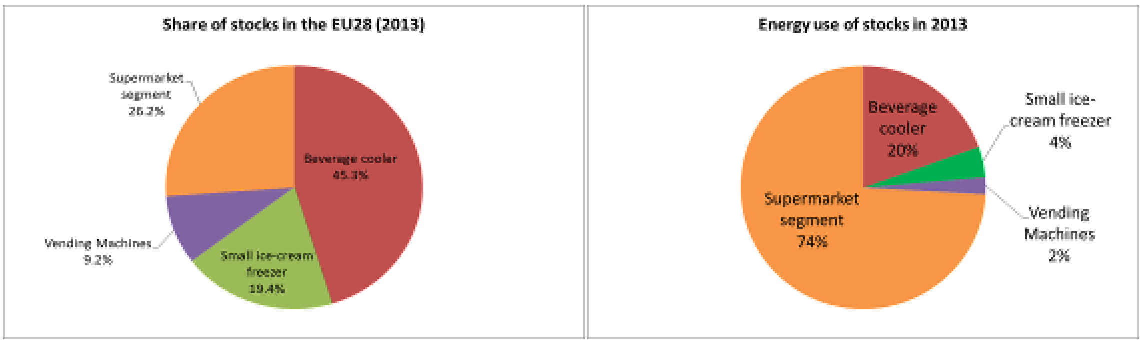

Figure 2 Share of stocks and energy use in the EU28 of the appliances under scope.

Figure 2 illustrates that the share of energy use differs significantly from the share of stocks, a reflection of the large variation of design, function and specific energy consumption of the different cabinet types.

3.3. What are the underlying drivers of the problem?

A substantial potential for economic saving and environmental improvement exists for this product group. Market, regulatory and communication failures are the main barriers that hinder the realisation of these improvements.

3.3.1. Regulatory failure

There is currently no EU legislation specifically dealing with the energy consumption of commercial refrigeration equipment. However, the Ecodesign Working Plan for 2009-2011 identified "refrigerating and freezing equipment" as one of the ten priority product groups.

There are national benchmarking initiatives in a number of Member States, and also at European level, but this does not address the problem for the EU as a whole. National rules could in fact hamper the functioning of the EU internal market. Additionally, due to a lack of commonly accepted standards for some of the cabinet categories, especially beverage coolers, there is currently a considerable variability of used test methods and conditions to define the energy consumption.

3.3.2. Limited/asymmetric information

The information about the energy consumption of the products is limited, even in cabinet types where a voluntary energy labelling scheme exists, *i.e.* the supermarket segment. Purchasers of equipment do not always know the energy consumption of the cabinets, also taking into account the large number of different cabinet types on the market, and producers do not regularly attach this information to the cabinet's technical dossier.

The necessary technical information affecting energy efficiency may be available somewhere (*e.g.* on a web site or in a technical documentation) but is hard to locate and/or to understand, or requires additional calculation (*e.g.* the power of the components is declared, but not the consumption, or the consumption is declared, but not the conditions/standard at which this was tested). Therefore, the complexity or lack of understandable information for consumers introduces asymmetrical information.

3.3.3. Information myopia

One of the main reasons for the persistent sales of low efficiency refrigeration cabinets and the out-dated, inefficient stock is that the end-user purchase decisions are not systematically based on life cycle costs of the product. Such life cycle costing should include purchase, installation, disposal, maintenance and running costs. Some users, including some large retail groups, do not realise that energy costs are commonly the major part of total life cycle cost, or knowing it, cannot convince procurement departments that the purchase shall not be based on purchase price only, or that reasonable payback times shall be provided considering the long (7-14 years) lifetime of the appliances. Even if many large retailers do life cycle cost calculations in their technical departments, the results from these are not the only parameter influencing the purchase decision. In particular, arguments from a procurement or marketing department, usually more interested in purchase price and design characteristics, also have to be taken into account. The final decision could well be to transfer the extra energy cost to consumers through the price of the cooled products sold. . Smaller retailers and corner / night shops still base their choice mainly on purchase price and other factors like availability, service or 'trusted' brand names, as they do not have the means to do life cycle cost calculations. Discount retailers tend to apply life cycle cost calculations, but they have special marketing preferences and design restrictions (e.g. open cabinets for large turnover business models).

3.3.4. Split incentive

Even in cases of full awareness of life cycle costs, the problems of asymmetric information can persist by lack of economic incentives for information provision on energy efficiency in the supply chain. Consequently, readily available cost-effective improvement potentials for the end-user are not realised.

This is especially true in business areas where the buyer of the appliance is not the end-user, such as for small ice-cream cabinets, beverage coolers and vending machines placed by a food or drink brand in supermarkets, corner shops, airports, railway stations, sport clubs, etc. These machines are owned by e.g. a food company, which provides the machines to retailers. Refrigerated vending machines are typically bought and owned by a vending service company that has contracts with end users (offices, public spaces, shopping malls, etc.), and ensures maintenance and product refilling. In all the cases above, the buyer/owner of the appliance will not pay for its electricity bill, so energy efficiency is not a purchase primary criterion. At the same time, the end-user pays the bill but does not choose or own the machine. This is only gradually changing. Some large food and beverage companies do increasingly pay attention to this factor because of corporate image reasons, and some end-users are increasingly demanding more energy-efficient appliances, especially in public procurement contracts.

3.3.5. Other barriers

Non-energy environmental impacts have been analysed as well. It has been noted that the WEEE Directive[8] will include commercial refrigeration appliances in its scope as of August 2018. The end of life treatment of all appliances will thus have to meet from this date WEEE requirements. While WEEE prescribes generic hazardous content goals, this policy provides no hint as to how appliances shall be dismantled in order to meet those goals.

3.3.6. Estimated lost savings due to market failures

Normally, remote supermarket cabinets are installed only at big retailers. It is difficult to estimate which retailers effectively practice life-cycle cost policies, but if we suppose that half of the remote supermarket cabinets that are bought were subject to in-depth life cycle costing, a maximum of 25% of the energy savings could be generated by the ‘best practice’

[8] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast).

retailers. Only 5-10% of the plug-in supermarket cabinets will end up in big supermarkets, so less than 1% of these cabinets will be ’covered’ by the ‘best practice’ retailers. The rest of these plug-in appliances usually are placed in smaller shops such as convenience stores, petrol stations, bars, etc., i.e. in cases where no extended life cycle costing calculations are done. Beverage coolers, small ice-cream freezers and vending machines are usually owned by another entity than the one that pays the electricity bill so there is no incentive for more energy efficient machines. Moreover, about 25% of the vending machines are placed in public places, which could benefit from a request for a certain energy class in the procurement process. Overall, this would mean that about 77% of the savings would be missed because life-cycle costs are not properly taken into account.

While it may be tempting to exclude product categories with a smaller market share, there are arguments to keep them in scope. Acting on the major categories makes improvements available also for the smaller ones. The energy efficiency technology is the same for all appliance subgroups, is known, available and affordable. Manufacturers are sometimes the same. The market share data alone is therefore not a reason for exclusion: the argument can be used indefinitely if used in isolation, as one can further split subcategories until only categories with <5% market shares are left. As a result, all subcategories could be excluded ultimately, even though they share 95% of the technology and functions.

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

The promotion of market uptake of efficient commercial refrigeration cabinets complies with the Europe 2020 Agenda and its 20% energy savings target by the year 2020, as it aims to support more efficient and sustainable use of resources, protect the environment, strengthen EU's leadership in developing new green technologies, improve the business environment and help consumers make more informed choices.

Directive 2012/27/EU[9] establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union’s 2020 20 % headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date. All EU-28 countries are thus required to use energy more efficiently at all stages of the energy chain – from the transformation of energy and its distribution to its final consumption. The new Directive will help remove barriers and overcome market failures that impede efficiency in the supply and use of energy and provides for the establishment of indicative national energy efficiency targets for 2020.

Directive 2010/31/EU on the energy performance of buildings[10] ("EPBD") requires Member States, amongst others, to apply minimum requirements to the energy performance of new and certain existing buildings. According to Recital (12) of the EPBD, Member States should use, where available and appropriate, harmonised instruments, in particular testing and calculation methods and energy efficiency classes developed under the Ecodesign and Energy Labelling Directives when setting energy performance requirements for commercial refrigeration[11]. The EPBD also categorizes wholesale and retail trade services buildings for the purpose of energy performance calculation.

No direct regulatory approach to reduce the energy consumption of commercial refrigeration products has been identified in the EU to date. In the preparatory study and earlier

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9 OJ L 315, 14.11.2012, p. 1–56.

10 OJ L 1, 4.1.2003, p.65

11 The interrelation between requirements on technical building systems and Ecodesign requirements for the placing on the market of products is further explained in the "Commission non-paper on the interaction between Ecodesign Directive and Energy Performance of Buildings Directive".

Consultation Forum debates, options such as self-regulation based on existing voluntary, sectorial benchmarks (*e.g.* Eurovent and/or EVA certification and labelling scheme) were analysed, and assessed insufficient to achieve the policy objectives.

The recently updated F-gas regulation[12] will increase investment to search for new technologies related to low GWP refrigerants such as hydrocarbons, HFOs or CO_2. Most of these technologies are available, but reliability and energy efficiency can be lower compared to established technologies. In Europe, most of this technology is under development.

3.5. Subsidiarity and proportionality

The adoption of ecodesign measures for commercial refrigeration products by individual Member States' legislation would lead to obstacles to the free movement of goods within the Union. Such measures must therefore have the same content throughout the Union. In line with the principle of subsidiarity[13], it is thus appropriate for the measure in question to be adopted at Union level.

The Consultation Forum meeting of 2 July 2014 resulted in broad support from Member States to EU-wide implementing measures for commercial refrigeration. The EU will limit itself only to setting the legislative framework. As far as certain aspects of the implementation are concerned, *i.e.* market surveillance and monitoring, EU action is not necessary to achieve the objectives, as Member States assume these responsibilities under the Ecodesign Directive.

Under the principle of proportionality, the content and form of Union action shall not exceed what is necessary to achieve the objectives of the Treaties. In accordance with this principle, the proposed measures do not go beyond what is necessary in order to achieve the objective. It offers requirements which act as an incentive for technology leaders to invest in high-efficiency refrigerating technology. It also intends to lead to higher savings than any other conceivable option with minimum administrative costs.

3.6. EU context

3.6.1. Existing EU legislation

No EU legislation has been identified in the field of energy consumption of commercial refrigeration. For commercial refrigeration, relevant Community legislation applies in the field of safety, both mechanical and electrical, and standards. Other legislation with relevance for commercial refrigeration products on environmental aspects includes:

- Directive 2012/19/EU[14] of the European Parliament and of the council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast)
- Directive 2011/65/EU[15] of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS);

12 OJ L 150, 20.5.2014, p.195

13 The principle of subsidiarity as is defined in Article 5 of the Treaty establishing the European Union intends to ensure that decisions are taken as closely as possible to the citizen; the Union should take action only in areas which fall within its exclusive competence and which do not lead to a more effective action if taken at national, regional or local level.

14 OJ L 197, 24.7.2012, p. 38

15 OJ L 174, 1.7.2011, p. 88.

- Regulation (EU) No 517/2014[16] of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006.

The previous WEEE Directive (2006) covered only some types of commercial appliances explicitly, *e.g.* vending machines (in category 10 "Automatic dispensers"). After its recent recast (2012/19/EU), the inclusion of all commercial refrigeration appliances is foreseen, with an adaptation time until 15 August of 2018.

The RoHS Directive does not apply explicitly to commercial refrigeration products, but the electronics in commercial refrigeration products are expected to be in compliance with this Directive through the implementation of the Directive in the general product portfolio of suppliers.

3.6.2. Consistency with other policies and objectives of the Union

The Ecodesign Framework Directive 2009/125/EC is an important instrument for achieving the objective of 20 % energy savings compared with projections for 2020, and its implementation is one of the priorities in the Commission's Communication on Energy 2020 and Energy Efficiency Plan 2011. Furthermore, implementation of the Directive 2009/125/EC will contribute to the EU's target of reducing greenhouse gases by at least 20 % by 2020, or 30 % if there is an international agreement that commits other developed countries to comparable emissions reductions. The proposed Regulation is a concrete contribution to this process and is in line with the Commission Action Plan on Sustainable Consumption and Production and Sustainable Industrial Policy[17].

Complementary to this proposal, Member States shall set requirements on air heating and/or cooling systems under the Energy Performance of Buildings Directive 2010/31/EU. Such requirements should complement the specificity of the proposed Regulation with the more general consideration of the building context of the products, and analyse from a system perspective the interaction of heat and chill demands of cabinets with other technical systems in stores and supermarkets such as air conditioning, heating, and other products/areas with high energy throughput (professional refrigeration and heating areas, kitchens).

3.6.3. Limitations of scope due to other ecodesign / energy labelling studies and measures

Two other ecodesign and energy labelling measures are closely related to the proposed Regulation on commercial refrigeration:

- Ecodesign requirements for household refrigerating appliances, Commission Regulation (EC) No 643/2009. Household refrigerators are also subject to energy labelling following Commission Delegated Regulation (EU) No 1060/2010.
- Professional refrigeration (ENTR Lot1, both energy labelling and ecodesign), currently in the last steps of the adoption phase. Publication of this Regulation is foreseen in the beginning of 2015.

The boundaries with these two policies are essentially clear. Household refrigerated cabinets are intended for the storage, but not the sale or display of chilled and/or frozen foodstuff, and are not designed for the use by commercial, institutional or industrial facilities. Commercial refrigeration is found in areas where customers have visual contact with the products and normally have access (supermarkets, beverage coolers, commercial ice cream freezers, etc.).

16 OJ L 150, 20.5.2014, p.195
17 COM(2008) 397

Professional refrigeration appliances are also for use by commercial, institutional or industrial facilities, but are found in areas where customers have neither visual contact, nor direct access, such as back shops, below or behind counters, or professional kitchens. Equipment used in gastronomy and non-household refrigerating equipment for storage purposes without any display or merchandising function are thus in the scope of the professional refrigeration implementing measures.

3.6.4. Other world regions

Some world regions already apply Minimum Energy Performance Standards (MEPS) and/or energy labelling for commercial refrigeration equipment. MEPS apply currently in Australia, New-Zealand, China, Mexico, and the US. China and Mexico are the only economies that apply mandatory energy labelling for refrigerated display cabinets. In addition to the MEPS, Australia applies a high efficiency designation scheme and the US operates a voluntary energy labelling through Energy Star.

In the EU, the UK Energy Technology List operates, indicating the better performing products on the market.

For some selected types of commercial cabinets, data and policies from the US, Australia and some Member States have been compared[18]. In this exercise, the data and threshold values applicable in the different countries were normalised and compared. However, care has to be taken in such comparison exercises, as appliances are often intrinsically not fully comparable (total size, different components, etc.), are usually tested under different conditions (temperature, humidity, duration of the test, sequence of door opening, test packages, etc.), and use different metrics and units to express the energy consumption (*e.g.* per volume versus per total display area).

Caution is thus advisable in the comparison of MEPS from other world regions, even after normalization of the measurement methods. Moreover, as implementing measures drive the market to more efficient appliances, it is often the case that in world regions where MEPS have been in place for a long time, the average energy use is much lower as a result of several years of improvements.

Once these cautions are applied, the comparison of the MEPS initially proposed in the CF with the MEPS levels in other world regions, together with the experience in the EU with other appliance types, have led to the proposal of alternative scenarios with more strict MEPS and a stricter energy labelling scheme as initially foreseen. More details about the comparison with the US and Australian MEPS and the impact of the Australian MEPS on the 2015 Australian market can be found in Annex 9.3.

3.7. Baseline scenario

3.7.1. Scope of appliances covered

Commercial refrigeration appliances need to fulfil the double function of storage at a given temperature below the ambient temperature, and allow that customers have visual contact with the products and/or direct access to them, in retail stores or private non-household

[18] Analysis of EU policy proposals for DG ENER Lot 12 Commercial Refrigeration, Jeremy Tait on behalf of CLASP, 21 August 2014 and Annex 9.3.

environments[19]. The denomination *freezer* is used when the cabinet contains frozen products, below 0^{o}C, and *refrigerator* is used for chilled products, above 0^{o}C.

The main subgroups of cabinets are listed in section 3.2 and the base cases are further detailed in Annex 9.4. Annex 9.2 provides a detailed list of subtypes of cabinets under the scope of the implementing measures, as well as a list of cabinets excluded from the scope, with explanations of the rationale for exclusion or inclusion.

The baseline assumes as reference that current policy measures at Member State level will not change and no further action at EU level will be introduced. Thus, it assumes a continuation of existing trends regarding size and use of appliances sold on the European market, but no change in the specific efficiency and emission values per product type. For this development, 'typical' product types and their properties have been defined in the preparatory study. Consequently, the following four functional types of cabinets are distinguished:

- Retail/supermarket display cabinets (both refrigerators and freezers)
- Small ice-cream freezers for merchandising (V ≤ 500 litre)
- Beverage coolers (refrigerators only)
- Refrigerated vending machines[20] (both refrigerators and freezers)

The properties and the typical energy efficiency values of base cases selected for these types in the year 2013 are reproduced in Annex 9.4.

The commercial refrigerated cabinets can be *plug-in* (also called *integral*, or *self-contained*) or remote. Plug-in cabinets are appliances where all refrigerating components are an integral part of the refrigerated equipment. Remote cabinets work with a remote refrigerating unit (condensing part and compressor) which is not an integral part of the display cabinet and is connected via piping. Frequently, these condensing components are located on the roof or façade of the store. The scope of this policy only includes the cabinets themselves, both remote and plugins, but not the remote components (condensing unit or other). Annex 9.14.2 discusses the complementarity of the proposed policy with a system (building and its thermal needs) perspective.

3.7.2. Functionality approach

The supermarket display cabinets are further segmented into freezers and refrigerators, and vertical and horizontal appliances. As such, different supermarket cabinet types are segmented according to their function and in accordance with the first layer of segmentation in the measurement standard ISO 23953. Further segmentation levels are possible, as described in ISO 23953, differentiating between different cabinet types, *e.g.* open vs. closed, semi-vertical, etc. This level of subdivision is not followed, as it is essentially not linked to the provision of a different function, but to a design option.

3.7.3. Efficiency and emissions

Manufacturers indicate that the launching by the Commission of the earlier phase of this ecodesign and energy labelling exercise in 2004, despite not resulting in a formal legislative

[19] A commercial refrigerated cabinet is defined as a refrigerated appliance intended for the storage and display for merchandising, at specified temperatures below the ambient temperature, of chilled and/or frozen products, and is accessible directly through open sides or via one or more doors, and/or drawers.

[20] Refrigerated vending machines are commercial refrigerated cabinets designed to accept consumer payments or tokens to dispense chilled or frozen products without on-site labour intervention.

text, has led to improvements in cabinet efficiency in the last decade. Other reported drivers for this evolution are the increase in energy prices, and the larger awareness of the saving potentials by retailers and food companies. This effect has been taken into account in the design of the baseline scenario, and is specified in quantitative terms in section 6.1.1. The specific efficiency assumed for the different base cases in the baseline are given in Annex 9.4.

3.7.4. Sales, stock and further assumptions

The preparatory study estimated the market shares of the different categories of cabinets, as well as the historic and forecasted sales of each type, using a stock model[21].

Sales data have been estimated based on 2004-2012 data obtained from industry. Stock data have been estimated based on sales, and on the average lifetime expectancy of appliances, and have been cross-checked with the few stock data available. The total annual sales of commercial refrigeration cabinets under consideration are about 1.6 million units in the EU in 2012. The largest share of sales are of beverage coolers (0.80 million), followed by supermarket display cabinets (0.44 million), small ice-cream freezers (0.34 million), and vending machines (0.063 million).

Assumptions for product prices, installation and maintenance costs in the base year (2013) are derived from data collected in the preparatory study and further data collected in the course of the impact assessment. Regarding ‘typical’ appliances, the ranges of purchase and installation prices can be large, due to product customisation, especially in the supermarket segment.

3.7.5. Market structure and sales destination

Remote supermarket segment cabinets are mostly sold directly to the end users (68%). About 1/3 is sold through a distributor and the rest to the food and beverage industry. Most medium and large retailers have technical departments which define, together with procurement departments, the need of provision of cabinets, as well as their technical details. Some retailers would launch open calls for each procurement batch, while others work with a closed list or framework contracts with one or more manufacturers.

Remote cabinets are mainly produced by bigger companies, who sometimes produce plug-ins for the supermarket segment as well. Smaller companies who produce plug-in supermarket cabinets usually also produce other products such as serve-over counters, professional refrigeration, household refrigeration, chest freezers, etc.

In the supermarket segment, remote cabinets have a 54% share of the total sales, the remaining 46% being plug-ins. Remote cabinet manufacturing is dominated by 5-7 large manufacturers that cover ca. 70 % of the market. Beverage cooler and ice-cream freezer manufacturing is also dominated by 5-10 companies, mostly non-SMEs[22]. The plug-in segment is more fragmented, with over 50 manufacturers in the EU, some of them SMEs. The vending machine market consists of about 16 manufacturers with a domination of the market by 5 companies. 5-10% of the production is carried by SMEs. Vending machine sales are dropping in general due to an increasing interest in refurbishing machines.

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21 See details in Annex 9.6 and Annex 9.7.. The energy price and other price assumptions of the analyses are presented in Annex 9.5.

22 SMEs are defined as companies with less than 250 employees. See http://ec.europa.eu/enterprise/policies/sme/files/sme_definition/sme_user_guide_en.pdf

Additionally, many SMEs are involved in the installation, operation and maintenance of the appliances.

More than 95 % of beverage coolers and small ice cream freezers are sold to the food and beverage industry. These companies deliver their choice of cabinets to end-users (retailers, corner shops, etc.), frequently subject to the condition that only certain (normally their) products can be stored in them. Food companies would still own the appliances and ensure replacement/repair when needed. Vending machines are operated in a similar way. A proportion of vending machines are produced for the food and beverage industry, as indicated above. Only 10 % of cold vending machines are sold directly to the end-users. The largest part is sold to vending companies, which own a stock of machines. Machines are then leased to end-users, and vending companies ensure maintenance and product replacement.

While intra EU trade is fluent, the EU has currently a relatively small share (<10%) of extra-EU exports, as commercial cabinets (contrary to the more homogeneous household refrigeration cabinets) are to a large extent tailored goods where end-users demand local maintenance and/or post-sale service. Trade is limited also because the cabinets are bulky, and of relatively low value in the basic configurations that do not incorporate advanced energy saving designs. The beverage cooler and vending machine markets have additional specificities, following the different consumer habits of the US, the EU or Japan.

The main industry associations that represent the EU industry in this sector are:

– Eurovent, an umbrella association for national associations and some direct members. Around 50 % of the members that are active in the discussions on commercial refrigerating appliances are SMEs.

– EPEE's members include direct members, which are mainly larger manufacturers, and national associations, which also represent SMEs. The members active in the discussions are mainly larger companies. However, all its members, including the national associations, endorse the comments sent by EPEE.

– EVA, an umbrella association for national associations and some direct members, represents mainly the vending machines manufacturers. Members include direct members, which are mainly larger manufacturers, and national associations, which also represent SMEs.

– EuroCommerce, represents the retailers. Members include direct members, which are mainly larger manufacturers, and national associations, which also represent SMEs.

3.7.6. Economic significance

The total annual sales in the EU of commercial refrigeration products is of about 1.6 million units in 2012, estimated to a value of about 1800 million euro, which is on average 20% of the total product costs of these appliances (ca. 9500 million euro annually). The current annual running costs of these appliances exclusively for energy (electricity) would make up for some 7200 million euro (ca. 75% of the total product cost). The remaining 5% of costs are of maintenance and disposal.

Life cycle cost calculations over the total product life (purchase, running costs, etc.) indicate differences between appliance groups. For the supermarket segment, the cost of electricity is the largest part (65-80%), while the purchase price is a small proportion (10 % for remotes, 30 % for plugins). Vending machines have a different distribution of the life cycle cost, with product price being about 40% and the cost of electricity being about 55% of the life cycle cost. For beverage coolers the cost is distributed as 20% related to purchase price and 75% to electricity costs. The purchase price for small ice-cream freezers is about 30% of the total life cycle cost while the electricity cost accounts for 65% of the total. The remaining costs are attributed to maintenance and end of life management.

For retailers, average energy costs of commercial refrigeration are estimated to be around 3-4% of the total sales prices of a refrigerated food or drink item. A reduction in energy consumption has thus a small deflationary effect on the retail price of chilled and frozen products.

3.7.7. Energy consumption and other environmental concerns

The use phase is responsible for up to 80 % of the total energy use in the life cycle of the product. Use phase energy consumption is about 6 times higher than energy consumption of the production phase. The distribution and the end-of-life phases are negligible in terms of energy consumption.

Regarding other impact categories, the use phase accounts for 75 % of water use, 85 % of acidification impacts, 42 % of non-hazardous waste production, and 34 % of heavy metals emissions to water.

It is thus justified that the energy ecodesign requirements deal essentially with technologies that reduce power consumption and improve energy efficiency in the use phase of the cabinets.

The average product life of most refrigerated display cabinets is estimated to be between 7-14 years (median 8-9 years). Some cabinets are in busy areas and therefore subject to very intensive use and wear. Most cabinets are not substituted because of malfunction, but because of aesthetics and commercial reasons related to their design (newer designs can attract consumers and increase sales), and image loss for retailers when displaying worn-out cabinets. Little reliable data is available on the end-of-life phase and the refurbishment rate. Cabinets are often refurbished or retrofitted to replace their most worn-out parts, or to install energy-saving elements (doors, night curtains, better fans or compressors). Some prolong their lifetime by moving to less demanding applications (backshops, retailers focusing on costs and not on image), be it in the EU or outside it.

Refurbishment, reuse of parts, and modularity are especially developed for vending machines. When finally dismantled, cabinets are normally split into smaller parts, and treated for recycling or disposal. The extent of compliance to WEEE depends until August 2018 on the MS interpretation, except vending machines, which are already covered by WEEE prescriptions. The two main concerns in end-of-life are (1) reclaiming of the materials for recycling, especially metals, and (2) the removal of potentially hazardous materials, especially the refrigeration fluid, the foaming agent, and any electronic component.

WEEE compliance has so far been dealt with in ecodesign regulations by means of a generic information provision request. The proposed Regulation lays out more specific requirements, as an alternative to better address the specific end-of-life impacts of refrigerated commercial display cabinets (see section 6.5).

3.8. Should the EU act?

As shown in Table 1, there is a clear untapped improvement potential of energy efficiency of the cabinets currently sold, and expected in the market in the next years. A comparison of base cases current performance, as assumed for the BAU, and best available technology (BAT) shows that further to the installation of the well-known improvement technologies that result in low life cycle cost, significant additional technical improvements are still possible (see Table 1).

Table 1: Comparison of base case and current best available technology (BAT) performance

Base case	Energy Efficiency (kWh/day)		Energy improvement (% of BAT to Base case
	Base Case (BAU)	BAT	
Open vertical multi-deck remote refrigerator (RVC2) (TDA = 5.25 m²)	56.9	36.3 *	36%
Open remote horizontal island for frozen products (RHF4) | (TDA = 2.9 m²)	32.2	27.1 *	16%
Beverage cooler, glass door (V = 500 litre)	7.5	1.3	83%
Small ice-cream freezer (V = 291 litre)	3.6	1.5	58%

* Note that this BAT does not include the installation of doors. The installation of doors could bring down the energy of the first base case to 21.2 kWh/day (63% improvement) and for the second base case to 16.0 kWh/day (50% improvement).

Without taking additional specific action on commercial refrigeration cabinets, the market transformation towards more efficient appliances will take place only very slowly, and negative impacts on environment and health readily avoidable would persist.

Action is necessary on EU level, as the outlined lack of harmonized specific regulation in the EU induces the risk that individual energy efficiency requirements set by Member States could hamper the functioning of the EU internal market. The Ecodesign Directive (Article 16 in particular), which has the internal market objective as Treaty legal basis, and the Energy Label Directive (Article 1) provide the legal basis for the European Commission to adopt implementing measures reducing energy consumption of commercial refrigerated cabinets as well as guiding consumers towards the most efficient appliances.

4. POLICY OBJECTIVES

4.1. General objectives

The preparatory study has confirmed an existing and cost-effective potential to reduce energy consumption. This potential is not sufficiently realised and the general objectives are therefore to develop a policy, which corrects the regulatory and market failures described in section 3.3:

- Reduce the average energy consumption of commercial refrigeration cabinets. Reduce additionally GHG emissions which for commercial refrigeration are mainly related to energy consumption, but also refrigerant leakage. Promoting energy efficiency, encouraging innovation, and reducing energy dependence.
- Promote energy efficiency as contribution to security of energy supply in the framework of the Community objective of saving 20 % of the EU's energy consumption by 2020.

Moreover, specific end-of-life requirements are proposed to address current imperfections in the dismantling of the cabinets and the fulfilment of the objectives of the WEEE Directive.

4.2. Specific and operational objectives

The specific objectives of this proposal are:

- to facilitate the removal of the poorest performing products from the market, where their life cycle cost disadvantages have proven insufficient to do this.
- to help purchasers to make an informed and rational choice based on performance information, thereby moving the market to adopt improved technology solutions.
- to drive manufacturer's investments in R&D towards energy efficient technology and products.
- to make energy-efficient products more affordable through mass production, and generate cost savings for end-users (and ultimately customers).

No negative impact should arise in terms of functionality of the product, health, safety and environmental aspects, industry's competitiveness, imposing proprietary technology and excessive administrative burden (Article 15 (5) of the Ecodesign directive).

The operational objectives are:

- to establish minimum energy performance levels to remove the worst performing products from the market.
- to establish information requirements coupled to an energy labelling scheme to establish a level playing field and foster an effective competitive market.
- regarding end-of-life requirements, to improve the design for recycling of products, in order to increase the quality and quantity of recycled materials, facilitate the removal of hazardous components, and ultimately facilitate enforcement of the prescriptions of the WEEE Directive.

5. POLICY SCENARIOS

In order to address the issues identified in Section 3 and to meet the targets defined as policy objectives in Section 4, a number of policy scenarios are considered for this Impact Assessment, as outlined below.

5.1. Basic assumptions

The energy labelling class limits and MEPS thresholds are parameterised using an Energy Efficiency Index (EEI), which refers to specific energy consumption values for the different segments proposed (see Annex 9.8). This is a known procedure in product ecodesign policy. The reference energy consumption is defined at EEI = 100 with the reference data, which for commercial refrigeration refers to year 2013.

Energy consumption is referred to the total display area (TDA) or volume according to the most common metric used in industry for each appliance subcategory.

The key assumptions of the analysed scenarios are summarised in Annex 9.5.

5.2. Assessment of energy efficient policies

In the preparatory study, four scenarios were analysed, and compared to a business as usual (BAU) scenario. These scenarios were (1) self-regulation based on voluntary agreements, (2) mandatory ecodesign (MEPS) requirements only, (3) mandatory energy label (EL) requirements only, and (4) mandatory ecodesign and energy label.

Scenario 4 was designed with 3 tiers of MEPS, as presented in Table 2. The energy labelling classes were set as to find a distribution of the data points similar to a normal distribution over the different energy classes, but leaving the top A- and B-classes essentially empty.

Table 2 Energy labelling classes threshold and MEPS for scenario 4 and 5

Commercial refrigeration			
Energy efficiency class	**EEI energy efficiency index**	**EEI MEPS Scenario 4**	**EEI MEPS Scecnario 5.1. and 5.2.**
A	EEI < 20		
B	20 ≤ EEI < 35		
C	35 ≤ EEI < 50		
D	50 ≤ EEI < 65		
E	65 ≤ EEI < 80		80 (1 Jan 2020)
F	80 ≤ EEI < 100		
G	EEI ≤ 100		
		110 (1 Jan 2021) 130 (1 Jan 2019) 150 (1 Jan 2017)	110 (1 Jan 2017)

The discussion of these scenarios in the Consultation Forum meeting of 2 July 2014[23] resulted in a number of suggestions, as follows:

- MEPS and energy labels: the thresholds of Scenario 4 are not stringent enough. About 20%-30% more stringency shall be proposed. Label class A shall be empty with current best practice to allow future development. This is supported by the Member States and environmental NGOs. EPEE and Eurocommerce are not in favour of a label.

- The number of tiers shall be reduced from three (Scenario 4) to two. Austria, the Netherlands and the UK, the EPEE and EuroCommerce support this.

- The revision shall take place after the last tier. This was supported by most stakeholders. EVA requested a quick revision in view of the publication of a new test standard.

- The functionality approach (see section 3.7.2) is largely endorsed by Member States and the NGOs, while industry is concerned about that the functionality approach does not reflect the diversity of products in the market. There shall be as few categories as sensibly possible. This would also facilitate market surveillance.

- The arguments for proposing end-of-life requirements are largely endorsed by Member States and NGOs, only EFCEM argued against such requirements. However, the labelling of the foaming gas can if appropriate be handled by means of a voluntary standard (IEC 60335-2-89). The wording of the requirement on dismantling shall be revised to facilitate market surveillance and to ensure reproducibility.

- A single energy labelling class structure shall be proposed for all the different appliances, i.e. supermarket segment, beverage coolers, small ice-cream freezers and vending machines. Prior to the Consultation Forum, different structures were proposed for the different appliance types. Most Member States supported this.

In response to this, new harmonised reference energy formulas, and a revamped labelling scheme has been proposed[24]. Two additional scenarios were added to the scenarios analysed

[23] See Annex 9.1

[24] Prior to the Consultation Forum, different energy labelling classes had been proposed for different appliances, *i.e.* supermarket segment, beverage coolers, small ice-cream freezers and vending

in the preparatory study and the CF working documents. All the options are based on the expected adoption of the measures in the end of 2015. The new scenarios 5.1 and 5.2 are defined as follows (see also Table 2 and Table 2A)[25]:

- Scenario 5.1: Two-tier scenario with more strict MEPS (EEI = 110 in January 2017, EEI = 80 in January 2020) and a redistribution of energy classes to ensure that the A class is not populated as of 2014. Introduction of temperature classes. This results in the following values:

Table 3A Updated energy labelling classes threshold for scenarios 4 and 5

Energy efficiency class	EEI energy efficiency index
A	EEI < 10
B	10 ≤ EEI < 20
C	20 ≤ EEI < 35
D	35 ≤ EEI < 50
E	50 ≤ EEI < 65
F	65 ≤ EEI < 80
G	EEI ≤ 80

- Scenario 5.2: Same as scenario 5.1, but additional breakdown for remote vs. plugin.

Other discussion points raised during the Consultation Forum such as the EoL requirements, linearity of the MEPS functions, and differences of testing vs. real-life conditions (see minutes of the CF in Annex 9.1) have been analysed in detail and when appropriate included in all the scenarios. The conclusions obtained on these issues are presented in Annex 9.14.

In the analysed scenarios, requirements for minimum energy efficiency and energy labelling are proposed for the following categories or segments of equipment:

- Supermarket segment display cabinets
- Beverage coolers
- Small ice-cream freezers
- Refrigerated vending machines

It is proposed that the cabinet category *soft scoop ice-cream cabinets* is still part of the scope of the policy.

Specific MEPS are proposed for the following subcategories of supermarket segment display cabinets:

- Horizontal refrigerators

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machines. After stakeholder comments at the Consultation Forum, this has been harmonised to have one labelling class distribution for all appliances. Accordingly, the reference energy consumption for beverage coolers has been adapted. Annex 9.8 shows the corresponding reference energy formulas and the according labelling scheme

25 After the analysis of the feasibility of these scenarios, the impact has been calculated by breaking down the different cabinet types according to the ISO 23953 standard detailed segmentation, instead of extrapolation of base case data. This allows for a more accurate impact assessment and leaves the study with scenario 4 (more lenient MEPS, 3 tiers) and scenario 5 (stricter MEPS, 2 tiers, with additional options of breakdown in plugins/remote if new technical information allowed this). Further it has been analysed that additional breakdown for different temperature classes does not result in significant impact differences, and is more related to operational enforcement issues.

- Vertical refrigerators
- Horizontal freezers
- Vertical freezers

In Scenario 5.2, the four categories above are further split into remote and plug-in, resulting in eight MEPS in total for supermarket segment cabinets.

5.3. Assessment of end-of-life policies

End-of-life requirements have not been presented as separate scenarios, as the introduction of such requirements would not have any significant effect on the energy consumption of the appliances, the related emissions, the expenditure or the associated employment.

5.4. Refrigerants

In the earlier phases of this project developed by BIO IS and Wuppertal Institute, a bonus-malus system related to the GWP of the refrigerant was discussed, as a means to reduce the extensive use of high GWP F-gases in commercial refrigeration detected in the early 2000's.

However, it has been observed in the revision of this work that substitution of the gases to low GWP agents has already taken place in this sector for over a decade by a combination of

- the effect of the updated F-gas Regulation[26]
- the better energy efficiency of a large number of low GWP refrigerants now in use, compared to fluorinated fluids.
- the efforts of image and green policy of a number of food and beverage companies.
- taxation policies to F-gases introduced in some Member States.

In line with this, the Professional Refrigeration policy (ENTR Lot 1) proposes no bonus-malus system for professional storage cabinets, as the markets have already taken up the policy signals and are gradually phasing out high GWP gases. In addition to the arguments above, remote cabinets can work in principle with different refrigerants, so it would be very difficult to impose a bonus-malus system if it is not decided beforehand which refrigerant will be used when operated.

The estimation of the direct emissions of refrigerants by leakage seems, according to the discrepancy in the information available, subject to large uncertainty. A wide range of between 4 and 20 $MtCO_2$/yr of direct refrigerant emissions would result in all the scenarios proposed (see Annex 9.14.6). The measures to reduce these emissions are now in place in the F-gas Regulation and are thus not further addressed in this impact assessment.

5.5. Scenario 0: No EU action (Business As Usual)

This scenario assumes continuation of current policy measures at Member State level, no further measures for cabinets in the EU and thus continuation of existing trends regarding size and use of appliances sold on the European market. Significant changes have been detected in the time period 2004-2014, as described in Section 3.7, including a gradual but very moderate efficiency increase. However, the market and regulatory failures would persist, harmonised information on energy consumption would not be systematically generated other

[26] Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006, The update prescribes an out-phasing calendar for hermetically sealed appliances, i.e. plug-in appliances; HFCs with GWP of 2500 or more will be banned from 2020 and HFCs with GWP of 150 or more will be banned from 2022.

than through one voluntary industry scheme, and consumers would not be able to differentiate between high-efficient and low-/average-efficient appliances. This option is included in the impact assessment as the baseline and serves as a reference to calculate the savings of the other policy options in Section 6.

Rising energy prices will contribute to the change but will not on their own turn the situation around. Even when customers are interested in long term costing, suppliers do not have a widely accepted means to certify consistently better efficiency. If the advantages of efficiency investments cannot be clearly communicated, then lowest purchase price practices will persist as the main driver. Moreover, customers (mainly retailers) of these appliances may simply transfer rising energy prices to their own clients by increasing the price of the cooled products. In this context it has to be noted that <5% of the price of food products is related to their refrigeration, divided in varying proportions between running and purchase costs of the display cabinet. Running costs include maintenance alongside electricity use. Even if electricity price is increased by 100%, and the increase is transferred fully to the food consumer, the resulting food price increase would be still quite limited. Smaller retailers without knowledge of life cycle costs would probably just pay more because of ignorance. In situations where the shop owner is not the owner or installer of the appliance, electricity prices would not be taken into account at all (most notably with vending machines, beverage coolers, and small ice cream freezers).

The option of this scenario is therefore discarded.

5.6. Scenario 1: Self-regulation, "Voluntary agreement"

Self-regulation or voluntary agreements have as benefits over legislative measures that the implementation may be much faster and at the same time offer more flexibility. However, in order to be accepted as viable alternative to legislation, self-regulation initiatives have to comply with a set of criteria defined by Annex III of Directive 2010/125/EC that are generally not easy to meet. Related to refrigerated cabinets, this would be very complex, due to diverse national regulations, combination of international, European and commercial measuring methods, and climate condition and traditions existing in the sub-markets within the EU (Nordic & UK, Central European, Eastern European, Southern European and others). The endorsement and support of the existing voluntary systems (Eurovent, EVA) has experienced important changes in support in the last decade.

This option is therefore discarded.

5.7. Scenario 2: Mandatory ecodesign (MEPS) requirements only

This scenario includes the setting of ecodesign requirements for energy efficiency (MEPS[27]) under the Ecodesign Directive, without an energy labelling scheme.

Mandatory minimum energy performance requirements alone would indeed ensure withdrawal from the market of the poorest performing products and through more stringent levels could significantly transform the market by driving through changes towards cost effective good performance levels.

It is not, however, a powerful tool to drive innovation as it lacks the means to secure recognition for the best performing products. The potential for more discerning customers to help draw the market onwards could remain under-exploited. Not opposing energy labelling, some industry stakeholders, i.e. EPEE and EuroCommerce have expressed that a MEPS only scenario would be sufficient in pushing industry to deliver more energy efficient products.

[27] MEPS = Minimum Energy Performance Standards

These stakeholders do not see the added value of energy labelling as they see cabinets as a commodity traded from business to business. These stakeholders also assume that the buyers (mainly retailers) are acquainted with life cycle costing, which is not always the case[28].

Conversely, several retailers, some of them large companies, have highlighted that energy labelling would indeed be a useful communication tool to purchase departments, and would help bring energy consumption to the centre of purchase considerations. Labelling would also be a very useful parameter in public procurement (vending machines) and in the communication between food producers and small retailers (beverage coolers, small ice-cream cabinets).

Moreover, minimum requirements alone would not drive the market to closed appliances, which is one of the most cost effective measures that could be taken to improve energy efficiency. By introducing minimum requirements together with an energy label, only the best performing open appliances would stay on the market, but would not obtain the higher classes on the label. Thus, the label plays an important complementary role in providing the right signals to retailers on how appliances perform in comparison with others. Minimum requirements in combination with an energy label would clearly show the benefits of closed appliances.

In addition to the arguments above, the implementation of this option would be incoherent with the approach chosen for household and professional refrigeration policies, as both include energy labelling and are either running (household) or close to adoption (professional).

For the reasons mentioned above, the option represented by this scenario is discarded.

5.8. Scenario 3: Mandatory energy labelling scheme only

This scenario includes labelling without ecodesign requirements. Mandatory energy labelling would help address the information failures in this market and enable manufacturers to secure recognition for the better performance of premium products and so help secure sales and justify a higher price (if applicable). This is the intention behind the voluntary energy label scheme that the industry association Eurovent has developed, but which is not embraced throughout the whole industry. 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 which many manufacturers would not wish to have in their range. 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 the poorest performers are likely to disappear from the market fairly quickly.

From the perspective of large retailers, labelling the cabinets would make it easier for technical departments to communicate the life cycle costs to marketing/procurement departments, and would give them more support in defending their calculations. Small retailers or corner/night shops do not have the means to do life cycle cost calculations, and a label is necessary to identify which appliance is more energy efficient. In situations where the owner of a plug-in appliance installs it but does not pay the electricity bills, the operator of the location where the appliance is installed could consider the energy label class before agreeing that the appliance is operated at the expense of his electricity bill.

[28] The assumption of widespread use of LCC has proven to be erroneous after a number of interviews with retailers.

Energy labels alone would, however, be unlikely to ensure improvement to the cost effective potential level due to the cost increases: in this highly price-sensitive market, price rises would not be taken on by the majority of the market if not also pushed by MEPS.

It is also known from earlier ecodesign-labelling experience of other product groups that a labelling scheme (as ‘pull-effect’) alone, while reported being a strong driver in improvement alone, is less effective without MEPS.

The retail market is very heterogeneous, and part of the market still does not recognise the importance of energy performance vis-a-vis other marketing parameters such as cabinet design, or is simply running low-cost, high turnover business models. With labelling alone, there is a risk that very poor performing appliances or cabinet types remain on the market, not applying the known and effective technical improvements at zero or very low cost.

Taking into account the size of the problems described, labelling alone would not fully address them and seize the potential energy savings. No stakeholder has expressed support to this option.

The scenario represented by this option is therefore discarded.

5.9. Scenario 4: Ecodesign requirements (MEPS) and energy labelling, 3 tiers

This scenario introduces ecodesign and energy labelling as a combined market 'push and pull' effect. It is intended to achieve a dual and synergic effect of removing the worst products from the market in a way that is fair to all manufacturers and with the motivating effect of transparency on efficiency information that will drive competition and innovation on energy efficiency.

In the preparatory study, this scenario was the one resulting in largest potential savings relative to scenarios 0, 1, 2 and 3. The energy efficiency classes and 3-tier MEPS proposed in the preparatory study are presented in Table 2.

5.10. Scenario 5: Ecodesign requirements (MEPS) and energy labelling, 2 tiers

This scenario reduces the number of tiers from three to two, and proposes more strict MEPS: EEI < 110 in tier 1 in 2017, EEI < 80 in tier 2 in 2020.

For the supermarket segment cabinets, two additional features have been investigated, *i.e.* the effect of accounting for different working temperatures and the differences between plug-in and remote cabinets.

The potential effect of temperature differentiation on total energy saving has been modelled and the quantitative, sales-weighted results obtained are conclusive: the effect of temperature differentiation is minimal, more specifically 0.21% for plugin cabinets, and 0.25% for remote cabinets[29]. Temperature class differentiation has thus barely any influence for the purpose of energy saving of the policy. It is important, however, to clearly indicate at which temperature class the energy consumption is tested, and how this relates to the temperature at which the labelling is declared, in order to harmonise the testing procedures, ensure a level playing field for the energy label, and to facilitate market surveillance.

Regarding the splitting between plug-in and remote cabinets, the assessment has two main conclusions: (1) for the purpose of estimating the potential energy savings, the differences are not large, as the saving options recorded are equally applicable to plug-in and remote cabinets, and (2) for the purpose of policy formulation, a split between plug-in and remote

29 See Table 34 in Annex 9.14.1 for details.

cabinets would be advisable, even if using identical values of MEPS for both remote and plug-in cabinets, as this would facilitate a future review in case new technologies dedicated to a certain type of cabinet are introduced in the market, or in case the ISO 23953 standard is updated for only one of the two categories[30].

The energy labelling scheme would enter into force as soon as feasible, *i.e.* with the entering into force of the first tier in 2017, in order to initiate the market transformation for energy efficiency

An early implementation of ambitious MEPS requirements on EU-level could be a challenge for those manufacturers which currently do not have best available technology (BAT) products in their portfolio and would need time to develop and to put on the market products complying to the new regulation. According to experts and representatives of the industry, the design cycle of cabinets lasts about 3 years, and approximately four years are necessary to develop and put such a new product on the market.

Based on these considerations, and on the available performance data of 2013 appliances, Scenario 5 foresees the adoption of a policy which includes a target 2020 tier with stringent ecodesign requirements (MEPS), and a transitional tier in 2017.

Stricter levels may not be achieved by industry on time for all cabinet types, despite the reported developments in 2004-2014.

5.11. Selected options for further analysis

In the preparatory study and the working documents for the Consultation Forum, the pros and cons of the scenario combining MEPS and energy labelling (Scenario 4) were presented, initially based on the assessment of this comparison presented in the earlier work by BIO IS, and further elaborated in the 2010 Impact Assessment by Wuppertal Institute. These studies already excluded the scenarios of 'no action' (BAU, Scenario 0) and self-regulation (Scenario 1). No new evidence has been collected in the course of the preparatory study in 2013-2014 suggesting that none of these two scenarios would be currently delivering the energy saving objectives proposed.

The analysis of the comparison of Scenario 4 (MEPS+EL) versus the scenarios of MEPS-only (Scenario 2) and EL-only (Scenario 3) were presented in the preparatory study, concluding that the combined effect of MEPS and EL resulted in the largest potential energy savings. Compared to BAU, Scenario 4 proposes a reduction of energy consumption in the use phase, by the implementation of minimum energy requirements (MEPS) and an energy labelling scheme. MEPS alone would ensure withdrawal of the poorest performing products from the market and push the market to better average performance levels. A pull effect to drive innovation, and recognition and reward for the best performing products is also established by means of an energy labelling scheme. Voluntary agreements based on MEPS and labelling may achieve these results in the long run, but it is assessed that they would not deliver them as quickly as the available technologies allow. Moreover, the industry did not show intention to develop such measures itself.

Therefore, only the proposed Scenarios 4 and 5 have been further analysed and compared in this Impact Assessment.

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[30] Note that Standard ISO 23953 does not allow a comparison of plug-in vs remote cabinets.

6. ANALYSIS OF IMPACTS

To analyse the full impact of a policy, it is important to consider a period during which the whole stock of installed appliances will be replaced by new products purchased after the MEPS requirements and the labelling scheme have entered into force. Assuming regulations are adopted by end of 2015, the ecodesign requirements and labels will apply in the years as indicated in the description of the options. The analysis of the impacts looks at the period until 2030.

The quantitative impacts presented in this chapter cover the cabinet types for which there is available information currently, as comprehensive data are available from the preparatory study. For certain categories, especially some subtypes of supermarket segment cabinets, no such comprehensive data are available, but information on them has been gathered[31] showing that they have similar technical characteristics to cabinets for which information is available, and thus the impacts would be similar as for those for which data is known.

Further information has been gathered also through the meetings of the Consultation Forum and bilateral meetings with industry representatives, including SMEs, with Eurovent, EPEE, Orgalime and Food&DrinkEurope contributing to the discussion (see Annex 9.1).

It has to be noted that ecodesign and energy labelling legislation applies to products "placed on the market". A product is "placed on the market" when it is made available for the first time in the Union market. Therefore, the introduction of requirements on a specific date would not mean that all products in use must be replaced. Products already in use or available on the market for sale before the date of application of the new regulations can be used and bought without an end date. Moreover, the lifetime of a commercial refrigerated cabinet is often between 10-15 years: this means that customers of these products may be impacted by the new requirements only after several years from the application of the new requirements (i.e. when the existing appliances need to be replaced).

Qualitative impacts of the regulation have been estimated and identified by interviewing a large number and variety of retailers and manufacturers.[32]. The main issues raised by stakeholders are described in the different sections below.

6.1. Economic impact

6.1.1. Electricity consumption, energy saving and security of supply

The total electricity consumption in the baseline has been estimated to gradually decrease from 65 to 59 TWh/yr in 2015-2020, and then remain stable until 2030. In the fifteen years from 2015 to 2030, the stock of cabinets is expected to increase by ca. 6%, but this would be compensated for by slow energy improvements of ca. 8% over 15 years, if following the current pace without ecodesign measures.

The figures and tables below present the results of total annual and accumulative impact of the policy scenarios outlined[33].

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31 See Annex 9.9

32 Annex 9.13 lists in detail the responses collected from stakeholders to the possible costs and benefits that the policy may bring

33 Projections are made to the reference years 2020 and 2030. The technology scenarios are based on the combination of two basic elements: a stock model, and the definition of a number of base cases which analyze the most representative categories of appliances under the scope of the policy. The base cases are representative appliance groups for which techno-economic data is analysed in detail. For commercial refrigeration appliances, it is estimated that the base cases cover ~88% of the total appliance stock in the EU.

Table 4. Total annual energy consumption of commercial refrigeration cabinets in the EU-28 of the scenarios analysed, in the reference years 2013, 2020 and 2030. Units: TWh/yr, BC: beverage cooler, ICF: small ice-cream freezer, VM: vending machines, Integrals: supermarket plug-ins/integrals, remote: supermarket segment remote

TWh/yr	2013				2020				2030			
Year	BAU	S4	S5.1	S5.2	BAU	S4	S5.1	S5.2	BAU	S4	S5.1	S5.2
BC	17.2	17.2	17.2	17.2	15.5	14.2	13.4	13.4	15.5	11.6	9.6	9.6
ICF	4.0	4.0	4.0	4.0	3.6	3.6	3.5	3.5	3.6	3.6	3.4	3.4
VM	2.5	2.5	2.5	2.5	1.6	1.4	1.3	1.3	1.6	1.1	0.9	0.9
Integrals	8.7	8.7	8.7	8.7	9.4	9.0	8.7	8.7	11.4	9.9	8.9	8.9
Remotes	32.5	32.5	32.5	32.5	29.1	27.0	25.8	26.0	27.4	21.0	17.6	18.2
TOTAL	64.8	64.8	64.8	64.8	59.2	55.2	52.8	53.0	59.5	47.2	40.3	41.0

Figure 3 depicts the evolution assumed for the BAU scenario, and the time evolution of the potential energy use reduction in the EU28 of the MEPS+EL scenarios, of about 12 TWh/yr in Scenario 4, and ca. 19 TWh/yr in Scenarios 5 in 2030. These estimations reinforce and refine the saving estimates predicted in BIO IS preparatory study (2007) and Wuppertal Institute IA study (2010).

Figures 4a and 4b depict the shares of potential savings that one can attribute to the different base cases and other supermarket categories for scenarios 5, as well as their evolution over time. The largest savings are attributable to improvement of beverage coolers (e.g. introducing EMDs: 20-40% energy reduction depending on the use conditions), and supermarket cabinets (most notably multi-decks, by installing doors: 40% energy reduction).

These electricity savings are expected to result in significant cost savings for retailers and other end-users, the magnitude of which depend on the electricity price.

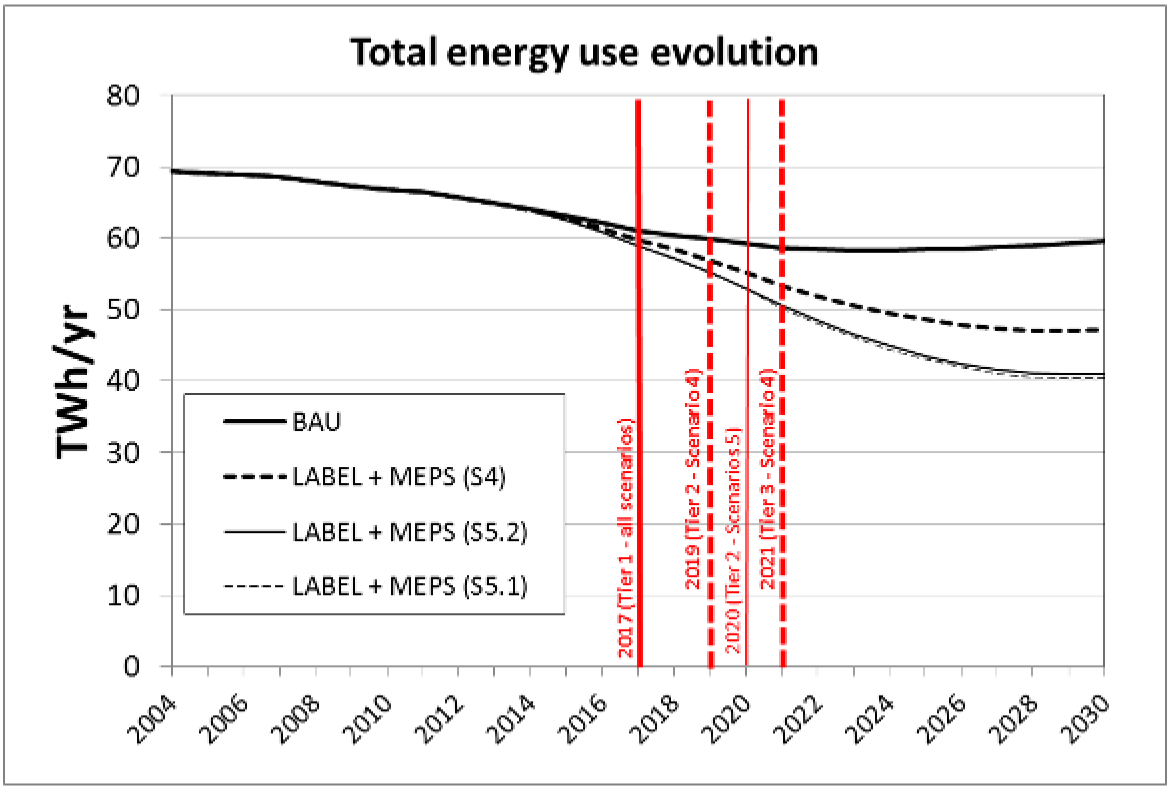
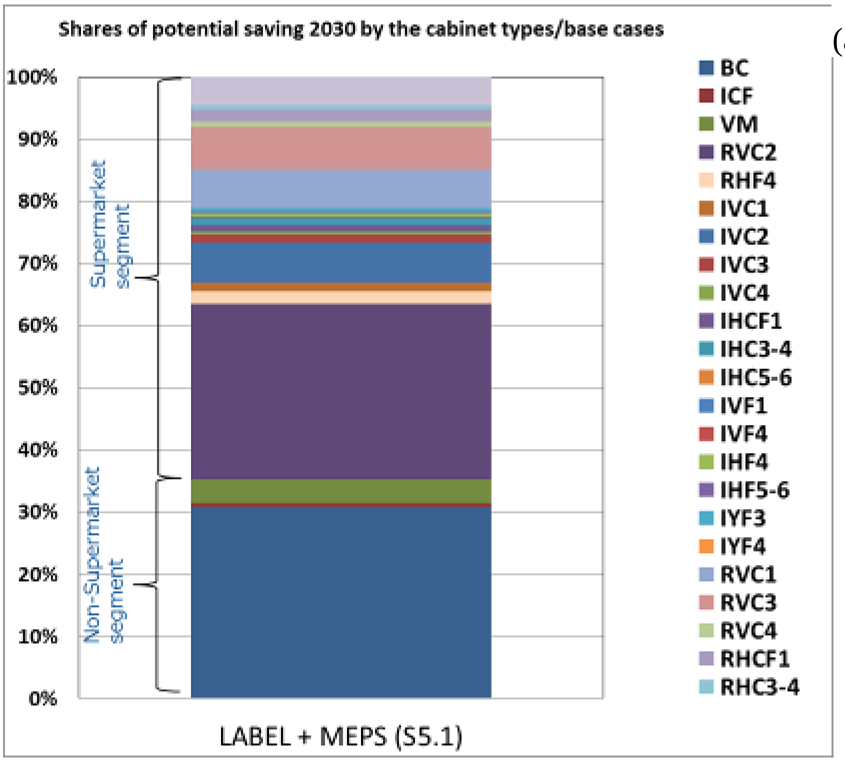
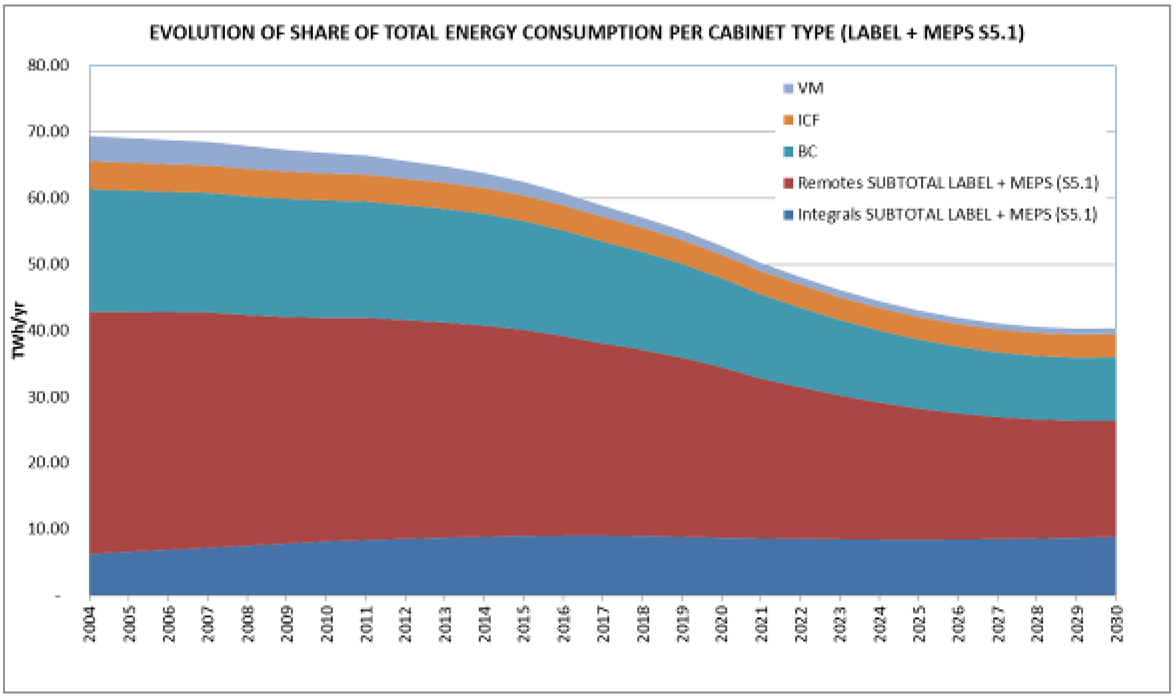


Figure 3 Estimated evolution over time of the total energy consumption of commercial refrigeration cabinets in the EU-28, including scenarios for Business as Usual (BAU), and Scenarios 4 and 5.



(a)

(b)



Figures 4a and 4b. Shares of the contributions of the different base cases and non-base-case cabinet types to the total energy use in the EU-28. BC: Beverage Coolers, ICF: Ice-cream Freezers. VM: vending machines; RVC2: remote, chilled, open multideck; RHF4: remote, open island freezer. The remaining acronyms are supermarket segment cabinet subtypes, following the ISO 23953 nomenclature (see Annex 9.9).

6.1.2. Competitiveness proofing and effects in third countries

It is estimated that the policy options analysed do not affect negatively competitiveness of the European industry. In theory, the proposed measures could potentially remove a number of cabinet models from the market. However, the effect of this will be limited as the technical analysis and the opinions from manufacturers suggest that the costs of redesign to meet proposed requirements is not particularly large. Conversely, already in the short term, the introduction of MEPS will raise the demand of high efficiency cabinets, components, and related services (*e.g.* retrofitting) providing opportunities for EU companies.

Extra-EU import is small for cabinets, and the import of commercial refrigeration cabinets with low efficiency to the European market will not be allowed once introducing MEPS. The extra-EU import of high efficiency components may rise. Prices for high efficiency products and services may rise in the short term due to the demand increase, and probably will not descend until the mid-term, when one can expect a drop in price for efficient components.

Development of innovative technology at competitive prices due to requirements set and additional policy implemented will increase competitiveness of European manufacturers in other markets, even though export outside Europe is currently low. Notably, the policy will foster competition between manufacturers within Europe, where markets seem to be not fully integrated yet.

Manufacturers interviewed — including SMEs — seem most concerned by:

(1) the higher costs of testing,

(2) the risk that they are not able to reflect the additional costs of testing and new components into the cabinet's price, due to the high negotiation power of retailers,

(3) that the market levelling role of enforcement and surveillance authorities in the EU may be weak and not sufficient to remove low performance cabinets from the market, and justify the higher prices of best performers, and

(4) that some inefficient cabinet types would be excluded from the market while they could still be specifically demanded by retailers.

The process for establishing ecodesign requirements is transparent, and before adoption of the measures a notification under WTO-TBT will be issued. There are a number of regulations on refrigerated cabinets[34] in third countries. Canada, Australia, New Zealand, the USA and Japan are among them. The EU is not leading standardisation and energy labelling on this product type, and it is thus likely that the mentioned countries will look carefully at how the EU policy compares with their own. The EU policy will strengthen the global effort to introduce high-efficiency cabinets in the market. In the short term this will constitute a negative impact for manufacturers of low-efficiency cabinets around the globe. Policy scenario 5 would imply a faster restriction of the low-efficiency models, and therefore would affect the competitiveness of EU manufacturers that have mostly or only these low-efficiency models in their portfolio. The enquiries to manufacturers have revealed that most manufacturers are able to provide cabinets in a wide range of efficiency levels. Some non-EU manufacturers do indeed specialise on low cost, low efficiency cabinets, and would be directly affected. To protect SMEs, the timing between the different tiers are aligned with the duration of the normal design cycles of the appliances so that manufacturers have sufficient time to adapt their products to the energy efficiency requirements. On the long run, the production of high-quality cabinets both in- and outside the EU will become more profitable.

6.1.3. Territorial impact

Territorial impact assessment (TIA) is one of the possible elements of the impact assessments. As stated in a recent presentation of the Commission services[35], TIA is only required when the policy explicitly targets a (type) of a region and/or the policy targets some regions or areas more than others. In this case, these conditions do not apply and thus the TIA is not required.

6.1.4. Small and medium-sized enterprises (SMEs)

According to Eurostat, in 2008[36] five large manufacturers held 67% of the market, while 43% of the 'commercial' refrigeration retail trade and repair businesses are consisting of micro SMEs and 7% of medium-sized SMEs[37]. Greater market fragmentation is observed in the plug-in market, which is believed to be split between more than 50 manufacturers in the EU. Refrigeration equipment is also produced in the mature markets of Western Europe, Japan and the US; however, there has been an increase in manufacturing from countries with low

[34] The mentioned countries have energy efficiency policies in one or more of the subcategories covered by the scope of the EU policy proposal, see Annex 9.3

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

[36] The market of refrigerating appliances for commercial use is a slow moving market: these data are still reasonable. In 2019 DG Energy and Eurostat of the European Commission are planning to cooperate to adapt the PRODCOM data in Eurostat to the classification of refrigerating appliances for commercial use according to the new ecodesign and energy labelling legislation. This will facilitate the collection of data for the reviews of the legislation.

[37] Eurostat. Statistics in focus. Industry, trade and services. Author: Manfred Schmiemann, 31/2008.

labour costs, such as Eastern European countries and Turkey, which aim to compete on price[38].

The major manufacturers in the integral and the remote commercial refrigeration markets tend to be larger companies. Generally within the EU, manufacturers of remote cabinets are located in Italy, France, Germany, the Czech Republic and Hungary whereas manufacturers of integral cabinets tend to be found in Italy, Germany, France, Sweden and Spain.

The technical competence of SMEs is variable and there are several types of SMEs that sell commercial cabinets[39]:

1. Larger SMEs who have their own test facilities and experienced engineers to operate the test rooms and develop the cabinets (mainly medium and small SMEs). These companies often have equivalent knowledge and experience compared to larger companies, but may not have access to expensive equipment or certain design capabilities.
2. SMEs that sell cabinets manufactured elsewhere and so do not have any detailed technical knowledge of how the cabinets were designed (distributors).
3. SMEs that developed from companies who cut metal and made metal shelves or components. Often these companies have less experience of refrigeration design and air flow optimisation. They often do not have test facilities and have less knowledge of design and optimisation of cabinets.
4. There are other SMEs that developed from companies who cut metal (as 3. above), but have experienced engineers who understand refrigeration systems and how to optimise the performance of a commercial cabinet. These companies can produce excellent well-built and energy efficient cabinets, often with innovative designs.
5. There are also innovative SMEs who design and build novel commercial refrigeration systems. These companies have a good grasp on the market and have engineers who understand how to optimise refrigeration systems. These companies sometimes invest in test facilities.

The proposed policy will not specifically affect larger or smaller manufacturers, although manufactures with a broad array of products and/or with experience in high efficiency cabinets, and own testing facilities would have market advantages. In Member States where electricity costs are highest, retailers are likely to have already demanded high efficiency appliances, and manufacturers serving these countries are more likely to have adapted their portfolio accordingly.

As regards the access to test facilities for SMEs, micro and small SMEs are less likely than medium sized SMEs and large companies to have access to a range of test facilities. Small and micro SMEs usually produce fewer cabinets than large companies and so have less incentive to build and manage test rooms. All companies, whether they are an SME or a large company, can have their cabinets independently tested. Depending on the number of cabinets that a company produces, the costs for testing may look attractive when compared to setting

38 BIO IS preparatory study (2007) and CLASP/Tait Consulting report “Analysis of specific issues regarding EU policy proposals for DG ENER Lot 12 Commercial Refrigeration” (2014).

39 CLASP/Tait Consulting report “Analysis of specific issues regarding EU policy proposals for DG ENER Lot 12 Commercial Refrigeration” (2014).

up and operating a test facility. It is not perceived that the availability of independent test facilities is an issue[40].

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 the size of the company.

The impact on SMEs is limited in Scenario 4 and 5. In Scenario 4, by introducing less ambitious minimum energy efficiency requirements, which would ensure that SMEs meet the requirements, but which lacks ambition for the other manufacturers. In Scenario 5, by a two-tiered approach with a transitional first tier, which only removes a limited number of appliances from the market, and a stringent second tier, which applies 3 years after the first tier to account for the design cycle of a commercial refrigerating appliance. This would allow introducing stringent requirements while ensuring that SMEs have sufficient time to develop products that comply with the new requirements.

Moreover, an initiative to reduce the burden of testing could help these and other companies, especially those without testing facilities. Hence, the calculation of the parameters based on the design, or the extrapolation from another model, or both is allowed.

6.1.5. Retailers and installers

Retailers report that on a life cycle perspective, the benefits of using energy efficient cabinets largely outweigh the drawbacks. This is also the case for efficient cabinets without doors (*e.g.* as preferred by some discount retailers).

6.1.6. Administrative burden

Administrative costs of the options analysed are comparatively low and almost the same for the investigated sub-scenarios, since they all assume the implementation of MEPS and energy labelling. They include requirements to provide information on the efficiency of the appliances as well as the measurement and calculation methods. The energy labelling measure includes the provision of an energy label and a technical fiche.

6.1.7. Compliance cost and timing

Compliance costs include the costs for product testing and provision of information as well as costs for market surveillance. More information is provided in section 6.3. Manufacturers are concerned that these costs may be high for the labelling, as this policy instrument is new to them, and would affect all cabinets. This concern extends to the EoL requirement for the identification of hazardous elements.

6.1.8. Expenditure in the EU

It is estimated that the implementation of Scenarios 5 would result in savings of about EUR 300 million by 2020 only for the base cases studied, representing 80% of the cabinet stocks, mostly associated to energy use savings (see section 6.7). It is assumed that due to technical similarities, the remaining 20% of the stock which are not base cases but still included in the scope of the policy would behave similarly and provide additional savings to the figure above.

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40 BIO IS preparatory study (2007) and CLASP/Tait Consulting report "Analysis of specific issues regarding EU policy proposals for DG ENER Lot 12 Commercial Refrigeration" (2014).

6.2. Market transformation

6.2.1. Market limitations

Stakeholders (especially component and cabinet manufacturers, including SMEs) have been interviewed to identify any possible bottleneck in the market, such as the availability of glass doors, efficient compressors or fans, low GWP refrigerants, etc. These stakeholders have not identified any foreseeable market constraint to the adaptation of production to the new policy. In the past, the availability of affordable CO_2 compressors is mentioned as an example of a constraint to the mass production of cabinets using CO_2 as refrigerant.

The production components contributing to efficiency, including the supply of materials for doors and night curtains and its installation is expected to grow, in economic and employment terms. Most manufacturers of components for the refrigeration industry are European[41].

6.2.2. Exclusion of cabinet types from the market

The functionality approach proposed, operationalised in the proposal as the minimal breakdown possible of commercial refrigeration categories, is intended to bring clear signals to the markets on which cabinet types and designs are more/less energy efficient in delivering the same function. Inefficient cabinet types/designs will have more difficulties to position themselves in a certain energy labelling class or exceptionally not even meet the minimum energy requirements. This effect is not only applicable for existing designs and concepts, but to future designs conceived after the policy enters into force. The identified pros and cons of this approach are presented in more detail in Annex 9.12.

Based on the above, a thorough assessment of the energy use data for the cabinet types currently on the market has been undertaken, in order to identify any possible conflicts.

In Scenario 4, no risk for exclusion is detected for any specific cabinet type. Closed cabinet types will typically not be excluded, unless extremely inefficient for other reasons. Open cabinets will not be excluded *per se* if they compensate this by energy efficiency measures such as night blinds, efficient fans and compressors, or additional insulation. Three cabinet types have been identified which may need additional efforts to meet the targets of scenario 5:

- roll-in cabinets;
- semi-vertical cabinets;
- vertical and semi-vertical (closed) freezers.

Roll-in cabinets are typically used for (fresh) dairy products, characterised by high turnover in stores, and high space needs. Most current front-access roll-in cabinet designs are open cabinets. Doors are more common in back-store access roll-ins, though. Some stakeholders have argued that it is difficult to install doors on front-access cabinets, as this makes it difficult to operate (reposition) with the heavy-weighted dairy trolleys. However, new closed designs are being introduced on the market. Open, roll-in cabinets that do not significantly improve their energy efficiency compared to current levels could face a gradual phase-out.

Semi-vertical cabinets have traditionally been open cabinets. If not significantly improving their energy efficiency compared to current levels, these cabinets could also face a gradual phase-out. It has been argued that the angled surface of lids and doors is prone to deposit

41 Apparently, this is not the case in the HVAC market

condensation, which is difficult to avoid by the use of air flows. In some cases, heating of the door/lid may be needed, increasing the energy use. Meeting the proposed MEPS in Scenario 5 will be difficult for semi-vertical cabinets unless a number of alternative energy efficiency measures are installed simultaneously. The thresholds will be easily met if the cabinets are closed with lids or doors, an option which is in the market, but at the moment rarely used by retailers.

Vertical and semi-vertical freezers are currently mostly closed, but even if closed could also experience difficulties in meeting the MEPS, as these appliances double the energy consumption of their horizontal counterparts. The higher energy use is explained by very important losses each time doors are open. Intensive design activity will be necessary to avoid these energy losses and keep these appliances in the market, e.g. by splitting the vertical doors so only a section of the cabinet is open. Additional UK data shows that more efficient cabinets of this type already exist on the market and can comply with the proposed MEPS.

Analysis of the available data has shown that the likely market response to the policy, in all scenarios analysed, is that the first choice for manufacturers and retailers for open cabinets will be to offer closed cabinets, as this ensures meeting MEPS and a short investment and payback time for users. Open cabinets equipped with a combination of alternative energy efficiency measures will also meet the MEPS, but the installation of these components (efficient compressors, fans, refrigerant change, etc.) may result in longer payback times than doors. Moreover, open cabinets will have more difficulties in positioning within the best energy labelling classes. It can still be the choice of retailers to use these cabinets, with the aforementioned drawbacks, if the retailers choose to use these models because they deliver additional functions for their store such keeping a certain market or sales concept, or supporting brand image.

It is foreseen that the commercial refrigeration market will by itself create internal competition, and new designs will push energy efficiency as one of the central elements of cabinet choice. This mechanism could phase out certain cabinet types, even if they still met energy efficiency limits.

An overview of which cabinet types would have more difficulties to reach the implemented MEPS is shown in Annex 9.10.

Certain manufacturers have argued that some large supermarkets drive innovation in the retail sector by demanding new sales concepts and equipment to manufacturers. These demands are usually intended to enhance the sales. They claim that ecodesign requirements could be an obstacle for manufacturers to meet the customers' demands. However, a thorough assessment of data for the variety of cabinets and technologies currently available in the EU market show that all display options can be delivered by means of both efficient and inefficient cabinets. It is thus concluded that the proposed MEPS (especially for Scenario 4, to a less extent for Scenarios 5.1 and 5.2), based on existing affordable technologies, do not interfere with meeting the needs of retailers. Inquired on this, some retailers have highlighted that the most beneficial part of the policy elements is for them the MEPS, even if it compromises some business models, as long as it is enforced equally for the entire EU. The labelling is seen as having less added-value for the large retailers that already use life cycle costing in their purchase. Unfair competition amongst retailers is the largest concern. Smaller shops or retailers that do not apply life cycle costing will benefit the most from energy labelling. The higher purchase cost of cabinets is also not seen as an important impact, as due to the energy savings under the use phase, it does not alter significantly the payback time.

Only some cabinet types would have limited improvement margins. Small ice-cream freezers are already virtually in all cases closed, and the substitution of components (*e.g.* compressors) would have large impacts on the price of the cabinets (which is already among the lowest of all cabinets analysed). Beverage coolers are also mainly closed, and improvements would come from the replacement of glass doors/sides by solid sides, energy management systems or other innovative concepts. Open beverage coolers and small desk beverage coolers would likely be excluded from the market in all scenarios. Vending machines for non-perishable goods can install energy management systems, as well as work further on designs that split and insulate the refrigerated sections, and/or only cool down the products that are about to be consumed and need refrigeration, and not all the volume of products stored. Vending machines with perishable foodstuffs would have to cool more specifically that zone where these products are stored.

6.2.3. Assessing timing and stringency of requirements

Annex 9.10 provides detail graphic representations of the relative stringency of the MEPS and the amount and nature of appliances likely excluded from the market.

The proposed sunset dates for MEPS have been set based on an assessment of the data collected as of 2014. The distribution of the energy labelling is also largely based on the experience collected in the last decade on the implementation of labels in other appliances, including household refrigerators. It also takes into account the developments detected in energy consumption of commercial cabinets in the last 5-10 years. The high stringency of the best classes (B, A) is proposed as a measure to avoid the early need of review and addition of classes (A+, A++, etc.).

The suited date for review has also been discussed. On the one hand, time has to be provided for the collection of data, especially for the cabinet types for which new testing standards are currently being developed. On the other hand, the review should be prompt in checking the fitness of the requirements to the new data obtained with new standards. Additionally, some MS have requested that the review shall not take place too much earlier than the last of the tiers for the MEPS.

6.3. Cost

6.3.1. Purchase and running cost

The manufacturing costs may likely increase in the short term due to the use of more efficient components such as high–efficiency fans, higher efficiency compressors, improved insulation, etc. Manufacturers reflect additionally in product costs the costs of machinery and production line adaptation, staff training, costs of trials/pilots, testing, etc. Due to economy of scale effects, competition and larger sales, it is also expected that component and cabinet costs will decrease in the mid and long-term, after ecodesign requirements are introduced.

The effect of these price fluctuations on cabinet sales depends additionally on the evolution of energy costs, as energy prices change the profitability of cabinet replacement (payback times) and therefore the purchase decision.

The life cycle cost of commercial refrigeration appliances is currently dominated by the cost of energy consumption in the use phase. More efficient appliances will reduce the overall life cycle cost and thus the most efficient appliance will represent the least life cycle cost. With current energy prices, payback times of 1-3 years are common for most energy-efficiency retrofitting options[42], or for the replacement of cabinets with more efficient ones. The average

[42] See Annex 9.14.2 on door closing retrofit

lifetime of refrigeration cabinets spans from 7 to 14 years, depending on the type. Once the shortest payback time measures have been introduced, additional energy efficiency gains are more costly, resulting in longer payback times.

Until the next review of this policy, it is expected that the most efficient appliances represent the appliances with the lowest life cycle cost, as a number of untapped low-cost measures can still be taken in many cabinet categories to bring down the energy consumption.

It is not expected that the initial higher prices of the cabinets would lead to retailers postponing investment in new more energy efficient installations. In a large part of the sector, purchasing decisions are made in the context of large refurbishments or the building of new shops, in which case the purchase price of the refrigerating appliances is such a minor aspect in the overall budget that a slight increase would not delay decisions. If the purchaser gets a clear indication through a label that more efficient appliances are on the market, the purchaser will be tempted to buy a more efficient appliance which is maybe a bit more expensive. Moreover, the payback times are usually short for the most expensive improvements (e.g. for a cabinet with doors about 2 years of additional payback time versus an open cabinet). Furthermore, large retailers are reported by manufacturers as having a large bargaining capacity, and will demand higher energy efficiency at no additional cost. For smaller retailers or other buyers, the same arguments hold as for household appliances: people tend to invest more in an energy efficient appliance because they know it will save money or they have some level of environmental awareness.

An overview of the acquisition cost and the running costs is given in section 6.7.

6.3.2. Testing

The introduction of MEPS and energy labelling will require more systematic testing. The frequency of testing will increase for the appliance types where this is not compulsory at the moment. In the past, energy information was provided in some cases as one among a number of technical specifications. The voluntary certification system from Eurovent encouraged the display of this information for the better performing cabinets. In the future, this data will be key information in purchase.

Remote cabinets are the category for which testing seems most costly. The testing of freezers is reported 10%-20% more expensive than of chillers. Average basic costs of EUR 2 500 – 4 000 are reported for the testing of a standard 2.5m supermarket cabinet, which takes 2-3 days. The testing of bottle coolers and ice-cream freezers is reported to cost EUR 1 500 – 2 500. Remote chillers are normally highly customised, and for some of them 1 week of testing may be needed to check different cabinet configurations leading to overall test costs of EUR 10 000. However, EU manufacturers of remote cabinets are ~15 large companies, not SMEs. Most of the larger SMEs and virtually all large companies have own test facilities to allow the frequent testing required by new designs before a market version is available. Small companies and market surveillance have in the past relied on accredited external testing. Building test facility with climatic chambers is reported to cost around EUR 100 000. Testing cost calculations for professional storage cabinets have shown that the expenses of testing could be about EUR 161000 per year per manufacturer. A similar figure is expected for commercial refrigerated display cabinets, and even higher for remote supermarket cabinets.

The introduction of MEPS and an energy labelling scheme will lead to testing of virtually all cabinet types, although there shall be flexibility to obtain energy use information from calculations if a cabinet has the same basis and different configurations. To reduce the cost of testing, the Commission could provide a method to extrapolate cabinet data for different configurations. Inspiration could come from an alternative efficiency determination method (AEDM) used in the US for commercial refrigeration. The guiding principle is to have a basic energy model of a family of products that allows algorithms to be developed that are supplemented by empirical lab test data. The idea is to be able to test a reasonably small sample of products from the family and produce accurate published data (working within a 5% tolerance).

6.4. Environmental impact

The environmental impact of the proposed measures has been quantified in terms of CO_2 emissions by conversion from the energy use forecasts. Additionally, a qualitative assessment is provided for the impact of the EoL requirements.

All investigated scenarios show a decrease in energy-related CO_2 emissions compared to the baseline scenario. The table below presents the overall savings over time of Scenarios 4 and 5, for 2.2 - 2.8 Mt CO_2-eq in 2020 and over 5.8 – 7.4 Mt CO_2-eq in 2030, compared to the BAU. The BAU scenario assumes a decrease in energy consumption, associated to a reduction of 17% of CO_2 emissions between 2015 and 2030 (4.7 Mt CO_2-eq). Scenarios 4 and 5 duplicate this percentage with 8-10 Mt CO_2-eq reductions (41% and 47%), respectively.

Table 3 Energy-related greenhouse gas emission evolution over time of the scenarios analysed.

	(Mt CO2-eq)				Mt CO2-eq savings vs BAU		
Year	BAU	S4	S5.1	S5.2	S4	S5.1	S5.2
2010	27.4	27.4	27.4	27.4	-	-	-
2011	27.1	27.1	27.1	27.1	-	-	-
2012	26.5	26.5	26.5	26.5	-	-	-
2013	26.0	26.0	26.0	26.0	-	-	-
2014	25.5	25.4	25.4	25.4	- 0.1	- 0.1	- 0.1
2015	24.9	24.8	24.7	24.7	- 0.2	- 0.3	- 0.2
2016	24.3	24.0	23.8	23.9	- 0.3	- 0.5	- 0.5
2017	23.7	23.2	22.9	22.9	- 0.5	- 0.8	- 0.8
2018	23.3	22.5	22.0	22.1	- 0.8	- 1.3	- 1.2
2019	22.9	21.8	21.1	21.2	- 1.1	- 1.8	- 1.7
2020	22.5	21.0	20.1	20.2	- 1.5	- 2.4	- 2.4
2021	22.0	20.0	18.9	19.0	- 2.0	- 3.1	- 3.0
2022	21.7	19.3	17.9	18.0	- 2.4	- 3.8	- 3.7
2023	21.5	18.6	17.0	17.1	- 2.9	- 4.5	- 4.3
2024	21.2	18.0	16.2	16.3	- 3.2	- 5.0	- 4.9
2025	21.0	17.5	15.5	15.7	- 3.5	- 5.5	- 5.3
2026	20.8	17.0	14.9	15.1	- 3.8	- 5.9	- 5.7
2027	20.7	16.7	14.5	14.7	- 4.0	- 6.2	- 6.0
2028	20.5	16.4	14.1	14.3	- 4.1	- 6.4	- 6.2
2029	20.4	16.2	13.9	14.1	- 4.2	- 6.5	- 6.3
2030	20.2	16.0	13.7	13.9	- 4.2	- 6.5	- 6.3

Direct emissions related to refrigerant leakage can additionally be added to the figures above, as outlined in Section 5.4. The estimation of direct refrigerant leakage is with current data subject to large uncertainty, spanning from 4 to 20 MtCO_2/yr, and would be identical for all scenarios proposed (see also Annex 9.14.6). No change in refrigerant use is foreseen by the introduction of energy efficiency thresholds and energy labelling scheme other than a consolidation of the currently observed trend of the BAU of substitution to lower, more efficient GWP refrigerants, to an extent motivated by the F-gas Regulation update. The extent of this substitution is limited by two factors, as described in the preparatory study: on the one hand, safety-related factors concerning mainly the use of hydrocarbons in large capacity cabinets, and on the other hand, the reduction in heat exchange capacity of certain refrigerants (e.g. CO_2) at high ambient temperatures.

6.5. End-of-Life (EoL)

The proposed Regulation sets specific requirements on manufacturers, on (1) compulsory hazardous component identification and dismantling instructions, and (2) foaming agent identification and labelling, both devised to help recyclers more effectively comply with the WEEE Directive (2012/19/EU) that will explicitly include in its scope all refrigeration cabinets from 15 August 2018.

The requirements will contribute to improve coherence between Ecodesign Directive and WEEE Directive. In particular it will facilitate the proper treatment of some target components in the waste appliances, avoiding that potentially hazardous substances would be dispersed in the waste flows. The requirements on EoL represent a novelty in ecodesign policy, requesting the provision of structured information, and thus go beyond the generic information requirements on EoL as enforced in the implementing measures of other products.

A screening of the potential impact of this information measure has been discussed with stakeholders including manufacturers, recyclers, MS, and market surveillance authorities, obtaining general support, as the measures are perceived as only resulting in marginal costs. A more detailed discussion of potential impacts of the proposed EoL requirements is provided in Annex 9.15.

In summary, it is estimated that the proposed EoL requirements will not have significant impact on the competitiveness of industry, will not imply additional costs for the consumers, and will not drastically increase administrative burdens in particular for manufacturers and Member States. They will however facilitate the end-of-life treatment of commercial refrigeration cabinets.

6.6. Social impact

6.6.1. Employment, training and certification of market actors

Stakeholders (associations, manufacturers, retailers) have been asked to evaluate qualitatively the potential social impact of the policy on their activity. Major risks for job losses have not been pointed out by industry, neither during the Consultation Forum nor in the exchanges that the Commission services have had with various industry representatives. SMEs involved in installation, testing and maintenance activities are likely to be affected positively. The paragraphs below summarise the answers provided[43].

<u>Manufacturers of cabinets</u>

Little or no impact for most production companies is expected as companies have broad product portfolios. It is possible however that SMEs have to reduce their product range. Little impact is expected for the companies specialised in high efficiency cabinets. These companies have already test rooms and test specialists. It cannot be excluded that some companies may have difficulties in achieving compliance in time. Negative impacts can be

[43] Additional details are provided in Annex 9.15.3.

foreseen for the companies currently specialised on low-cost cabinets, usually related to low efficiencies. As mentioned in the assessment, Tier 1 requirements are reachable at low cost, using existing technologies, for a vast majority of cabinets. The requirements of Tier 1 will likely only affect a part of the palette of cabinets that manufacturers normally offer. Tier 2 requirements will need investments and redesign. For this reason, specifically to protect SMEs, the date of application of this tier takes into account the design cycle of the cabinets. Testing costs are indicated to be the main burden.

Indirect employment

Positive impacts are expected for component manufacturers such as doors (glass/plastic, including their fittings and heating when needed), high efficiency compressor and fan producers, insulation, sealing and fittings. Existing certified testing laboratories can also expect higher demand, as well as all the manufacturing and installation industry related to testing equipment (energy consumption meters, probes, test packages, etc.).

Retailers

Small changes are foreseen in employment, essentially on workload on some areas (maintenance and cleaning of doors, reposition time, HVAC technicians).

Maintenance/Installers

Changes are foreseen for the installation and maintenance of new cabinets, including proper training and certifying technicians, sizing and installing, system adaptation, etc.

Quantitative employment impacts have been estimated based on the calculated revenues. The results for the base cases are presented in section 6.7.

6.6.2. Consumer economics and affordability

The preparatory study and further interviews with retailers reveal that most energy efficiency measures, including the installation of doors, larger insulation thickness, and higher efficiency compressors and fans have payback times of less than 3 years, and are therefore assumable by retailers. Vending machines, beverage coolers and small ice-cream freezers operate under split incentive conditions and therefore the mechanisms for payback for the purchaser of the additional purchase costs are twofold. On the one hand this will be based on non-energy related benefits (*e.g.* corporate image, status) and on the other hand on the gradual awakening of awareness and pressure from the end-user, once the benefits of the high-efficiency cabinets are communicated.

In this respect, the only difference between the analysed scenarios is the speed of transformation of the market, which in Scenarios 5.1 and 5.2 will be faster and put more pressure on the transformation of the purchase mechanisms of cabinet buyers. It also aligns better with the MEPS in other world regions (see Annex 9.3). As payback times for more efficient cabinets are shorter than the cabinet's lifetime, retailers do not conceive to pass any form of costs to the consumer in the refrigerated product prices. Energy costs are calculated to be around 3% to 4% of the total sales revenue of a refrigerated food or drink item. In principle, lowering the energy cost for cooling could lower the cost of food and drink items. Thus, one may expect on the contrary a mid-term saving for retailers, which is not expected to be transferred to the end-user in the form of lower product prices. Rebound effects for retailers may be expected, as the energy expense savings from refrigeration may be used into other energy-using investments[44].

6.6.3. *Health and safety aspects*

The only aspect under this impact heading detected in the dialogue with stakeholders is the expected better preservation of products in closed cabinets, which are reported by some retailers to reduce food wastage.

44 A quantification of these effects would be very difficult due to the wide variety of users of cabinets, and if estimated quantitatively would provide a false perception of knowledge, as these are based on speculative assumptions and subject to very large uncertainty

6.7. Conclusion on economic, social and environmental impacts

The table below gives a comparative overview of the main impacts of the analysed policy options. Note that these calculations are based on the base cases for which detailed economic data is available and which represent about 88% of total market (in terms of stocks[45]).

Table 5 Comparative overview of the main impacts of the analysed policy options for the base cases.

Commercial Refrigeration base cases	unit	2010			2020			2030		
Sales	'000	1 347			1 371			1 463		
Stock	'000	12 593			12 779			13 593		
	Scenario	BAU	Scenario 4	Scenario 5	BAU	Scenario 4	Scenario 5	BAU	Scenario 4	Scenario 5
Electricity	TWh elec/a	41	41	41	34	32	30	33	25	21
CO_2 emissions[46]	$MtCO_2/a$	16.7	16.7	16.7	13.0	12.0	11.4	11.4	8.6	7.2
Acquisition costs (incl. install)	bn EUR	1.6	1.6	1.6	1.6	1.8	2.0	1.8	2.0	2.2
Energy costs	bn EUR	4.3	4.3	4.3	5.1	4.7	4.5	7.4	5.6	4.7
Maintenance costs (incl. VAT)	bn EUR	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total running costs	bn EUR	4.8	4.8	4.8	5.7	5.3	5.0	8.0	6.2	5.3
Total expenditure	bn EUR	6.4	6.4	6.4	7.3	7.1	7.0	9.8	8.2	7.5
Revenue Industry	m EUR	1087	1087	1087	1123	1256	1360	1221	1370	1493
Revenue Wholesale	m EUR	466	466	466	481	538	583	523	587	640
Revenue Installation	m EUR	32	32	32	35	42	47	37	45	51
Revenue Maintenance (excl. VAT)	m EUR	564	564	564	569	569	569	596	596	596
Jobs Industry (⅓), OEM (⅓) & services (⅓)	'000 jobs	21.7	21.7	21.7	22.5	25.1	27.2	24.4	27.4	29.9
Jobs Wholesale	'000 jobs	1.9	1.9	1.9	1.9	2.2	2.3	2.1	2.3	2.6
Jobs Installation/ maintenance	'000 jobs	6.0	6.0	6.0	6.0	6.1	6.2	6.3	6.4	6.5
Jobs Total	'000 jobs	29.6	29.6	29.6	30.4	33.4	35.7	32.8	36.2	38.9

45 And about 60% of the total energy use of commercial refrigeration appliances. While the stock share figures are expected to remain stable, the energy share of the base cases is expected to evolve with time to be around 50% in 2030

46 Note that these CO_2 emissions account only for indirect emissions related to electricity production. Direct emissions related to refrigerant leakage would add up to the CO_2 emissions about 4 $MtCO_2/a$ for all scenarios in all years. Assumptions for this calculation can be found in Annex 9.14.6. No differentiation is made between the scenarios for this specific item.

Acquisition costs rise for the different scenarios, but total running costs decreases. This results in a decrease of total expenditure for both scenario 4 and 5.

The energy efficiency standards for both scenarios require more efficient and expensive technologies, which can have a positive impact on the manufacturer turnover. This could lead to a related job increase as well.

7. COMPARISON OF POLICY OPTIONS

All scenarios analysed in this impact assessment contribute to an improvement of energy efficiency compared to the baseline development. The analysis shows that in comparison to the baseline, the assessed policy options save between 12 and 19 TWh/yr in 2030. The overall accumulated savings from 2015 to 2030 are respectively 108 TWh with Scenario 4 and about 170 TWh with Scenarios 5. In terms of sensitivity, the scenarios can be considered robust to some of the variables analysed (temperature classes, cabinet breakdown). More influential is the difference between test conditions and real-life conditions. This has been accounted for in the model, using the information available[47].

Table 6 below evaluates semi-quantitatively the policy scenarios in terms of their impacts compared to the baseline:

Table 6 Evaluation of the policy scenarios in terms of their impacts compared to the baseline.

	Scenario 4	**Scenario 5.1**	**Scenario 5.2**
1.Promote energy efficiency hence contribute to security of supply	+	++	++
2.Reduce energy consumption and related air missions	+	++	++
3.Impacts on the functionality of the product from the perspective of the customer	-/+	-/+	-/+
4.Impacts on the functionality of the product from the perspective of the producer/retailer	-/+	-/+	-/+
5.Overall impact on health, safety and the environment (excluding energy)	+	+	+
6. Impact on the quality and shelf life of the refrigerated products, and on food wastage	+	++	++
7.Impacts on the freedom of choice of technical options from the perspective of the retailer/buyer or the producer	-	-	-
8.Impact on affordability to buyers/users (retailers, etc)	-	-	-
9.Impact on users (retailers, etc) in particular as regards life- cycle costs	+	++	++
10.Impacts on industry's competitiveness –short term (especially for SMEs)	+	-	-
11.Impacts on industry's competitiveness –medium and long term	+	++	++
12.Setting of an ecodesign requirement shall not have the consequence of imposing proprietary technology on manufacturers	+	+	+
13.Impose no excessive administrative burden on manufacturers	-/+	-/+	-/+

Legend: ++: very positive impact, +: positive impact, -/+: no significant impact, -: negative impact, --:very negative impact.

47 See the data sources and parameters used in Annex 9.5.3.

The scenarios have several positive impacts, in particular the following:

- removal of the least efficient models from the market is guaranteed;
- synergistic impact of the pushing effect of the eco-design specific requirements and the pulling effect of a functioning labelling scale;
- compared to the BAU, reduction of the electricity consumption of about 12 to 19 TWh/yr (30 to 48 TWh/y in primary energy terms[48]) in the decade 2020-2030, i.e. 0.83% to 1.3% of the Commission's 2030 target for final energy consumption savings. These results correspond to accumulated savings of over 108 TWh in Scenario 4 (almost the final energy consumption of Bulgaria in 2015, i.e. 9.51 TWh) and 170 TWh (more than the final energy consumption of Denmark in 2015, i.e. 13.95 TWh) in Scenarios 5 in the time from 2015 to 2030. These energy savings would additionally mean yearly savings of 2.2 - 2.8 Mt CO_2-eq in 2020 and over 5.8 – 7.4 Mt CO_2-eq in 2030, compared to the BAU;
- a clear legal framework for product design which leaves flexibility for manufacturers to achieve the energy efficiency levels;
- although there could be an increased purchase cost, it will be largely compensated for by savings during the use-phase of the product;
- savings in annual expenditure are estimated to be at least 400 million euro in 2020 and about 2.9 billion euro by 2030;
- reduction of the costs by economies of scale for cost-effective technologies;
- correction of market failures and proper functioning of the internal market;
- no significant administrative burdens reported by manufacturers or retailers;
- the specific mandate of MS to the Commission is respected;
- fair competition by ensuring that a level playing field is defined;
- no negative impact on employment;
- no identified negative impact on trade.

Gathering all the analyses above, the conclusion is that both Scenario 4 and 5 result in significant energy and emission savings compared to the BAU. Scenario 5, with more stringent MEPS in terms of timing and thresholds would be especially effective in meeting the objectives of the policy (see section 4), and accelerate the pace of change compared to Scenario 4. However, the exigent speed of transformation that it proposes may cause a number of medium-term adaptation difficulties to industry, and the removal from the market of a number of existing cabinet designs if no extra energy saving options are developed. Between Scenarios 5.1 and 5.2, Scenario 5.2 with a split between remote and plug-in supermarket cabinets is preferable, as it would allow more future flexibility in the updates and review of the policy.

Finally, it is worth to compare the electricity savings potential for commercial cabinets (12 to 19 TWh/y in 2030, respectively for Scenario 4 or 5) with those for other refrigerating appliances that are also in scope of the ecodesign and energy labelling legislation, namely:

[48] Applying a primary energy factor for electricity generation of 2.5, according to Directive 2012/27/EU on energy efficiency.

- For refrigerating appliances typically used in household context[49]: the legislation that will apply from 2021 estimates electricity savings of 9.6 TWh/y in 2030;
- For professional refrigerated storage cabinets, blast cabinets, condensing units and process chillers[50]: the legislation that applies from 2016 estimates electricity savings of 4.1 TWh/y at 2030.

8. MONITORING AND MARKET SURVEILLANCE

8.1. Monitoring

The main monitoring element will be the tests carried out to verify correct energy efficiency determination, rating and labelling, and the monitoring of the fulfilment of the EoL requirements.

The monitoring of the impacts should be done by market surveillance authorities from Member States. An effective market shift towards upper labelling classes will be the main indicator of progress towards market uptake of more efficient cabinets.

The main issues already identified in a possible revision of the proposed MEPS and labelling scheme are:

- Improved standards (CEN/CENELEC/ISO/IEC) for vending machines, beverage coolers, small ice-cream freezers and scooping ice-cream cabinets. Update of ISO 23953 to reflect the real current differences between plug-in and remote supermarket cabinets energy use, if possible making possible cross-comparability.
- Necessity to revise the MEPS and labelling classification scheme according to technological improvements, and any discrepancy between the existing database and the database generated with the new standards.

Revision and adaptation to technical progress (*e.g.* availability of suitable measurement or testing standards, upgrading of classes following market evolution) could be also implemented through comitology.

Taking into account the time necessary for the activities above, a review of the main elements of the framework could be presented five years after implementing the regulation. In order to ensure and enhance further coherence with professional refrigeration (ENTR 'Lot 1') ecodesign and labelling requirements, the review of both could be coordinated.

8.2. Market surveillance

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.

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49 Review of Commission Regulation (EC) No 643/2009 on the ecodesign requirements for household refrigerating appliances and Commission Delegated Regulation (EU) No 1060/2010 on the energy labelling requirements for household refrigerating appliances.

50 From the impact assessment for Commission Regulation (EU) 2015/1095 of 5 May 2015 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.

Some stakeholders are very prudent in trusting the degree of enforcement of the market surveillance mechanisms. If compliance was seen to be poor, the benefits described in this impact assessment would rapidly deteriorate, particularly with regards differentiating better performing products. Given the investment major manufacturers will be making in performance information and product development, manufacturer vigilance will be high. It is therefore likely that products (also from competitors) suspected of not complying will be reported to the authorities if it is in the economic interest of a certain manufacturer.

Market surveillance authorities from several countries have been interviewed in order to survey the operational feasibility of the requirements of the policy, especially concerning the EoL requirements, which are novel to ecodesign policy. The result of this consultation has been a general support to the proposals, and the perception that the measures only result in marginal costs.

9. ANNEXES

9.1. Annex I: Minutes Consultation Forum 2 July 2014 and comments

EC Participants: Robert NUIJ (Chairman - ENER), Santiago GONZALEZ HERRAIZ (ENER), Davide POLVERINI (ENTR), Ferenc PEKAR (ENV), Alejandro VILLANUEVA (JRC), Hans MOONS (JRC), Oliver WOLF (JRC), Fabrice MATHIEUX (JRC).

Documents:

The Commission services circulated the working documents on "Possible requirements for refrigerated commercial display cabinets" on 02 June 2014 (corrected on the 06 June 2014).

WELCOME AND INTRODUCTION

The **Chairman** welcomed the participants and indicated that the purpose of the meeting was to discuss the working documents on possible requirements for refrigerated commercial display cabinets. Two stakeholders (EPEE, CLASP) will be allowed to make short presentations outlining their positions.

ADOPTION OF THE AGENDA

The agenda was adopted without changes.

WORKING DOCUMENT ON POSSIBLE REQUIREMENTS FOR REFRIGERATED COMMERCIAL DISPLAY CABINETS

The **Commission** presented the working documents.

SCOPE

BE asked if walk-in cold rooms found in supermarkets would be covered by the scope, as they were taken out of the scope of professional refrigeration. **IT** declared that major changes would be necessary before a final version can be agreed, in particular as regards the inclusion of small ice-cream freezers (ICF) and vending machines (VM)) with low savings potential, and the need for further segmentation that should include the product types, temperature classes, remote and plug-in cabinets . **ECOS** asked how commercial and/or household refrigeration regulations would be aligned, in particular for wine coolers, minibars and vertical static air cabinets. Moreover, **ECOS** asked if there would be information requirements (in tier 1 or 2) and whether for built-in cabinets the same information requirements would eventually apply. **NL** fully agrees with the Commission proposal regarding scope and classification as it is simple and allows products to compete in functionality and efficiency. In particular for labelling, **NL** is not in favour of making many subclasses or categories, while for ecodesign it might make sense to make more subcategories as we need to make sure there are no unintended consequences due to an overly broad categorisation. The debate between the NL request for a simple approach and the IT request for segmentation to suit the market needs was lengthy. **DE** asked whether wine cooler devices are in the scope of the household cold appliances regulation.

The **Commission services** responded by stating that:

- The preparatory phase showed that walk-in cold rooms are substantially customized and very few retailers have this type of cabinets. Nevertheless, the Commission remains open to eventually re-include them if this is deemed appropriate.
- The Commission acknowledged the low savings potential for the ICF and VM categories and clarified that the proposed segmentation was based on the data provided by industry (2.600 data entries) and the observed distribution of performance and efficiencies.
- Concerning wine coolers and minibars, the Commission considered that both types should be under the scope of the household cold appliances regulation regardless of whether the intended use is domestic or commercial. Vertical static air cabinets are normally not used for commercial purposes as they cannot withstand the opening regime typical for such cabinets and represent a very minor share of the market. Built-in cabinets should be further explored in particular as regards the appropriateness of information requirements.

Eurovent considered that the estimated savings potential should be recalculated taking due account of the actual ambient temperatures and maximum usage of the cabinets, and that the proposed segmentation should be revisited. **Eurovent** proposed taking corner cabinets out of the scope because there is no test method available **UK** agreed with the scope, although some cabinets (e.g. roll-in) may unintentionally be excluded if the categories are too broad. Moreover, exemptions should be carefully treated not to create loopholes, e.g. in the case of herbs and lettuce in soil that may erroneously be interpreted as living foodstuffs. **IT** clarified that minibars with automatic accounting (i.e. when a beverage is dispensed) are to be considered vending machines ('minibar' is in fact a commercial name and not a technical definition). Moreover, **IT** considered that any further sub-categorisation should be the same for both energy label and ecodesign proposals.

ECODESIGN REQUIREMENTS

FI proposed a more stringent tier 1 (130) and 2 (110), and to remove tier 3. **UK** opposed tier 3 coming into force after the review date and considered the current draft proposal to be too lenient as there are already cabinets in UK today that comply with tier 3. The **UK** proposed tier 1 (110) and tier 2 (80). **FI** supported the UK proposal. **DK** also considered the tiers to be too lenient, suggested to skip tier 2 and proposed a three year period between tier 1 and tier 2. **CLASP** was concerned about the categorisation and about some products affected within these categories. **EPEE** advocated only two tiers and considered approx. 2600 data entries as too few for a good analysis. **NL** also opposed having any tier coming into force after the revision date and considered two tiers to be sufficient.

CLASP presented a preliminary comparison between public data from other regions (i.e. USA-California, Canada and UK) and the EU draft proposal. The presentation focused on (i) stringency and reference lines for beverage coolers (BC), (ii) impact of new test methods on reference lines and (iii) stringency level for the supermarket segment.

The **Commission services** presented industry data (>1800 data points) for vertical, semi-vertical and combined chillers (the most populated subcategory). This data does not allow drawing the conclusion that remote and plug-in cabinets should be treated with different M-N values (see previous comments under point 3.1.), nor that a big share of these cabinets would be phased out in tier 1, or even in tier 3. A similar analysis for other subcategories was shown.

NL questioned the different segmentation for both EL and ED draft measures. **DE** drew attention to the adjusted net volume for multi-temperature cabinets (see *Annex III (d))* and asked why a total display area parameter was not defined and why temperature classes were not taken into account in the calculation method, not even as correction factors. **IT** considered that the 3 tiers are unevenly distributed and that an analysis for each cloud of data points should be performed (each subcategory of products). **ECOS** recommended more stringent requirements, supported the three tiers approach as it gives a long term signal to industry but only makes sense if the third tier is ambitious enough. **Eurovent** questioned the appropriateness and quality of the M-N values, and considered that the maximum energy savings do not properly reflect reality.

The **Commission services** responded by stating:

- Concerning further segmentation of the cabinets and the requirements, the proposal is based on functionality (i.e. to display/present a foodstuff 'X' at a temperature 'Y'). This function can be achieved by using different cabinet designs and display options.
- For BCs, comparisons with the US are difficult, as they have a long history of different MEPS criteria and their products have already moved to other efficient levels. The average volume of the US BC's is also much larger.
- The approach for MEPS and labels is aimed at achieving a clear proposal, based on the above mentioned principle of functionality. While for MEPS a single value for all products is proposed, a one-size-fits-all solution could not be found for the label.
- Concerning the adjusted Total Display Area (TDA), the Commission considered that the method should be in line with method for adjusted net volume.

BE considered that the presented linear regression might not be appropriate and non-linear functions should be explored. **NL** agreed with the approach based on functionality since otherwise a category for each individual cabinet would be necessary. **CLASP** considered that there is a legitimate right to use certain cabinets (i.e. roll-in) which may have difficulties to reach higher efficiencies (e.g. VC2 multi-deck), mainly due to physical limitations. Nevertheless, in France the majority of retailers have signed a voluntary agreement to phase out open cabinets by 2020. **EPEE** said that energy savings will be welcomed by retailers but food retailing is about merchandising/displaying and sales, and the views of retailers would be useful. **Orgalime/EFCEM** considered that the display function is not adequately accounted for, and that other aspects such as flexibility (for the retailer or customer, manufacturer) and different constraints (positioning of the cabinet, safety, local temperatures) need to be taken into account. **BE** supported the proposal from the NL for BC. **SE** did not see a problem with phasing out some specific product types (including open cabinets), and there could be stricter requirements for smaller products than for larger ones. The use of TDA as a metric might result in negative effects (i.e. increase in energy consumption compared to volume) and for some products volume would be better than TDA. **UK** did not support roll-in cabinets being phased out and supported not being too prescriptive about doors. The impact of the TDA measurement needs to be looked at as cabinets with different thickness but the same TDA might actually have very different energy consumption. **DK,** after consultation with Danish industry, recommended the use of metric TDA only for soft scoop ice cream cabinets; for the other categories 'volume' might be better. The Commission should look more into the question of roll-in cabinets.

The **Commission services** responded by:

- Requesting **SE** to send written evidence on the use of volume instead of TDA as a parameter.
- Stating, concerning roll-in cabinets, that data showed that both very inefficient and efficient ones, which could even meet tier 3, exist.
- Stating, concerning the temperature classes classification based solely on chilling versus frozen temperatures, that the proposed measures are based on the assumption that a cabinet designed to be energy efficient for a given temperature class will be efficient within a close range of similar temperatures. Moreover, temperature classes are included in the information requirements.

IT insisted that the analysis should take into consideration temperature classes. **CLASP** said there is evidence that the same cabinet at H1 or M2 classes could have a 25% difference in energy consumption. Therefore, the regulation should prescribe the reference temperature at which the MEPS would be tested. **EPEE** saw the need to differentiate subcategories as well as the required temperature classes. One option to address this might be using the most demanding temperature range as reference for calculations for all cabinets.

The **Commission services** answered that these two issues (subcategories and temperature classes) would be analysed further in the next steps and requested input from industry.

NL said it should be clearly specified at what temperature the product should be tested to meet the MEPS requirements, otherwise cabinets will be tested at the temperature range with the least energy consumption and this might have a large impact on the label classes. **IT** agreed with the comments from NL. This problem might be solved by measuring at the lowest temperature range the manufacturer declares the cabinet is designed for. The key point is that cabinets may not perform outside the designed temperature class. One option to deal with this would be the introduction of correction factors to avoid penalizing one cabinet vs. another.

EPEE considered that (i) the calculation of energy consumption in the Business as Usual scenario (BAU) is too high; (ii) laboratory conditions should not be considered and instead conditions under normal operation must be taken into account (i.e. lower ambient temperature); (iii) the display function is of utmost importance and cabinets should not only be seen as a simple storage device; and (iv) their sector does not have actual energy consumption of the cabinets available.

As regards the actual energy consumption of cabinets (under real life operation conditions), **DK** considered that it would be good for such data to be available even though contacts with

Danish retailers showed that laboratory data only deviate slightly from real conditions and that the EC approach is fine.

IT asked whether ambient temperatures are different from laboratory tests and suggested the possibility of modifying testing conditions through a mandate. **EPEE** confirmed that average ambient temperatures are in general below 25ºC and added that humidity is probably lower as well (below 60%). **Eurovent** indicated that there are only data at class 3 (25ºC and 60% humidity, according to the standard). **NL** considered that this difference should have been taken into account during the preparatory study as it might be possible to derive correction factors for base cases, BAU and savings. While the measurements are laid down in harmonised standards, if there is a significant gap this should be taken into account during the impact assessment phase. **DK** declared that according to some field tests the actual ambient temperature conditions are more similar to climate class 3 than 4. **Eurovent** said that normally climate class 3 is chosen for robustness purposes but this does not reflect actual energy consumption, which is why various correction factors are applied when designing the whole system. **Eurovent** recalled that the majority of retailers do not seem to want to move to other ambient testing conditions. **DE** asked for more clarification of the distinction between 'unit' vs. 'unit model' (see Annex V) as this might lead to confusion. Clear definitions and/or the use of a similar approach to the 'allowance scheme' in the UK might be necessary. **UK** asked to include in the review clause the refurbishment of cabinets. **NL** agreed with UK and recommended the replacement of the text in Annex V with the final agreed text from the omnibus review as regards the notion of 'equivalent product'. **Eurovent** said that some wording in the text did not come from the standard and highlighted the concern that some cabinets are substantially modified after the manufacturer ships them.

The **Commission services** commented as follows:

- In the preparatory phase, several retailers supported the use of a label to better inform purchasing decisions, especially for procurement departments.
- Retailers have been involved in the work and were invited to this Consultation Forum meeting.
- Concerning the wording 'unit' and 'unit model', this is standard language in the context of eco-design/energy labelling and market surveillance. The 'equivalent model/product' notion is already included in the definition of these draft proposals.
- It should be taken into account that eco-design measures apply only to products placed on the market, and not to products that have been substantially modified (as per the Blue Guide).

DK considered the definition of volume according to Annex III (d) too simple and recommended using the net volume and load limit value as per the approach used for household appliances. **IT** warned that the exclusion of refurbished cabinets would discourage resource efficiency solutions for existing products. Additionally, the correction factor for freezers in Annex III (d) – that is, 1.92 - corresponds to an ambient temperature of 25ºC and a freezer temperature of -12ºC. If instead a freezer temperature of -18ºC were to be used, this factor would increase to 2.15. **EPEE** considered that for some ICF and supermarket freezer cases there seem to be overlaps and asked for a clear definition of these two categories. The convenor of CEN TC 44 WG 6, ensured that a good definition of 'net volume' will be proposed in the WGs responsible for drafting the standards for BC and ICF, while for other commercial products TDA should be the preferred parameter. **CLASP** stated that the relevant test standard is the right place for a good definition of volume to be worked out.

END OF LIFE REQUIREMENTS (EOL)

The **Commission services** presented the EoL proposal, clarifying that they consider these requirements to be complementary to the WEEE Directive.

IT suggested dealing with the safety issue of flammable gases in foams by means of an expansion of the scope of standard IEC 60335-2-89 (apparently currently only applied to household refrigerators). **IT** opposed the dismantling requirements, while several other Member States, including **NL**, **UK**, **DK** and **SE**, supported the proposal but called for a revised formulation of the requirements. In particular, terminology such as 'easily identified', 'easily accessed' or ‘standard tools’ would be difficult to verify coherently across the EU. The inclusion of a video was suggested, although **IT** doubted its effectiveness as a stand-alone requirement.

UK mentioned that the issue of EoL requirements as part of Ecodesign is currently being addressed horizontally by a dedicated standardisation mandate, as it is relevant for many product groups.

Orgalime mentioned confidentiality as an argument against providing detailed (public) dismantling information. However, several other participants considered that products on the market can be readily bought by competitors, dismantled and examined, so confidentiality does not seem to be an issue in this respect.

EVA indicated that in the case of vending machines, modularity is already one of the essential design parameters, as retrofitting is commonplace in this sector.

LABELLING REQUIREMENTS

NL asked why 5 different label tables have been proposed while 2 might suffice, supported an A-G scale and recommended validity for a period of 5-7 years with class A not populated and reserved for BNAT, and B (and maybe C) for BAT. **IT** advocated going beyond class A and using pluses, BNAT in A^+, BAT in A, following professional or household refrigeration - also to prevent a clustering of products in classes C and D which deters technological development. **IT** agreed with having five tables but argued that further differentiation inside categories (for instance between remote and plug-in) would be necessary. **DK** agreed with NL about reserving class A for BNAT and questioned the benefits of having big cabinets (beyond plug-in) labelled. **SE** preferred A with plusses as customers are used to it and recommended A class being empty at the beginning. **FR** agreed with NL, supported the A-G scale and recommended class A exclusively for BAT. Industry expressed mixed views on labelling, it might be unnecessary for a B2B market with around 50-70% of cabinets being customized, and where proper surveillance cannot be guaranteed as there is only a limited number of qualified laboratories in the Member States. However labelling could be a powerful tool to promote the energy efficiency and differentiate between remote and plug-in cabinets **SE** suggested not labelling larger cabinets, in order to take into account the constraint of adequate monitoring by MS. **NL** argued that if compliance with the label cannot be ensured, it can also not be ensured for the eco-design requirements. If a specific situation arises (i.e. for customized products) **NL** recommended an approach based on an 'equivalent product', 'product family' or 'base model' notion to cope with this. **ECOS** supported the top classes being empty at the start as efficiency developments are usually underestimated (e.g. in the case of dishwashers and professional refrigeration). **IT** recommended avoiding that manufacturers compete only on low prices with products clustered around only 2-3 static classes. **ECOS** suggested a more ambitious label with more stringent F/G classes and avoiding A with pluses. **UK** considered that the top classes should be empty and asked the Commission services for clarification about the foreseen review of all labelling regulations. **EVA** was concerned that the proposed labels are based on current test methods, which will differ from the future testing method that is being developed. **ECOS** supported an indication of the refrigerant (natural refrigerants and low GWP) on the label to complement the F-gases regulation. **CLASP** recalled the risk of overlap between ICF and horizontal freezers, both having to be tested and labelled under climate classes 3 and 4. If this happens the same product would appear with different labels. The convenor of CEN TC 44 WG 6, said they are working on new standards for ICF and BC where the specific climate class would be defined. Nevertheless, it is preferable to use climate class 3 and if other climate classes were needed the use of correction factors should be encouraged (as in the case for domestic cold appliances).

The **Commission services** responded as follows:

- Given that a one-size-fits-all solution could not be found, it was decided to propose five different label classes. The labelling (and ecodesign) proposal as currently drafted already provides a definition of what is an equivalent refrigerating appliance.
- Concerning the possible revision of the energy labelling Directive, this will depend in the first instance on the outcome of the ongoing review. If the label scale is changed, this could indeed mean that existing labelling delegated regulations would have to be revised. The procedure for this, if indeed it were to be necessary, could take different forms.
- The distinction between horizontal supermarket freezers and ICF is based on (i) volume, (ii) technology (e.g. static air vs. forced air, since only forced air can deliver the refrigeration capacity needed for frequent openings in supermarkets), and (iii) the fact that ICF are frequently exposed to higher ambient temperatures and are thus tested under climate class 4 rather than 3.

DE had investigated having daily instead of annual energy consumption indicated on the label but concluded that this would lead to oversizing of products. **Food&drink Europe** asked whether the responsibilities of dealers as outlined in Article 4 are applicable to producers of equipment or to buyers that subsequently re-sell this equipment. The **Commission services** answered that the responsibilities of dealers, and the definitions of 'manufacturer', 'supplier', and 'dealer', can be found in the eco-design and energy labelling Directives.

COMMENTS ON REMAINING ISSUES (INCLUDING DEFINITIONS, PRODUCT FICHE, VERIFICATION PROCEDURE, BENCHMARKS AND REVIEW CLAUSE)

IT supported the inclusion of benchmarks (also for subcategories and volume ranges). The verification procedure should be adapted in line with the ongoing review as regards tolerances and custom-made products should be properly addressed. **UK** cautioned against the risk of loopholes in the definition of 'supermarket segment', which may be avoided by inserting the word 'exclusively' before the text 'in catering or similar non-retail applications' in the relevant definition. **DK** expressed concern about the definition of Energy Management Device (EMD) and suggested giving a bonus to VM with EMD. **CLASP** considered that a three year review period might be more appropriate, as it expects a rapid change in energy performance in the first 2-3 years. **EVA** said the draft standard for

VM already includes provisions for energy saving systems (i.e. EMD) e.g. switching off some systems. **Eurovent** was against a review period of three years, which is a period similar to the 'time to market' for a complete design of a new cabinet. **Eurovent** expressed concern about how cabinets whose design is based on individual customer specifications and made on a one-off basis would be addressed. **Eurovent** mentioned that a test for a refrigerated display cabinet costs around €10 000. **CLASP** clarified that this cost is for a remote cabinet, which is another reason to separate remote from plug-in cabinets and have separate categories within the regulation. **ECOS** questioned the limited data on soft scoop ice-cream freezers (SSICF) and warned against dropping this category out of the scope for this reason. As regards customised products, **UK** suggested looking at the approach adopted in the regulations for professional refrigeration or large ventilation units.

The **Commission services** responded:

- Concerning SSICF, there are energy consumption data but detailed information for improvement options is lacking.
- As regards the MSAs problem mentioned by Eurovent and the UK, the Commission services will look into those specific regulations (i.e. professional refrigeration or large ventilation units) for a solution.

FURTHER STEPS

The **Commission services** explained the steps leading to the possible adoption of the draft measures (end 2015) and asked for written comments and input from Forum members and stakeholders to the draft working documents (WDs) at the latest by 2 September 2014.

EPEE asked if one year between adoption and the entry into force of the first tier was foreseen. **CLASP** suggested taking on board comments made during the meeting on energy savings calculation during the impact assessment and suggested improved communication with stakeholders about what scenarios, segmentation and stringency levels are to be modelled. **IT** asked whether a revised text with more categories, more analysis and different reference scenarios would be available before the inter-service consultation (ISC).

The **Commission services** responded:

- Concerning the period between adoption and the entry into force of the first tier, while this should not be less than a year, the dates may still need to be changed as industry needs sufficient time to adapt to the requirements in the regulations.
- Concerning the revision of the draft regulations, all comments received will be taken into account as far as possible. As usual, draft regulations will be shared with CF members for information once the ISC starts.

AOB

No issues were raised.

9.2. Annex II: Scope

In this annex a more detailed overview is given why certain appliance types are included and excluded from the scope of the Regulation. The main groups of appliances that are foreseen to be regulated are:

- supermarket segment
    - horizontal refrigerators
    - vertical refrigerators
    - horizontal freezers
    - vertical freezers
- beverage coolers
- small ice-cream freezers
- refrigerated vending machines
- scooping ice-cream

Included in the scope:

Table 7 Overview of appliance types included in the scope of the proposed Regulation.

	INCLUDED in the scope	**Rationale**	**Energy consumption measurement method**
i.1.	Refrigerated retail display cabinets for the sale and display of foodstuffs, mostly supermarket segment (vertical, horizontal, semi-vertical, with or without doors, with or without drawers, etc.)	General application of Commercial Refrigeration, clearly for sale and display	EN ISO 23953:2005 + A1:2012
i.2.	Refrigerated retail display cabinets for the sale and display of other goods than foodstuffs (*e.g.* flowers, lettuce , live bait).	Small niche of Commercial Refrigeration, but similar in shape and function to those used for foodstuff and are categorised following EN ISO 23953:2005+ A1:2012	EN ISO 23953:2005 + A1:2012
i.3.	Serve-over counters	General application of Commercial Refrigeration, clearly for sale and display	EN ISO 23953:2005 + A1:2012
i.4.	Serve-over counter with integrated storage	Mix of Commercial Refrigeration and Professional Refrigeration, but the primary function is Commercial Refrigeration	EN ISO 23953:2005 + A1:2012.

i.5.	Beverage coolers (open and with transparent or solid doors).	General application of Commercial Refrigeration, clearly for sale and display	A number of B2B methods coexist, developed by food/beverage companies. Could be measured by EN ISO 23953:2005 + A1:2012 by addition of definitions of volume and a procedure for measurement of EMDs. A specific standard is under development by CENELEC.
i.6.	Refrigerated vending machines (cans and beverages, snacks, food)	General application of Commercial Refrigeration	EVA-EMP 3.0a, in the final stage to be confirmed by CENELEC
i.7.	Ice-cream freezers (open or closed). These ice-cream freezers can be installed in the retail sector or used on streets, beaches, *etc.*	General application of Commercial Refrigeration	EN ISO 23953:2005 + A1:2012 can be used, by addition of a definition of volume. A specific standard is under development by CENELEC.
i.8.	Self-service counters (*e.g.* dessert bars) in canteens and restaurants	Products are for sale and display	EN ISO 23953:2005 + A1:2012
i.9.	Switchable cabinets (can be used as refrigerator as well as freezer)	Products are for sale and display, usually for spot offers and campaigns. Small percentage of the total refrigerated volume in retailers (normally <5%, sometimes up to 10%), but general appliactaion of Commercial Refrigeration.	EN ISO 23953:2005 + A1:2012. Will have to tested and classified for the lowest working temperature, i.e. freezing.
i.10.	Static air cabinets	Although not explicitly excluded, vertical static-air cabinets are usually not used as they	EN ISO 23953:2005 + A1:2012. (Current vertical static-air cabinets will have difficulties to pass the

		cannot deliver the function required, often because of lack of capacity to pull down or maintain low temperatures. Horizontal static-air cabinets are more often used, although minimal.	door opening test in the ISO 23953 standard and are therefore rarely used).
i.11.	Artisan gelato ice cream freezers, scooping cabinets.	General application of Commercial Refrigeration, but very small market niche. The specific working temperature (-10°C) is not defined in ISO 23953. Subtle technical differences compared to display cabinets.	Not defined. A new working group (WP5) for 'Refrigerated display cabinets for artisan self-made gelato' is established in CEN/TC 44. A specific testing procedure is under preparation at CEN/TC 44.

Excluded from the scope:

Table 8 Overview of appliance types excluded in the scope of the proposed Regulation.

	EXCLUDED from the scope	**Reason**	**Energy consumption measurement method**
e.1.	Refrigerated retail display cabinets for the sale and display of goods which are non-foodstuffs (flowers, live bait, etc.) and are **not similar in** shape and function to the types used for foodstuffs described in EN ISO 23953. Flowers are out in the USA as they could have an extra system to keep certain moisture levels.	They are normally tailored to the specific use, making the development of harmonised measurement methods very difficult. The market of these products is marginal.	None

e.2.	Refrigerated retail display cabinets for the sale and display of live foodstuff e.g. fish and shellfish refrigerated aquaria and water tanks, displayed at restaurants and some supermarkets.	The market of these products is marginal. They are normally tailored to the specific use, making the development of harmonised measurement methods very difficult.	None
e.3.	Domestic chest freezers used for commercial appliances	Covered by the Household Refrigeration regulation. Similar products under ENTR Lot 1 (professional closed chest freezers) are to be subject to same energy requirements and energy label as domestic chest freezers.	c.f. Household Refrigeration regulation
e.4.	Walk-in cold rooms	Different technical specifications. Should be treated under ENTR Lot 1 Professional Refrigeration.	
e.5.	Water dispensers	Different technical specifications. Usually designed to chill and keep cool 1-5 litres of water.	None
e.6.	Ice makers	Different technical specifications and function (food/drink processing element).	None
e.7.	Ice-cream makers	Different technical specifications and function (food processing element).	None
e.8.	Minibars for household use	If for domestic use, these fall under the Household Refrigeration Regulation.	The requirements are defined in the household Regulation.

e.9.	Wine coolers for domestic use	If for domestic use, these fall under the Household Refrigeration.	Labelling regulation already applies. DG Energy will soon launch preparatory work for Ecodesign requirements.
e.10.	Wine coolers for commercial use	Although for commercial use, the products are usually not displayed for sale, rather stored. They are not regulated at the moment, but could be included in the revision of the Regulation for professional refrigeration or the Household Refrigeration Regulation.	The measurement can be the same as wine coolers for domestic use, and be part of forthcoming Ecodesign preparatory work.
e.11.	Professional service cabinets	Is a UK terminology for professional storage cabinets (ENTR Lot 1).	See ENTR Lot 1 standard development.
e.12.	Storage for medicines and scientific research	These are usually not intended for the storage, display and sale of products and usually have solid doors.	None
e.13.	Ice-cream freezers on vehicles (e.g. motorbikes, vans)	They are normally tailored to the specific use, making the development of harmonised measurement methods very difficult. The market of these products is marginal.	None
e.14.	Vending machines with combined heating and cooling parts, or food preparation	General application of Commercial Refrigeration, but with food processing element. Different technical	EVA-EMP to be confirmed by CENELEC (under preparation)

		specifications.	
e.15.	Hotel minibars	These fall under the Household Refrigeration regulation.	The requirements are defined in the household Regulation 1060/2010.
e.16.	Corner cabinets, cabinets used as angles	Very small percentage of the total refrigerated volume in retailers (normally <1% of the total in large supermarkets), as they are more expensive, have difficulties to maintain cold temperatures. Moreover, there are normally no physical constraints in the stores. They can be more common, but still limited in smaller shops where space and building shape is fixed and the cabinets have to adapt to that.	Cannot be tested by EN ISO 23953:2005 + A1:2012

9.3. Annex III: Comparison with other world regions

These figures are only indicative as it is very difficult to compare data and MEPS from different world regions because different measurement standards are used. Moreover, the nomenclature and definitions of certain cabinets can hinder a fair comparison.

Some regions have already MEPS in place for a certain time which has already induced an energy efficiency improvement of the stock. A comparison of MEPS in Australia and US shows that the EU MEPS proposed for scenario 5 (*i.e.* EEI < 80) are in line with 'best in the world' MEPS in other regions.[51]

9.3.1. US

1. US make a difference between open and closed (both solid and transparent doors). General segmentation in the US is vertical, horizontal, semi-vertical (only open), serve-over counter and pull-down. This is similar to the EU proposal although the EU does not propose separate segmentation for semi-verticals and serve-over counters. According to EU data, serve-over counters do not differ much in energy consumption than their horizontal counterparts. The US pull-down category corresponds to the category of beverage coolers for the EU. No difference is made in the EU proposal between open and closed cabinets as a functionality approach is applied.

2. Very little difference is detected in the US Regulation for vertical open vs. semi-vertical open cabinets. No specific measures have been detected for closed semi-vertical cabinets, neither for roll-in cabinets.

3. In the US Regulation, a big difference is detected for remote vs. plug-in cabinets. This can be related to the protocol of energy measurement which is based on the ANSI/ASHRAE 72-2005 standard where it seems that the difference between plug-in and remotes is better reflected than in the current ISO 23953 standard.

4. Slope of EU cut-off line is similar to the US measures. EU and US cut-off limits for poor appliances look similar although care has to be taken in the comparison because of the reliability of conversion factors between different test standards.

5. Issues in the US on reporting have been reported concerning the alternative efficiency determination method (AEDM).

6. New limits should go into force in the US in March 2017, similar to the measures foreseen in the EU.

7. Currently, the impact of the Regulation on US products is unknown.

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[51] Analysis of specific issues regarding EU policy proposals for DG ENER Lot 12 Commercial Refrigeration, *Second interim report,* October 2014, J. Tait, J. Evans, M. Baton, CLASP Europe

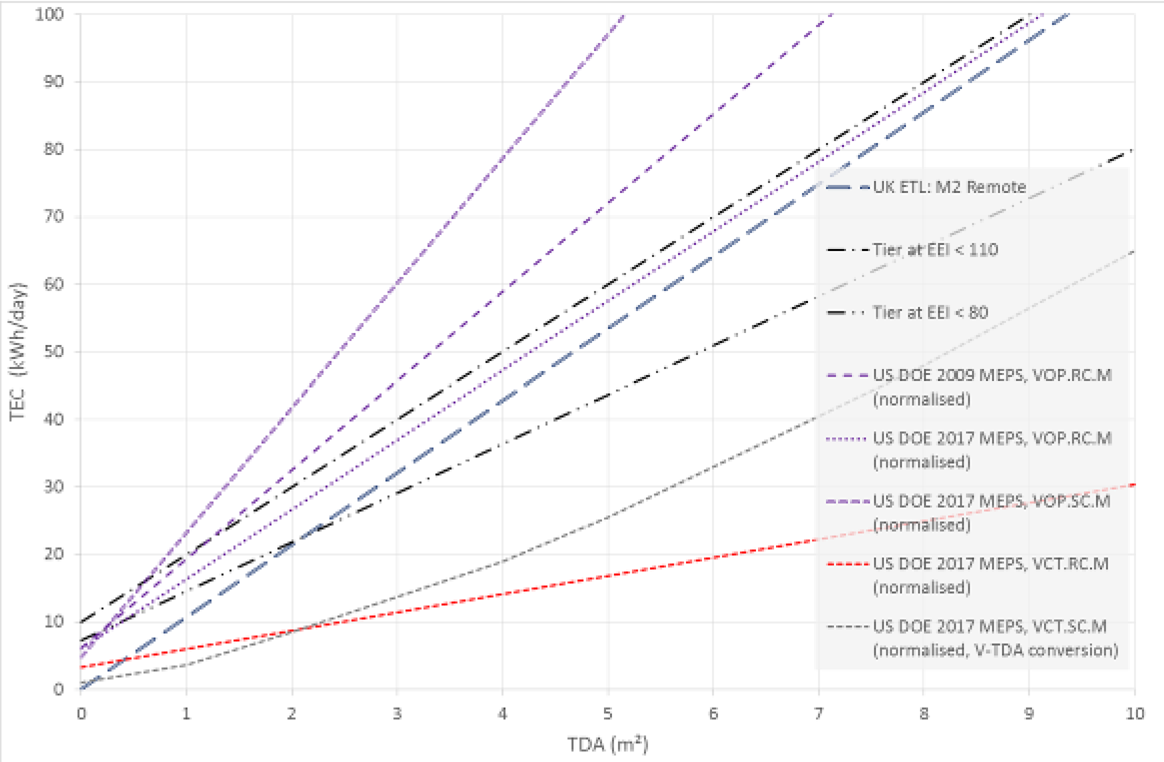


Figure 5 Comparison of the proposed EU tiers with US MEPS and the UK ETL scheme.

Table 9 Nomenclature used in US Regulation.

Case Structure & Energy Nomenclature (2017)

Case Structure

- **VOP** Vertical Open
- **SVO** Semi-Vertical Open
- **HZO** HoriZontal Open
- **SOC** Service Over Counter
- **VCT** Vertical Closed Transparent
- **HCT** Horizontal Closed Transparent
- **VCS** Vertical Closed Solid
- **HCS** Horizontal Closed Solid
- **PD** Pull Down

Temps

- **M** Medium
- **L** Low
- **I** Ice Cream

Condensing

- **RC** Remote
- **SC** Self-Contained

Energy Calculation (kW)

- **TDA** Total Display Area (ft^2)
- **V** Volume (ft^3)

Table 10 MEPS applied in the US for commercial refrigeration.

Key	M = Med Temp L = Low Temp I = Ice Cream	RC = Remote SC = Self-Contained	TDA = Display Area V = Volume
Case Structure	Equipment Class	2017 Energy Limits	2012 Energy Limits
Vertical OPen	**VOP.RC.M**	**0.64 x TDA + 4.07**	**0.82 × TDA + 4.07**
	VOP.RC.L	2.2 x TDA + 6.85	2.27 × TDA + 6.85
	VOP.RC.I	2.79 x TDA + 8.7	2.89 × TDA + 8.7
	VOP.SC.M	**1.69 x TDA + 4.72**	**1.74 × TDA + 4.72**
	VOP.SC.L	4.25 x TDA + 11.82	4.37 × TDA + 11.82
	VOP.SC.I	5.4 x TDA + 15.02	5.55 × TDA + 15.02
Semi-Vertical Open	**SVO.RC.M**	**0.66 x TDA + 3.18**	**0.83 × TDA + 3.18**
	SVO.RC.L	2.2 x TDA + 6.85	2.27 × TDA + 6.85
	SVO.RC.I	2.79 x TDA + 8.7	2.89 × TDA + 8.7
	SVO.SC.M	1.7 x TDA + 4.59	1.73 × TDA + 4.59
	SVO.SC.L	4.26 x TDA + 11.51	4.34 × TDA + 11.51
	SVO.SC.I	5.41 x TDA + 14.63	5.52 × TDA + 14.63
HoriZontal Open	HZO.RC.M	0.35 x TDA + 2.88	0.35 × TDA + 2.88
	HZO.RC.L	**0.55 x TDA + 6.88**	**0.57 × TDA + 6.88**
	HZO.RC.I	0.7 x TDA + 8.74	0.72 × TDA + 8.74
	HZO.SC.M	0.72 x TDA + 5.55	0.77 × TDA + 5.55
	HZO.SC.L	1.9 x TDA + 7.08	1.92 × TDA + 7.08
	HZO.SC.I	2.42 x TDA + 9	2.44 × TDA + 9
Service Over Counter	SOC.RC.M	0.44 x TDA + 0.11	0.51 × TDA + 0.11
	SOC.RC.L	0.93 x TDA + 0.22	1.08 × TDA + 0.22
	SOC.RC.I	1.09 x TDA + 0.26	1.26 × TDA + 0.26
	SOC.SC.M	0.52 x TDA + 1	0.60 x TDA + 1.00
	SOC.SC.L	1.1 x TDA + 2.1	0.75 x V + 4.10
	SOC.SC.I	1.53 x TDA + 0.36	1.76 × TDA + 0.36

9.3.2. Australia

1. Australia uses a different classification scheme for remotes and plug-ins. For plug-ins the segmentation is based on the ISO 23953 standard, but only for certain cabinet types MEPS are defined.
2. Australia also provides indications for efficient appliances, the so-called HEPS (high efficiency performance standard).
3. Even though EU proposals seem more strict compared to the Australian ones, the highly efficient plug-in appliance will be able to comply with future EU tiers. The slope of the cut-off line for Australian high-efficiency, remote vertical multidecks is in accordance with the EU proposal. The strictest tier in the EU proposal corresponds to the high, efficiency, plug-in closed vertical cabinet (VC4).

4. An Australian report[52] has shown that already in 2009 almost 30% of the plug-in chillers where registered as high-efficiency appliances. For the remote chillers, these Australian data show that for remote chillers it is more difficult to reach the high-efficiency regime. It thus seems that Australian MEPS for plug-in chillers are too lenient, but MEPS for remote chillers seem to be fit for purpose.
5. A comparison of the EU tiers with Australia should focus on the Australian HEPS for plug-in appliances and on the Australian MEPS for remote appliances. This points to the feasibility of a more strict tier in the future for the EU, *e.g.* EEI < 80.

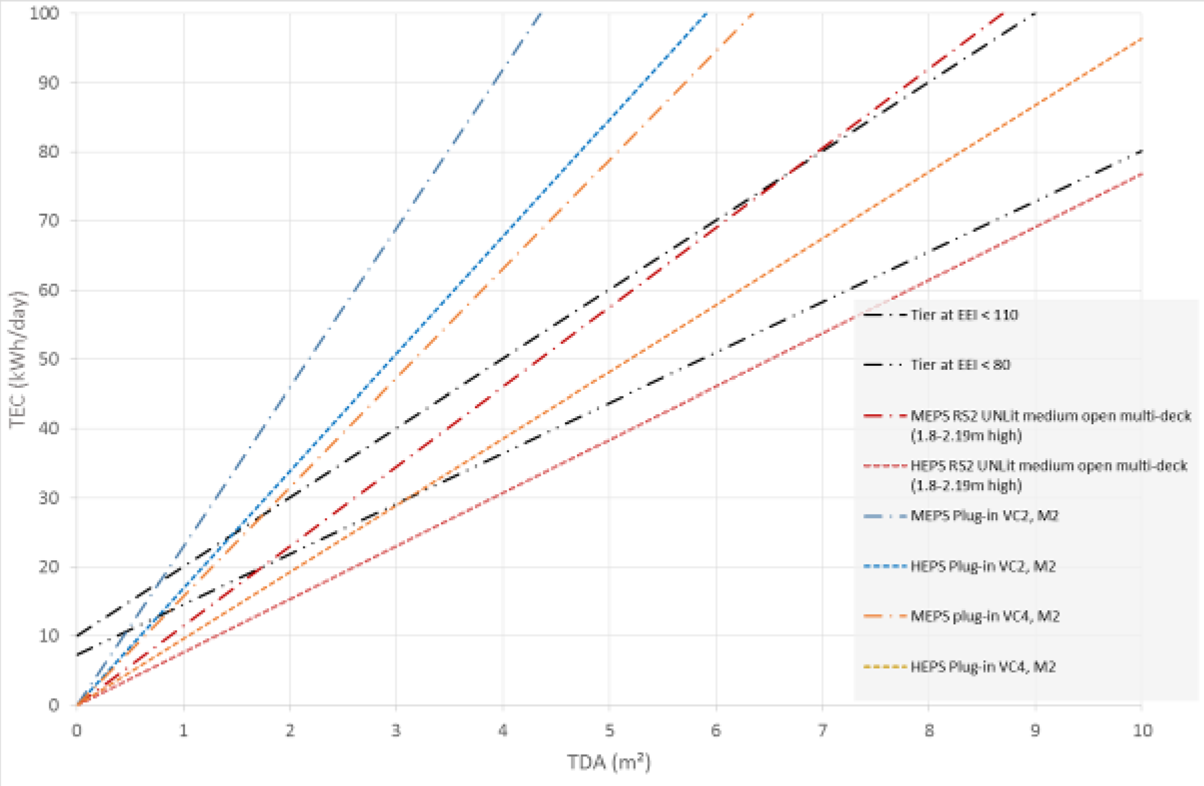


Figure 6 Comparison of the proposed EU tiers with Australian MEPS and the Australian indication for high-efficiency appliances (HEPS).

6. The following table shows the impact of the Australian MEPS on the actual sales of models based on 2015 data.

Table 11 Summary of 15 groups of display and storage cabinets and impacts on Australian models from Australian MEPS.

	Group Abbrev.	Application	Temperature	Configuration	AS 1731.14 Types	ISO 23953 Types	Models affected	Sales affected
1	IRH Integral Refrigerated Horizontal Cabinets	Integral Refrigerated Display Cabinets	Refrigerator	Horizontal	HC1, HC2, HC3, HC4, HC5, HC6	IHC1, IHC2, IHC3, IHC4, IHC5, IHC6, IHC7, IHC8	51	50%

[52] In from the cold, Background technical report volume 1, 30 October 2009, Mark Ellis & Associates Pty Ltd, p.12-14

2	IRV Integral Refrigerated Vertical Cabinets			Vertical	IVC1, IVC2, IVC3	IVC1, IVC2, IVC3, IYC1, IYC2, IYC3	21%	11%
3	IRV-4 Integral Refrigerated Vertical Cabinets with Glass Door				IVC4 Glass door	IVC4, IYC4	25%	20%
4	IFH Integral Freezer Horizontal		Freezer	Horizontal	IHF1, IHF3, IHF4	IHF1, IHF3, IHF4	59%	79%
5	IFH-5 Integral Freezer Horizontal with Lid				IHF5, IHF6	IHF5, IHF6	21%	55%
6	IFV Integral Freezer Vertical			Vertical	IVF1, IVF2, IVF4 Glass door	IVF1, IVF2, IVF4, IYF1, IYF2, IYF3, IYF4	33%	35%
7	RRH Remote Refrigerated Horizontal Cabinets	Remote Refrigerated Display Cabinets	Refrigerator	Horizontal	RS6, RS7, RS8, RS9	RHC1, RHC2, RHC3, RHC4, RHC5, RHC6, RHC7	44%	36%
8	RRV Remote Refrigerated Vertical Cabinets			Vertical	RS1, RS3, RS4, RS5, RS10	RVC1, RVC3, RVC4, RYC1, RYC2, RYC3, RYC4	11%	0%
9	RRV-2 Remote Refrigerated Vertical Cabinet, open, medium temp				RS2	RVC2	6%	0%
10	RFH Remote Freezer Horizontal		Freezer	Horizontal	RS13, RS14,	RHF1, RHF3, RHF4, RHF5, RHF6, RHF7	25%	11%
11	RFV Remote Freezer Vertical			Vertical	RS11, RS12, RS15, RS16, RS17, RS18, RS19, RS20	RVF1, RVF2, RVF4, RYF1, RYF2, RYF3, RYF4	29%	3%
12	SRH Service Cabinet, refrigerated Horizontal with solid door	Integral Refrigerated Storage cabinet	Refrigerator	Counter (Horizontal)	No equivalent registered	Storage cabinet types are defined into four categories (but not classified by the technical standards yet)	NA	NA
13	SRV Service Cabinet, Refrigerated, Vertical with solid door			Vertical	IVC4 Solid door M1 & M2		NA	NA
14	SFH Service Cabinet, Freezer, Horizontal with solid door		Freezer	Counter (Horizontal)	No equivalent registered		NA	NA
15	SFV Service Cabinet Freezer, Vertical with solid door			Vertical	IVF4 Solid doors L1 & L2		NA	NA
Overall effect (Groups 1 to 11)							25%	19.5%

Table 12 Nomenclature used for the Australian MEPS for remote cabinet. Note that for plug-in cabinets, Australia follows the ISO 23953 segmentation definitions.

Classification OF REMOTE refrigerated CABINETS (Medium Temp)

Name	Australian Class	Definition	Subclass		
High Open Multideck	RS 1	Medium temperature multideck, single air curtain, length of air curtain 1.5-1.9m. Cabinet height 2.2-2.5m and depth 0.6-1.2m.	Lit Shelves	Unlit Shelves	
Medium Open multideck	RS 2	Medium temperature multideck, single air curtain, length of air curtain 1.0-1.5m. Cabinet height 1.8-2.19m and depth 0.6-1.2m.	Lit Shelves	Unlit Shelves	
Low Open Multideck	RS 3	Medium temperature multideck, single air curtain, length of air curtain 0.8-1.2m. Cabinet height 0-1.79m and depth 0.6-1.2m.	Lit Shelves	Unlit Shelves	
Self Service & Storage Closed Cabinet	RS 4	*Requires detailed definition*	Solid Door	Glass Door	
Self Service & Storage Closed Cabinet – undercounter	RS 5	*Requires detailed definition*	Solid Door	Glass Door	
Flat Glass Fronted – single deck	RS 6	Medium temperature single tier cabinet with a flat front glass and a sliding door service access to the rear. Cabinet height 1.25-1.4m, depth 0.8-1.2m. Cabinets are dividing into two subclasses on the basis of their evaporator coil arrangements.	Gravity coil	Fan coil.	
Flat Glass Fronted – 2 tier or more	RS 7	Medium temperature two or more tier cabinet with a flat front glass and a sliding door service access to the rear. Cabinet height 1.25-1.4m, depth 0.8-1.2m. Cabinets are dividing into two subclasses on the basis of their evaporator coil arrangements.	Gravity coil	Fan coil.	
Curved Glass Fronted – single deck	RS 8	Medium temperature single tier cabinet with a curved front glass and a sliding door service access to the rear. Cabinet height 1.25-1.4m, depth 0.8-1.2m. Cabinets are dividing into two subclasses on the basis of their evaporator coil arrangement	Gravity coil	Fan coil.	
Curved Glass Fronted – 2 tier or more	RS 9	Medium temperature two or more tier cabinet with a curved front glass and a sliding door service access to the rear. Cabinet height 1.25-1.4m, depth 0.8-1.2m. Cabinets are dividing into two subclasses on the basis of their evaporator coil arrangements.	Gravity coil	Fan coil.	
Island/Walk around merchandiser	RS 10	High, Cabinet height 2.2-2.5m Medium, Cabinet height 1.8-2.19m Low, Cabinet height 1.0-1.79m	High	Medium	Low

9.4. Annex IV: Properties and typical energy efficiency values of base cases

Different base cases have been identified in the background study and are displayed below. These correspond to the status in 2013.

Figure 7 Open vertical multi-deck remote refrigerating display cabinet for chilled products (category RVC2 according to EN ISO 23953), with 5.25 m² TDA, operating in temperature class M2 (-1°C to 7°C), using R404a as refrigerant, with a product life of 9 years. Energy consumption: 56.9 kWh/day

Figure 8 Open remote horizontal island for frozen products (category RHF4 according to EN ISO 23953), with 2.9 m² TDA, operating in temperature class L1 (-18°C to -15°C), using R404a as refrigerant, with a product life of 9 years. Energy consumption: 32.2 kWh/day

Figure 9 Beverage cooler with one glass door, operating at temperature classes H1 (1°C to 10°C), with a net volume of 500 litres, using R134a as refrigerant, with a product life of 8 years. Plug-in. Energy consumption: 7.5 kWh/day

Figure 10 Packaged horizontal ice cream freezer with lids (category IHF6 according to EN ISO 23953), with a net volume of 291 litres, operating in temperature class L1 (-18°C to -15°C), using R507 as refrigerant[53], with a product life of 8 years. Plug-in. Energy consumption: 3.6 kWh/day

53 As of 2014 mostly hydrocarbons

Figure 11 Spiral vending machine, with a net volume of 750 litres, operating in temperature class M2 (-1°C to 7°C), using R134a as refrigerant, with a product life of 8.5 years. Plug-in. Energy consumption: 7.1 kWh/day

9.5. Annex V: Assumptions for the stock model

9.5.1. Sales figures

Table 13 Assumptions for back- and forecasting of the sales data obtained by industry for the years 2004-2012

Base case	Sales 1990-2004	Sales 2004- 2012	Sales 2012-2030
Remote vertical chiller (RVC2)	backcasting with similar linear growth as 2004-2012	Industry data	forecasting with similar linear growth as 2004-2012
Remote horizontal freezer (RHF4)	backcasting with similar linear growth as 2004-2012	Industry data	forecasting with similar linear growth as 2004-2012
Beverage cooler	backcasting with similar linear growth as 2004-2012	Industry data	forecasting with similar linear growth as 2004-2012
Small ice-cream freezer	backcasting with similar linear growth as 2004-2012	Industry data	forecasting with similar linear growth as 2004-2012
Vending machine	backcasting with similar linear growth as 2004-2012	Industry data	forecasting with similar linear growth as 2004-2012

9.5.2. *Energy consumption*

Table 14 Fore- and backcasting assumptions of the average energy consumption for different scenarios.

	BAU - scenario 0					**Scenario 4**			**Scenario 5**		
Base case	**Energy improvement 1990-1997**	**Energy improvement 1997-2013**	**Energy improvement 2013-2017**	**Energy improvement 2017-2021**	**Energy improvement 2021-2030**	**Energy improvement 1997-2013**	**Energy improvement 2013-2021**	**Energy improvement 2021-2030**	**Energy improvement 1997-2013**	**Energy improvement 2013-2021**	**Energy improvement 2021-2030**
Remote vertical chiller (RVC2)	0.25%/year	2%/year	1.5%/year	0.5%/year	0.25%/year	2%/year	linear from EEI (2013) = 100 to EEI (2021) = 63	0.25%/year	2%/year	linear from EEI (2013) = 100 to EEI (2021) = 49	0.25%
Remote horizontal freezer (RHF4)	0.25%/year	2%/year	1.5%/year	0.5%/year	0.25%/year	2%/year	linear from EEI (2013) = 100 to EEI (2021) = 72	0.25%/year	2%/year	linear from EEI (2013) = 100 to EEI (2021) = 59	0.25%

Beverage cooler	0.25%/year	2%/year	1.5%/year	0.5%/year	0.25%/year	2%/year	linear from EEI (2013) = 100 to EEI (2021) = 70	0.25%/year	2%/year	linear from EEI (2013) = 100 to EEI (2021) = 51	0.25%
Small ice-cream freezer	0.25%/year	2%/year	1.5%/year	0.5%/year	0.25%/year	2%/year	linear from EEI (2013) = 100 to EEI (2021) = 62	0.25%/year	2%/year	linear from EEI (2013) = 100 to EEI (2021) = 45	0.25%
Vending machine	1%/year	2%/year	1%/year	1%/year	no change	2%/year	linear from EEI (2013) = 100 to EEI (2021) = 69	no change	2%/year	linear from EEI (2013) = 100 to EEI (2021) = 50	no change

The stock model assumes the removal from the market of appliances that are older than the average lifetime. The average lifetime is assumed constant for both old and new appliances.

9.5.3. Correction factor lab conditions vs. real life

Standard ISO 23953 clearly informs that in-store conditions can differ from laboratory conditions.

Table 15 Comparison between lab and real-life conditions as indicated in the ISO 23953 standard.

Comparison between laboratory and in-store conditions

The complete range of various climate conditions and various ways of loading in stores cannot be simulated in the laboratory. For these reasons, specific climate classes and loading are defined for tests in the laboratory to classify cabinets and to make comparisons.		
For open refrigerated display cabinets, test results in laboratory cannot be directly transposed in stores.		
	Laboratory	**In-store**
The reference is defined by:	En 23953	The law in the country concerned.
	The M-package temperature and the corresponding classes H2, H1, M2, M1, L3, L2, L1.	The temperature of each foodstuff type, affected by its own packaging (dimensions, material, emissivity) and thermal inertia.
	The same standardized loading throughout the test.	A continuous loading variation throughout the day.
The surrounding space is:	The test room climate class and the corresponding stabilised conditions (example: Class 3: 25 °C, 60 % RH).	Some variations of temperature and humidity, notably between day and night.
	A little variation of temperature along the test room height.	A significant stratification of the temperature in the chilled foodstuff zone in the store which is favourable for cabinet running.
	A continuous and horizontal air flow at 0,2 m/s (0; –0,1) which highlights the weak points of the cabinet and so imposes a strong air flow influence.	Some short disruptions made by consumers which creates few disturbances because they are spaced in time and length.
	A defined infrared radiation from the internal lab surfaces.	An indefined infrared radiation from the store surfaces, depending on building insulation, air stratification, lighting type.
The performance evaluation is taken on:	The M-package temperature when the variation is less than 0,5 °C after 24 h in stable conditions.	The foodstuffs temperature in the cabinet; it can depend on the foodstuff temperature at the loading; [A1⟩ the most exposed to the infra red radiation are the first taken by the consumers ⟨A1]
	And the heat extraction rate and the electrical energy consumption measured according to ISO 23953.	The real needs of the store are the figures to calculate the refrigerating system and the yearly energy consumption, taking into account the seasons (summer/winter), the daily cycle (day/night), the store opening periods.

This divergence can have a strong influence on the estimation of the total saving potential of the regulations. However, no matter how accurately the standard testing conditions represent reality, they provide a level playing field against which comparison of cabinets is possible, and both ecodesign and energy labelling values can be set. The estimation of real-life energy savings can be undertaken by means of correction factors. It has to be noted though that it is very difficult to reflect in-store conditions for the whole of Europe as many factors have to be accounted for, *e.g.* regional climatic conditions and in-store conditions. The following correction factors were proposed in the base cases of the previous impact assessment:

Table 16 Correction factors provided by stakeholders to account for real-life versus lab conditions.

Real life energy consumption compared to test standard values (EN ISO 23953) or EVA-EMP protocol	**Wuppertal Institute IA (2010)**	**Kapanen (2014)**
Remote, open vertical multi-deck refrigerator (RCV2), TDA = 7m^2	77% (that is, 23% less energy consumption in real-life conditions than in test conditions)	Source 1: 77% Source 2: 65-70%
Remote, open island freezer (RHF4), TDA = 7m^2	88%	84%
Remote, open island chiller		80%
Closed beverage cooler, V = 500 litre	80%	
Small ice-cream freezer, V = 291 litre	89%	
Spiral vending machine, V = 750 litre	100%	

One shall also take into account that while test conditions are fixed for a given climate class (*e.g.* CC3 at 25^{o}C and 60%RH), real-life conditions vary with the location (especially North-South for average temperature and humidity), and additionally with the season (*e.g.* winter store temperatures of 16-18^{o}C , and summer of 23-27^{o}C).

Therefore, for each location the difference with ISO test conditions will vary.

The differences between test and real-life of the table above are somehow lower than the theoretical enthalpy difference between climate class 0 (20°C and 50%RH) and climate class 3 (25°C and 60%RH), which is around 30%.

The following factors have been used to model real life conditions vs the test results:

Table 16 Correction factors used in the impact analysis to account for real-life versus lab conditions.

CF Commercial Refrigeration	correction real vs test						
	VHK meth	Kapanen (	Kapanen (	Eurovent (	BIOIS (200		Used in the JRC model:
CF open vertical chilled multi deck (RCV2)	0.77	0.77	0.65-0.7	0.5-0.6	0.66	0.7	used for vertical open (frozen and chilled)
CF open horizontal frozen island (RHF4)	0.88	0.84		0.5-0.6	0.66	0.85	used for all horizontal (open and closed)
remote, open island chiller		0.8		0.5-0.6	0.66		
supermarket closed cabinets			0.77-0.82	0.5-0.6	0.66	0.8	used for vertical closed
CF Plug in one door beverage cooler	0.8				0.66	0.8	BCs
CF Plug in horizontal ice cream freezer	0.89				0.66	0.89	ICFs
CF Spiral vending machine	1				0.66	1	VM

In addition to the above, the installation of doors and lids is known to reduce energy consumption, for open cabinets the potential saving has been reported to about 40%, when measured at CC3 (+25C/ 60%RH). However, according to some sources, the energy saving would not be that large at other less demanding climate classes that are closer to real-life conditions in stores in winter, *e.g.* CC0. The following data would illustrate this:

Table 18 Energy saving by application of doors for different climatic conditions.

Saving of adding doors/lids (kWh/m^2)	**Energy consumption at CC3 (kWh/day)**	**Energy consumption at CC0 (kWh/day)**	**% difference**
M1 vertical multideck	5.2	4.0	23%
L1 freezer island	5.7	4.7	18%
M1 chilled island	3.0	2.4	20%

These examples illustrate that the exact energy saving potential of a cabinet in the field has to be calculated over an annual average temperature profile in store conditions. The variety of shops across whole Europe does not allow to account for this in the impact assessment. However, correction factors (Table 16) have been introduced to reflect real-life conditions.

9.5.4. Economic modelling

Table 19 Assumptions for the modelling of economic parameters.

Base case	Average energy consumption (2013) (kWh/day)	Increase in purchase cost compared to BAU price per efficiency improvement percentage point [% / %-point]	Lifetime (years)	Purchase cost (2013)	Installation cost (euro/unit)	Repair and maintenance cost (euro/unit)	Discount rate	Escalation rate
RVC 2	56.9	1.19	9	3500	350	240	4%	4%
RHF4	32.2	0.36	9	4000	400	260	4%	4%
BC	7.5	0.56	8	830	0	28	4%	4%
Small ICF	3.6	0.34	8	800	0	21	4%	4%
VM	7.1	0.31	8.5	3500	0	47	4%	4%

A unit is considered as an average size/length cabinet (~5.25m^2 TDA for a RVC2; ~2.9 m^2 TDA for a RHF4; 500 litre for a beverage cooler, 291 litre for a small ice-cream freezer; 750 litre for a vending machine).

Table 20 Electricity rate for the calculation of electricity costs.

Electricity rate **(in Euro 2010, inflation corrected**)	**2010**	**2015**	**2020**	**2025**	**2030**
Inc: 4%/a	0.105	0.122	0.149	0.181	0.220

Table 21 Shares of revenues split. Note that for the retail industry 0% is assumed as the products under study are sold business to business.

	Retail	**Wholesale**	**Industry**
Revenues split	0%	30%	70%

9.6. Annex VI: Sales figures

Table 22 Estimated sales figures 1990 – 2030 based on industry data 2004-2012.

Sales (units)					
Year	**Beverage cooler**	**Small ice-cream freezer**	**Vending machine**	**Supermarket segment Remote**	**Supermarket segment Plug-in**
1990	668 100	286 329	104 854	215 151	185 267
1991	673 950	288 836	105 653	215 917	185 927
1992	679 800	291 343	106 459	216 684	186 587
1993	685 650	293 850	107 270	217 451	187 247
1994	691 500	296 357	108 088	218 217	187 907
1995	697 350	298 864	108 911	218 984	188 568
1996	703 200	301 371	109 741	219 751	189 228
1997	709 050	303 879	110 578	220 517	189 888
1998	714 900	306 386	111 421	221 284	190 548
1999	720 750	308 893	112 270	222 051	191 208
2000	726 600	311 400	113 126	222 817	191 868
2001	732 450	313 907	113 988	223 584	192 529
2002	738 300	316 414	114 857	224 351	193 189
2003	744 150	318 921	115 732	225 117	193 849
2004	750 000	321 429	116 614	225 884	194 509
2005	760 000	325 714	113 023.25	231 400	199 259
2006	790 000	338 571	109 432.50	239 073	205 866
2007	810 000	347 143	105 841.75	245 255	211 190
2008	820 000	351 429	102 251	219 723	189 204
2009	830 000	355 714	70 887	224 395	193 227
2010	818 933	350 971	79 189	236 965	204 051
2011	807 867	346 229	75 088	259 407	223 376
2012	796 800	341 486	63 184	232 017	199 791
2013	802 650	343 993	63 662	232 784	200 451
2014	808 500	346 500	64 143	233 551	201 111
2015	814 350	349 007	64 629	234 317	201 771
2016	820 200	351 514	65 117	235 084	202 431
2017	826 050	354 021	65 610	235 851	203 092
2018	831 900	356 529	66 106	236 617	203 752

2019	837 750	359 036	66 606	237 384	204 412
2020	843 600	361 543	67 110	238 151	205 072
2021	849 450	364 050	67 618	238 917	205 732
2022	855 300	366 557	68 129	239 684	206 392
2023	861 150	369 064	68 645	240 451	207 053
2024	867 000	371 571	69 164	241 217	207 713
2025	872 850	374 079	69 687	241 984	208 373
2026	878 700	376 586	70 214	242 751	209 033
2027	884 550	379 093	70 745	243 517	209 693
2028	890 400	381 600	71 280	244 284	210 353
2029	896 250	384 107	71 819	245 051	211 014
2030	902 100	386 614	72 363	245 817	211 674

Figure 11 Estimated sales figures 1990-2030 based on industry data 2004-2012.

9.7. Annex VII: Stock figures

A stock model has been prepared for the estimation of the stocks of appliances in the EU over a time series, based on historical stock and sales figures. Depending on the average lifetime of products, the historical time series of sales may trace back a few years only (for short-lived products), or go far in the past for long-lived products. Life expectancy changes have not been accounted for.

For commercial refrigeration, the average lifetime is normally not more than 10 years. Thus, a time series 1990-2030 has been modelled in a stock spreadsheet model. By insertion of historical sales figures, the spreadsheet calculates the past and future stocks in the EU, including the projection years 2020 and 2030. The stock model assumes the removal from the market of appliances that are older than the average lifetime. The stock model calculates the stocks specifically for each appliance group for which detailed data is available, *i.e.* the base cases, and is then extrapolated to all commercial refrigeration appliances using market share data for different appliances.

Stock figures from the stock model based on sales figures and the lifetime of the product have been compared with the stock figures provided by industry. The comparison shows a considerable overlap of these figures which put confidence in the assumptions related to stocks and sales. It can however not be excluded that *e.g.* in the future the lifetime of the products will be extended. The main expectation is that the lifetime could be prolonged by a few years, but probably not much more because of commercial interests in refreshing the aesthetics of a shop at regular times.

Table 22 Estimated stock figures 2004-2030 based on sales figures and product lifetime.

STOCKS (units)					
Year	**Beverage cooler**	**Small ice-cream freezer**	**Vending machine**	**Supermarket segment Remote**	**Supermarket segment Plug-in**
2004	6 539 400	2 802 600	1 413 638	2 223 573	1 914 724
2005	6 596 200	2 826 943	1 467 105	2 236 756	1 926 075
2006	6 677 150	2 861 636	1 508 310	2 256 078	1 942 714
2007	6 772 250	2 902 393	1 557 290	2 280 816	1 964 016
2008	6 871 500	2 944 929	1 585 825	2 279 255	1 962 671
2009	6 974 900	2 989 243	1 560 464	2 281 599	1 964 690
2010	7 061 383	3 026 307	1 556 716	2 295 747	1 976 873
2011	7 130 950	3 056 121	1 538 164	2 331 571	2 007 720
2012	7 183 600	3 078 686	1 522 132	2 339 237	2 014 322
2013	7 236 250	3 101 250	1 469 621	2 346 904	2 020 924
2014	7 284 750	3 122 036	1 418 946	2 354 571	2 027 526
2015	7 309 100	3 132 471	1 372 347	2 357 488	2 030 038
2016	7 319 300	3 136 843	1 329 827	2 353 499	2 026 603
2017	7 325 350	3 139 436	1 291 391	2 344 095	2 018 505
2018	7 327 250	3 140 250	1 270 928	2 360 989	2 033 053
2019	7 346 067	3 148 314	1 262 496	2 373 978	2 044 238
2020	7 381 800	3 163 629	1 252 468	2 375 163	2 045 258
2021	7 434 450	3 186 193	1 250 950	2 354 673	2 027 614
2022	7 487 100	3 208 757	1 255 656	2 362 340	2 034 216
2023	7 539 750	3 231 321	1 260 398	2 370 007	2 040 818
2024	7 592 400	3 253 886	1 265 176	2 377 673	2 047 420
2025	7 645 050	3 276 450	1 269 989	2 385 340	2 054 021
2026	7 697 700	3 299 014	1 274 840	2 393 007	2 060 623
2027	7 750 350	3 321 579	1 279 727	2 400 673	2 067 225
2028	7 803 000	3 344 143	1 284 651	2 408 340	2 073 827
2029	7 855 650	3 366 707	1 289 612	2 416 007	2 080 429
2030	7 908 300	3 389 271	1 294 611	2 423 673	2 087 030

Figure 12 Estimated stock figures 2004-2030 based on sales figures and product lifetime.

9.8. Annex VIII: MEPS and energy labelling

The MEPS and energy label are based on an energy efficiency index (EEI) which is defined as follows. For the calculation of the EEI of a refrigerated commercial display cabinet, the Annual Energy Consumption (AEC) of the cabinet is compared to its Standard Annual Energy Consumption (SAEC).

The EEI is calculated and rounded to the first decimal place, as:

$$EEI = (AEC/SAEC) \times 100$$

Where:

$$AEC = E24h \times 365$$

With

AEC = Annual Energy Consumption of the cabinet in kWh/year,

E24h = the energy consumption of the cabinet over 24 hours

and

$$SAEC = (M + N \times Y) \times 365$$

With

SAEC = Standard Annual Energy Consumption of the cabinet in kWh/year

For beverage coolers, small ice-cream freezers and vending machines:

Y = net volume of the appliance, which is the sum of net volumes of all compartments of the cabinet, expressed in litres.

For all other refrigerated commercial display cabinets:

Y = total display area, which is the sum of the display areas of all compartments of the cabinet, expressed in squared meters (m^2).

M and N are given in the table below.

Table 23 M and N coefficient values for the different categories of commercial refrigeration under the scope of the proposed Regulation.

M and N coefficient values		
Category	**Value for M**	**Value for N**
Beverage coolers	1.6	0.006

Small ice-cream freezers	1.0	0.009
Vending machines	4.1	0.004
Vertical, semi-vertical and combined supermarket freezer cabinets	1.6	19.1
Horizontal supermarket freezer cabinets	4.2	9.8
Vertical, semi-vertical and combined supermarket refrigerator cabinets	9.1	9.1
Horizontal supermarket refrigerator cabinets	3.7	3.5

9.8.1. MEPS

MEPS are defined according to different scenarios. A cut-off limit for EEI is forseen, *e.g.* EEI < 80.

9.8.2. Energy label

The energy label would be defined as follows, giving minimum and maximum EEI values for the different energy classes.

Table 24 Distribution of energy labelling classes based on EEI.

Energy efficiency class	EEI
A	EEI < 20
B	20 ≤ EEI < 35
C	35 ≤ EEI < 50
D	50 ≤ EEI < 65
E	65 ≤ EEI < 80
F	80 ≤ EEI < 100
G	100 ≤ EEI

9.9. Annex IX: Data sources

Different data sources have been consulted for the development of the proposed MEPS and energy labelling classes:

1. Eurovent. In September-October 2013, an up-to-date (2013) dataset of more than 2500 data entries has been shared with the JRC by the industry association Eurovent. The companies behind this dataset represent about 55% of the EU market of refrigerated display cabinets. This dataset basically covers the display cabinets in the supermarket segment.

2. The Enhanced Capital Allowance (ECA) Scheme. This scheme is part of the UK Government's program to manage climate change. Relevant data registered at that scheme in October 2013 has been made available to JRC by the Carbon Trust. It consists of 1430 data entries, including remote and plug-in appliances and different types of cabinets (horizontal, vertical, combined, frozen, chilled, etc.). This dataset could if needed be used to cross-check the Eurovent dataset.

3. Assofoodtec/ACOMAG, the Association of Gelato Machines, Shop fittings and Equipment Manufacturers, has provided 73 data entries for artisan gelato ice-cream display cabinets.

4. Other. Datapoints provided by stakeholders (mostly manufacturers) and organizations (*e.g.* TopTen[54]) through questionnaires or on a voluntary basis as a general rule. In all cases when requested by the data owners, confidential data has been anonymised. These data points manage to include the appliance types (ice-cream freezers, beverage coolers, vending machines) not covered by the two larger databases above (Eurovent and ECA).

Data from other world regions, *e.g.* where MEPS are in place, are hard to compare, as they are usually measured under different conditions (temperature, humidity, duration of the test, sequence of door opening, test packages, etc.) and use different metrics (and units) to express the energy consumption (*e.g.* per volume versus per total display area). A glimpse of this is provided in Annex 9.3 while a more extended comparison has been done by CLASP (2014). Even if absolute comparison is difficult, the study shows a significant scope for improvement of refrigerated display cabinets.

[54] TopTen is an independent international program to create a dynamic benchmark for the most energy efficient products. http://www.topten.eu

For supermarket cabinets, even though a vast amount of data is available, for some cabinet types described in the ISO 23953 standard, data is lacking. Cabinet types for which no data is available are very rarely used or are very similar to other cabinet types for which data is available. The table below gives an overview. No critical data gaps have been identified. The market share data (Table 26 and Table 27) also shows that data is available for the most important cabinet types.

Table 25 Distribution of supermarket cabinet types according to ISO 23953 and the number of data points available for that specific cabinet type.

Cabinet type, vertical chilled		Number of data points	Comment for low data availability
Chilled, semi-vertical, plug-in	IVC1	13	
Chilled, semi-vertical, remote	RVC1	445	
Chilled, multi-deck, plug-in	IVC2	72	
Chilled, multi-deck, remote	RVC2	1295	
Chilled, roll-in, plug-in	IVC3	0	Similar to RVC3, but plug-in
Chilled, roll-in, remote	RVC3	34	
Chilled, glass door, plug-in	IVC4	24	
Chilled, glass door, remote	RVC4	244	
	Total	**2127**	

Cabinet type, Horizontal chilled		Number of data points	Comment for low data availability
Chilled, serve-over counter open service access, plug-in	IHC1	0	Similar to RHC1, but plug-in
Chilled, serve-over counter open service access, remote	RHC1	95	
Chilled, serve-over counter with integrated storage open service access, plug-in	IHC2	7	

Chilled, serve-over counter with integrated storage open service access, remote	RHC2	0	Similar to IHC2, but remote
Chilled, open, wall site, plug-in	IHC3	0	Similar to RHC3, but plug-in
Chilled, open, wall site, remote	RHC3	33	
Chilled, open, island, plug-in	IHC4	8	Similar to RHC3, but plug-in
Chilled, open, island, remote	RHC4	0	Similar to RHC3
Chilled, glass lid, wall site, plug-in	IHC5	0	Similar to IHC3, but with glass lid
Chilled, glass lid, wall site, remote	RHC5	0	Similar to RHC3, but with glass lid
Chilled, glass lid, island, plug-in	IHC6	16	
Chilled, glass lid, island, remote	RHC6	0	Similar to IHC6, but remote
Chilled, serve-over counter closed service access, plug-in	IHC7	1	Similar to IHC1, but closed
Chilled, serve-over counter closed service access, remote	RHC7	0	Similar to RHC1, but closed
Chilled, serve-over counter with integrated storage closed service access, plug-in	IHC8	0	Similar to IHC2, but closed
Chilled, serve-over counter with integrated storage closed service access, remote	RHC8	0	Similar to RHC2, but closed
	Total	**160**	

Cabinet type, Vertical frozen		**Number of data points**	**Comment for low data availability**
Frozen, semi-vertical, plug-in	IVF1	0	Used rarely. Cf IVF4
Frozen, semi-vertical, remote	RVF1	0	Used rarely Cf IVF4

Frozen, multi-deck, plug-in	IVF2	0	Used rarely Cf IVF4
Frozen, multi-deck, remote	RVF2	0	Used rarely Cf IVF4
Frozen, glass door, plug-in	IVF4	0	Similar to RVF4, but plug-in
Frozen, glass door, remote	RVF4	18	
Frozen, open top, open bottom, plug-in	IYF1	0	Used rarely, similar to IYF2, IYF3, IYF4
Frozen, open top, open bottom, remote	RYF1	0	Used rarely, similar to RYF2, RYF3, RYF4
Frozen, open top, glass lid bottom, plug-in	IYF2	0	Used rarely, similar to IYF3, IYF4
Frozen, open top, glass lid bottom, remote	RYF2	0	Used rarely, similar to RYF3, RYF4
Frozen, glass door top, open bottom, plug-in	IYF3	12	
Frozen, glass door top, open bottom, remote	RYF3	19	
Frozen, glass door top, glass lid bottom, plug-in	IYF4	13	
Frozen, glass door top, glass lid bottom, remote	RYF4	16	
Multi-temperature, open top, open bottom, plug-in	IYM5	0	Similar to IYM6, but open
Multi-temperature, open top, open bottom, remote	RYM5	0	Similar to IYM6, but open and plug-in
Multi-temperature, open top, glass lid bottom, plug-in	IYM6	12	
Multi-temperature, open top, glass lid bottom, remote	RYM6	0	Similar to IYM6, but remote
Multi-temperature, glass door top, open bottom, plug-in	IYM7	0	Similar to IYM6

Multi-temperature, glass door top, open bottom, remote	RYM7	0	Similar to IYM6
Multi-temperature, glass door top, glass lid bottom, plug-in	IYM8	0	Similar to IYM6, but completely closed
Multi-temperature, glass door top, glass lid bottom, remote	RYM8	0	Similar to IYM6, but completely closed
	Total	**90**	

Cabinet type, Horizontal frozen		**Number of datapoints**	**Comment for low data availability**
Frozen, serve-over counter open service access, plug-in	IHF1	0	Rarely used cf RHF1
Frozen, serve-over counter open service access, remote	RHF1	2	Rarely used
Frozen, open, wall site, plug-in	IHF3	2	Similar to RHF3, but plug-in
Frozen, open, wall site, remote	RHF3	10	
Frozen, open, island, plug-in	IHF4	12	
Frozen, open, island, remote	RHF4	14	
Frozen, glass lid, wall site, plug-in	IHF5	0	Similar to IHF3, but closed
Frozen, glass lid, wall site, remote	RHF5	3	
Frozen, glass lid, island, plug-in	IHF6	25	
Frozen, glass lid, island, remote	RHF6	7	Similar to IHF6, but remote
Frozen, serve-over counter closed service access, plug-in	IHF7	0	Similar to IHF1, but closed
Frozen, serve-over counter closed service access, remote	RHF7	0	Similar to RHF1, but closed
	Total	**75**	

Table 26 Market share data of plug-in supermarket cabinets in 2012.

Plug-in market share 2012					
Multidecks & semi-verticals	**Counters: service & self service**	**Frozen food islands**	**Glass doors & frozen multidecks/Semi-Verticals**	**Chilled with doors**	**Combis**
IVC1/IVC2/IVC3	IHC1/IHC2/IHC7/ IHC8/IHF1/IHF7	IHC3 to IHC6 & IHF3 to IHF6	IVF4 + IVF1 & IVF2	IVC4	IYC1 to IYC4 & IYF1 to IYF4
7%	4%	15%	2%	3%	1%

Table 27 Market share data of remote supermarket cabinets in 2012.

Remote market share 2012					
Multidecks & semi-verticals	**Counters: service & self service**	**Frozen food islands**	**Glass doors & frozen multidecks/Semi-Verticals**	**Chilled with doors**	**Combis**
RVC1/RVC2/RVC3	RHC1/RHC2/RHC7/ RHC8/RHF1/RHF7	RHC3 to RHC6 & RHF3 to RHF6	RVF4 + RVF1 & RVF2	RVC4	RYC1 to RYC4 & RYF1 to RYF4
36%	9%	8%	4%	6%	4%

Table 28 Market share data of total remote and plug-in supermarket cabinets in 2012.

Subtotal		
Plug-in	**Remotes**	**TOTAL**
48%	52%	100%

9.10. Annex X: Data distribution, MEPS and labelling classes

All data available has been plotted together with the MEPS cut-off and the distribution of the energy labelling classes. This has been done for the different product groups, *i.e.* vertical and horizontal refrigerators and freezers, beverage coolers, small ice-cream freezers and vending machines. Furthermore, an overview is given for the data points which would be non-compliant according to the proposed MEPS for EEI < 110 and EEI < 80. Note that for some supermarket cabinet types no data is available. For these categories, it is estimated that they could follow the same technological trend as other categories similar in function for which data is available, see Table 25. For some cabinet types, exclusion is foreseen for EEI < 80 without energy efficiency improvement. The most affected cabinet types would be vertical freezers, roll-in cabinets and semi-vertical cabinets. Closed chilled cabinets will comply with the MEPS, while only the most efficient open cabinets would be allowed on the market in the future if EEI < 80.

9.10.1. Supermarket segment, vertical chilled

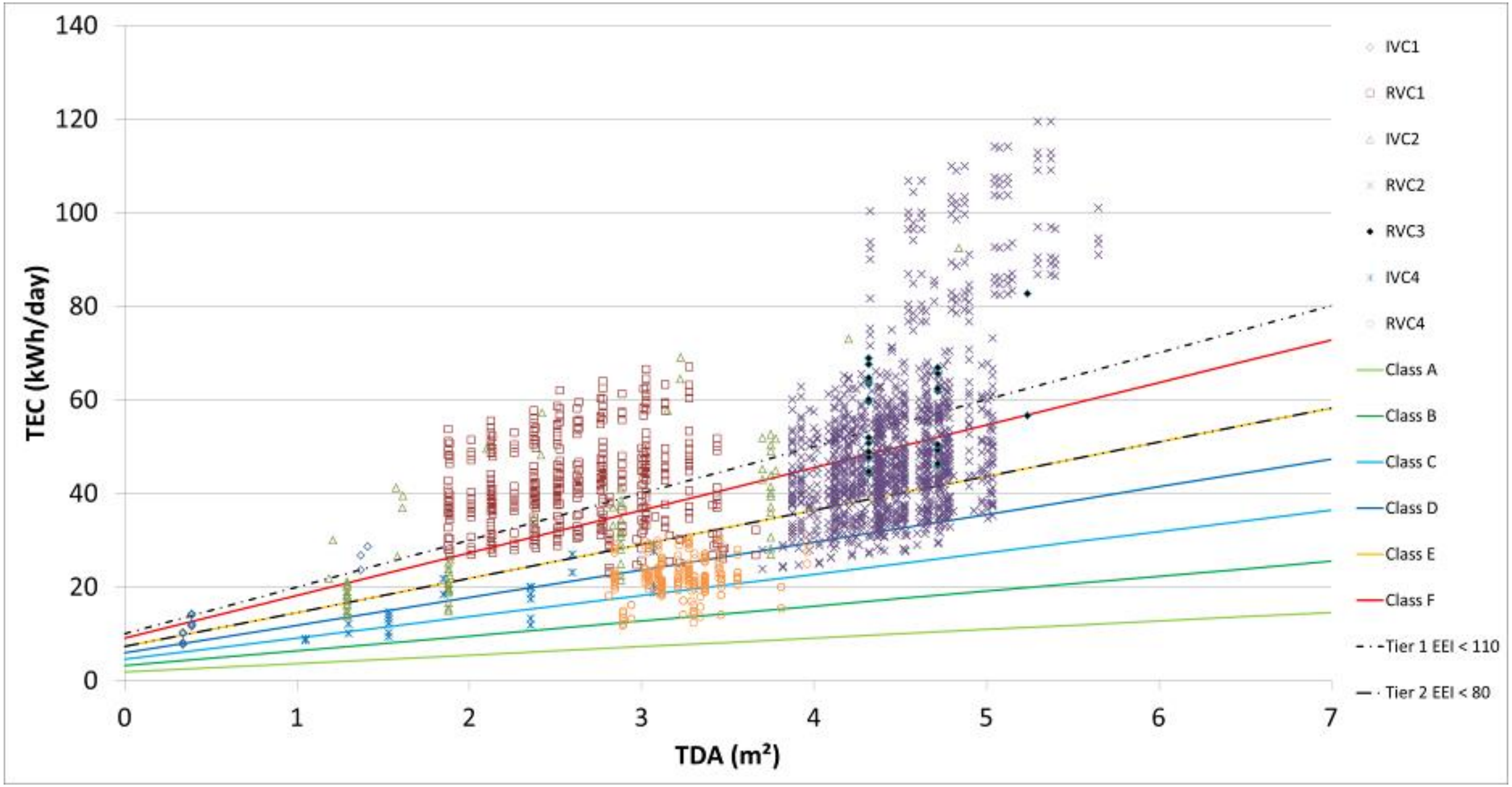
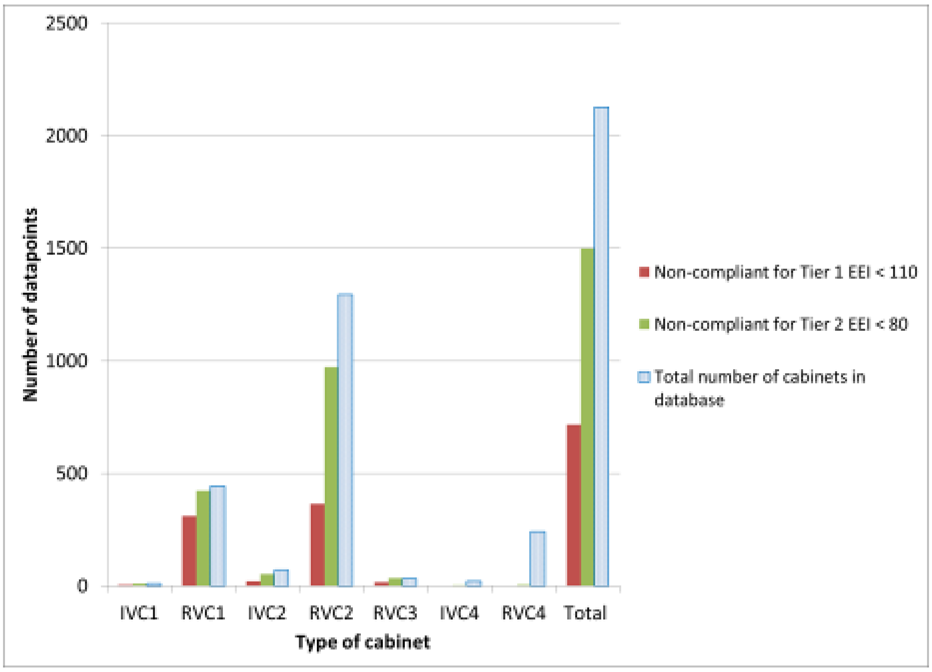


Figure 14 Data points of supermarket vertical refrigerators, according to their classification in ISO 23953.The tiers EEI < 80 and EEI < 110, and the energy labelling classes are presented as well.



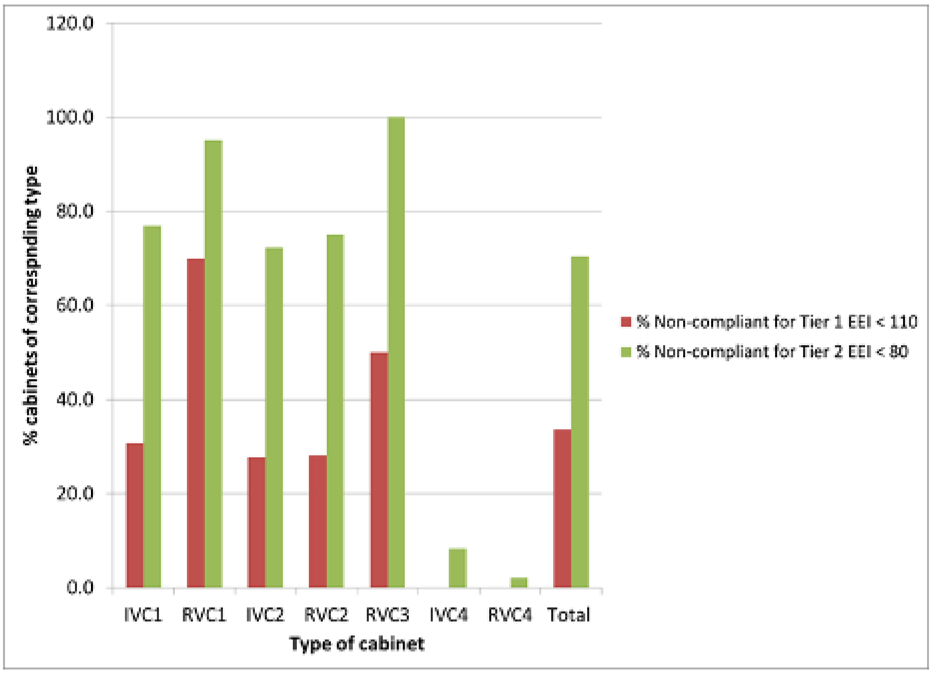


Figure 15 Number and percentage of data points of supermarket vertical refrigerators non-compliant with EEI < 110 or EEI < 80.

The data analysis shows that about 34% of the data points of current vertical supermarket refrigerators would not comply with EEI < 110. About 70% would not comply with a tier at EEI < 80 even though the most energy efficient open cabinets could remain on the market. Especially current roll-in cabinets (VC3) could be non-compliant with a tier at EEI < 80. Industry and retailers are however investigating how these appliances could be closed and what impact that could have. Another affected product type is the semi-vertical group (VC1). Even if some current cabinets could comply with MEPS at EEI < 80, these are indicated to be more difficult to be closed. Some retailers use semi-verticals according to their specific retail concept.

Supermarket segment, horizontal chilled

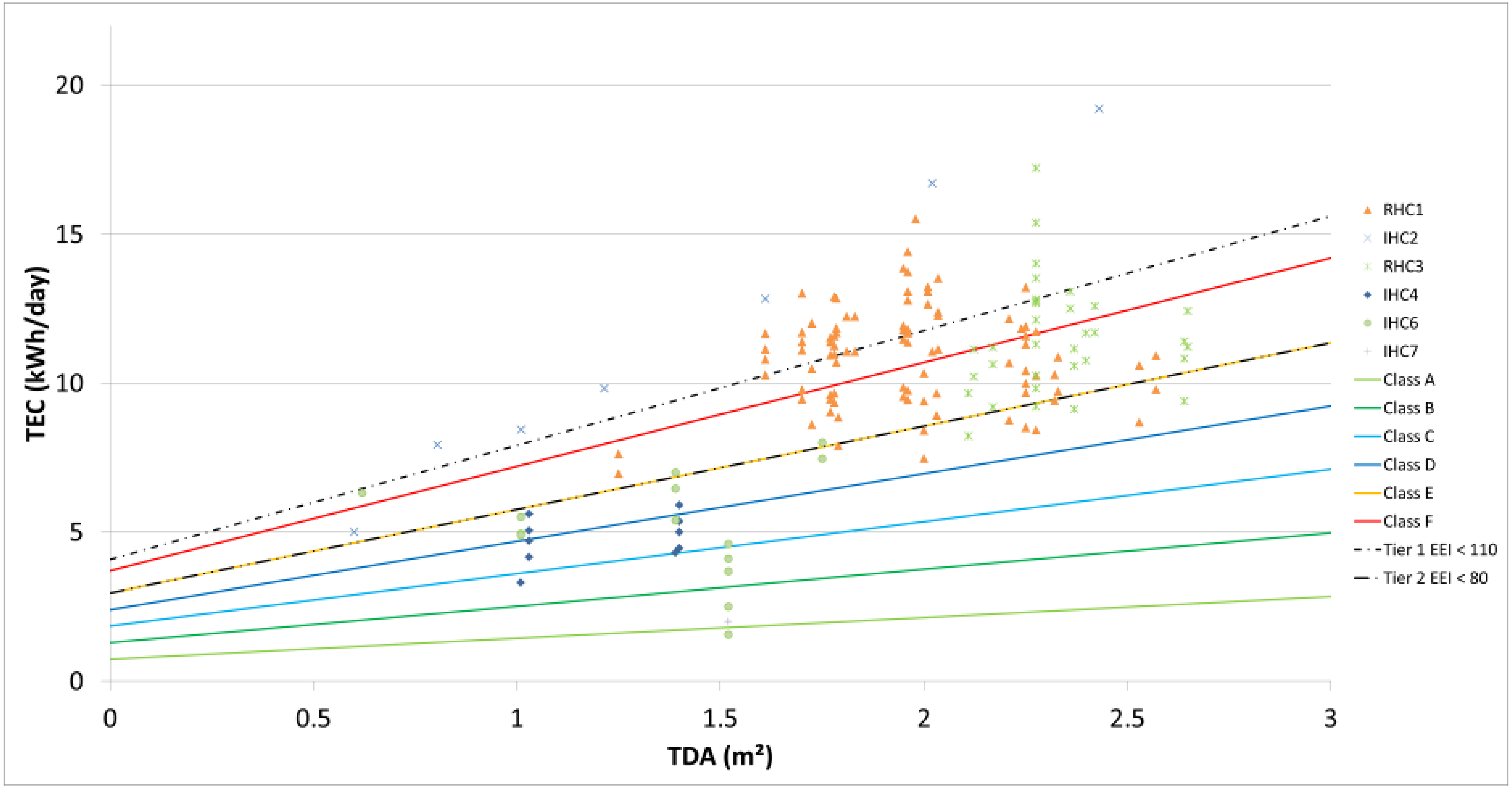


Figure 16 Data points of supermarket horizontal refrigerators, according to their classification in ISO 23953.The tiers EEI < 80 and EEI < 110, and the energy labelling classes are presented as well.

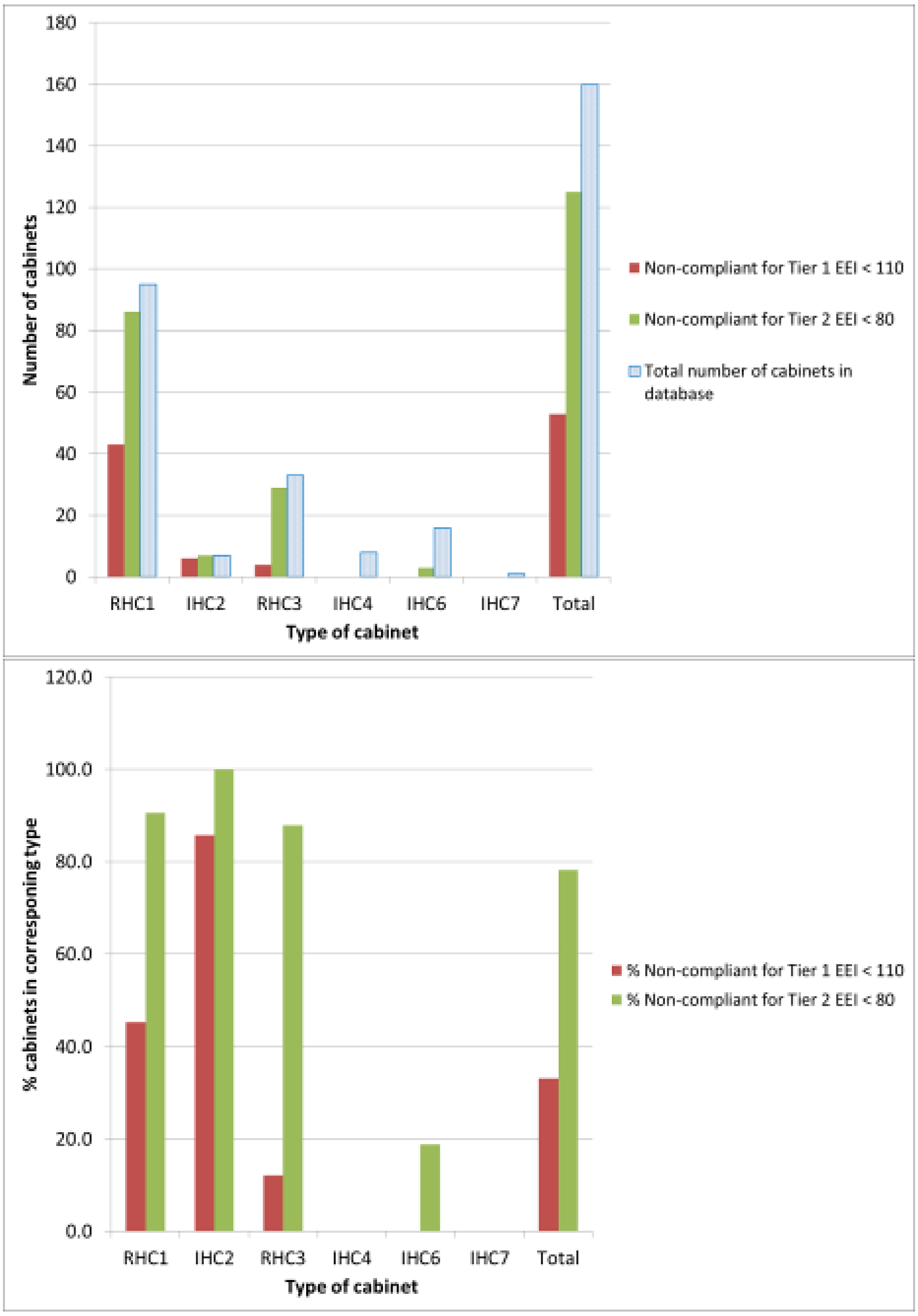


Figure 17 Number and percentage of data points of supermarket horizontal refrigerators non-compliant with EEI < 110 or EEI < 80.

The data analysis shows that about 33% of the data points of current vertical refrigerators would not comply with EEI < 110. About 78% would not comply with a tier at EEI < 80. Especially open cabinets (HC1, HC2, HC3) could be non-compliant with a tier at EEI < 80. These appliances can however easily be closed without significant impact other than energy efficiency improvement.

Supermarket segment, vertical frozen

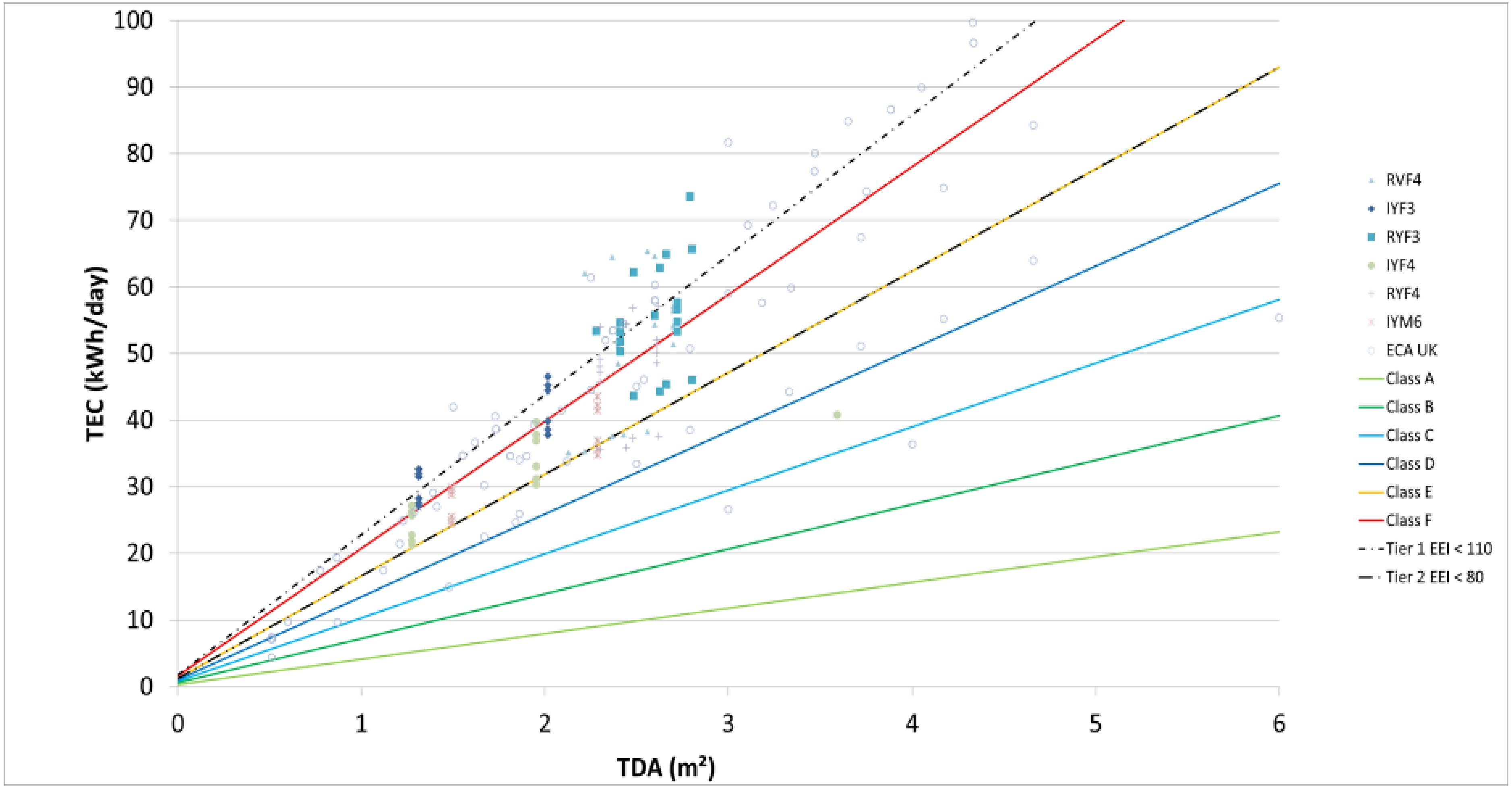


Figure 18 Data points of supermarket vertical and combined freezers, according to their classification in ISO 23953, together with ECA UK data for VF$ cabinets. The tiers EEI < 80 and EEI < 110, and the energy labelling classes are presented as well.

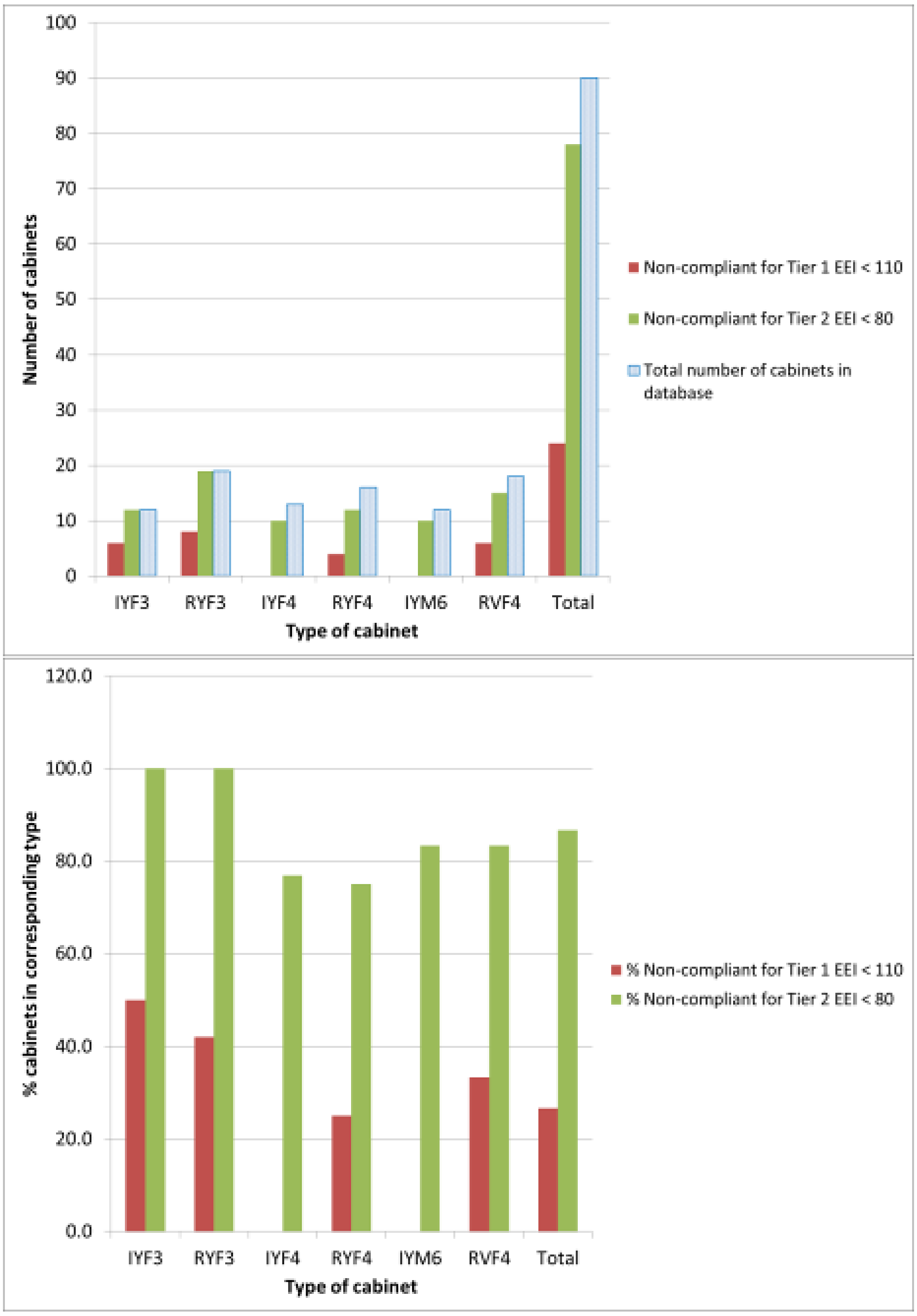


Figure 19 Number and percentage of data points of supermarket vertical and combined freezers non-compliant with EEI < 110 or EEI < 80.

The data analysis shows that about 27% of the data points of current vertical refrigerators would not comply with EEI < 110. About 87% would not comply with a tier at EEI < 80. Especially open cabinets (YF3, YM6) could be non-compliant with a tier at EEI < 80. These appliances can however easily be closed without significant impact other than energy efficiency improvement. The cabinet type VF4 is a closed cabinet type and seems to have difficulties as well to comply with the stricter MEPS. ECA UK data however shows that more efficient cabinets are already on the market. Note that these ECA UK data points are all VF4 appliances, but have not been included in the analysis. They are presented for comparison only.

Supermarket segment, horizontal frozen

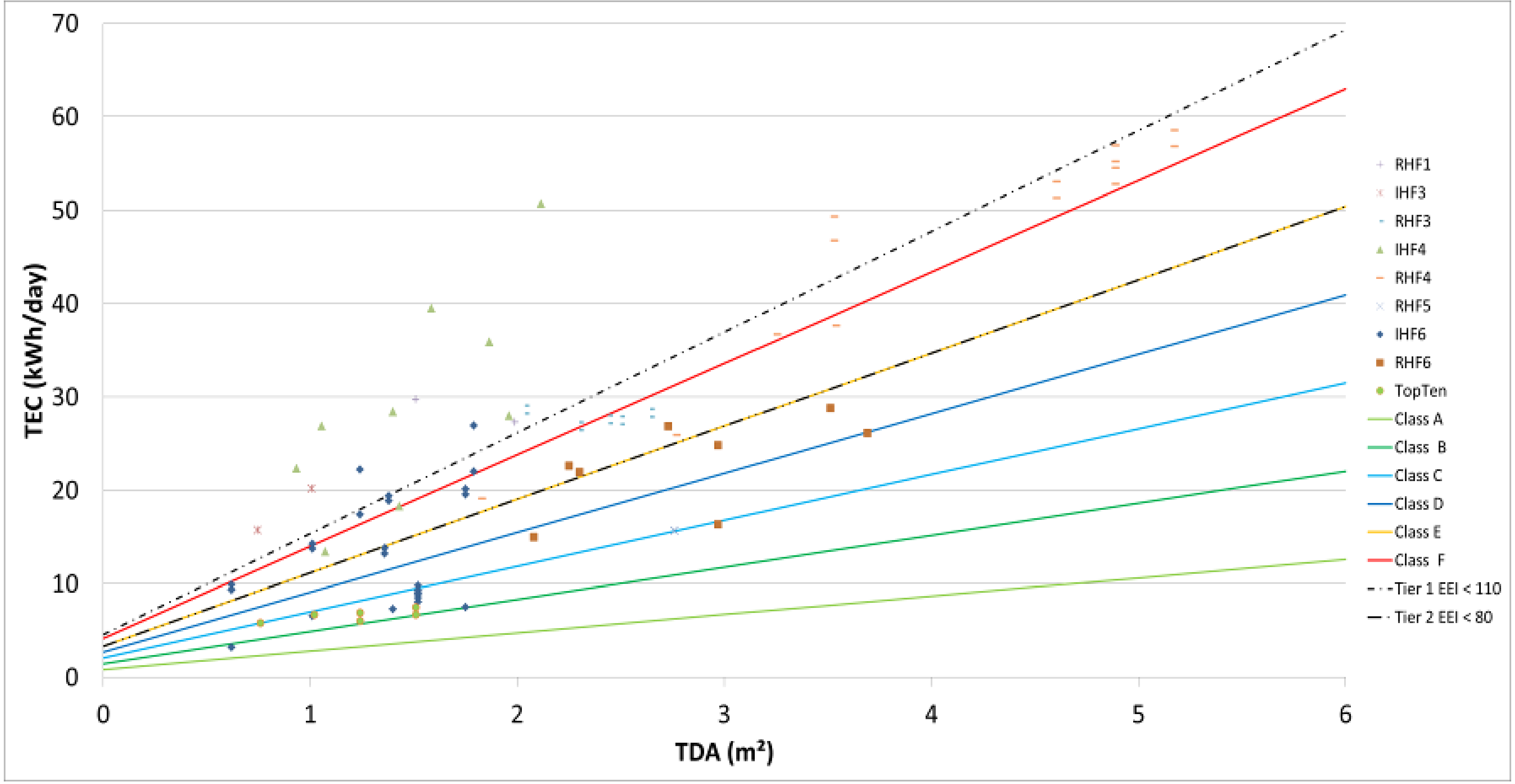


Figure 20 Data points of supermarket horizontal freezers, according to their classification in ISO 23953, together with some TopTen data points. The tiers EEI < 80 and EEI < 110, and the energy labelling classes are presented as well.

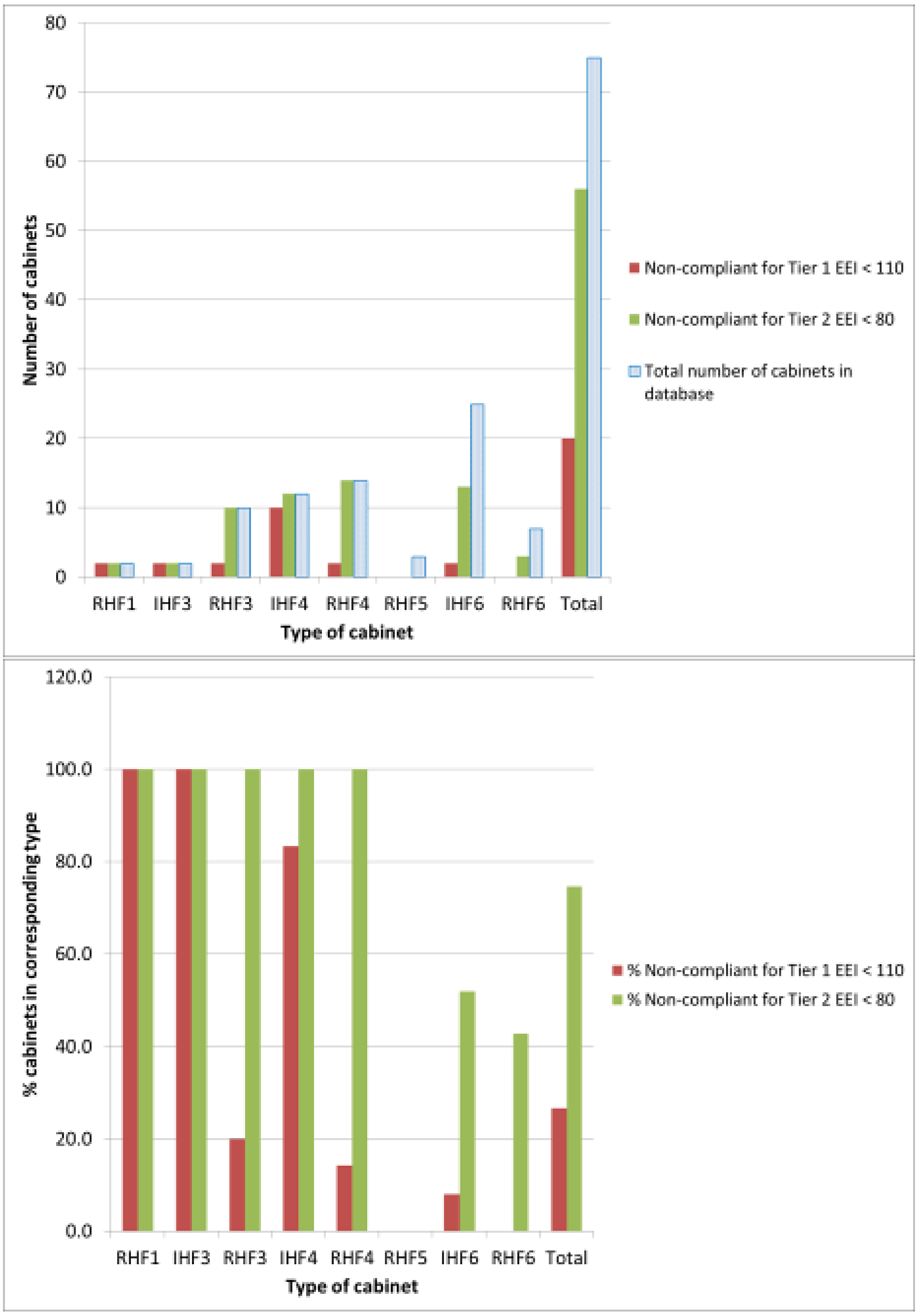


Figure 21 Number and percentage of data points of supermarket horizontal freezers non-compliant with EEI < 110 or EEI < 80.

The data analysis shows that about 27% of the data points of current vertical refrigerators would not comply with EEI < 110. About 75% would not comply with a tier at EEI < 80. Especially open cabinets (HF1, HF3, HF4) could be non-compliant with a tier at EEI < 80 or even a tier at EEI < 110. These appliances can however easily be closed without significant impact other than energy efficiency improvement.

Beverage coolers

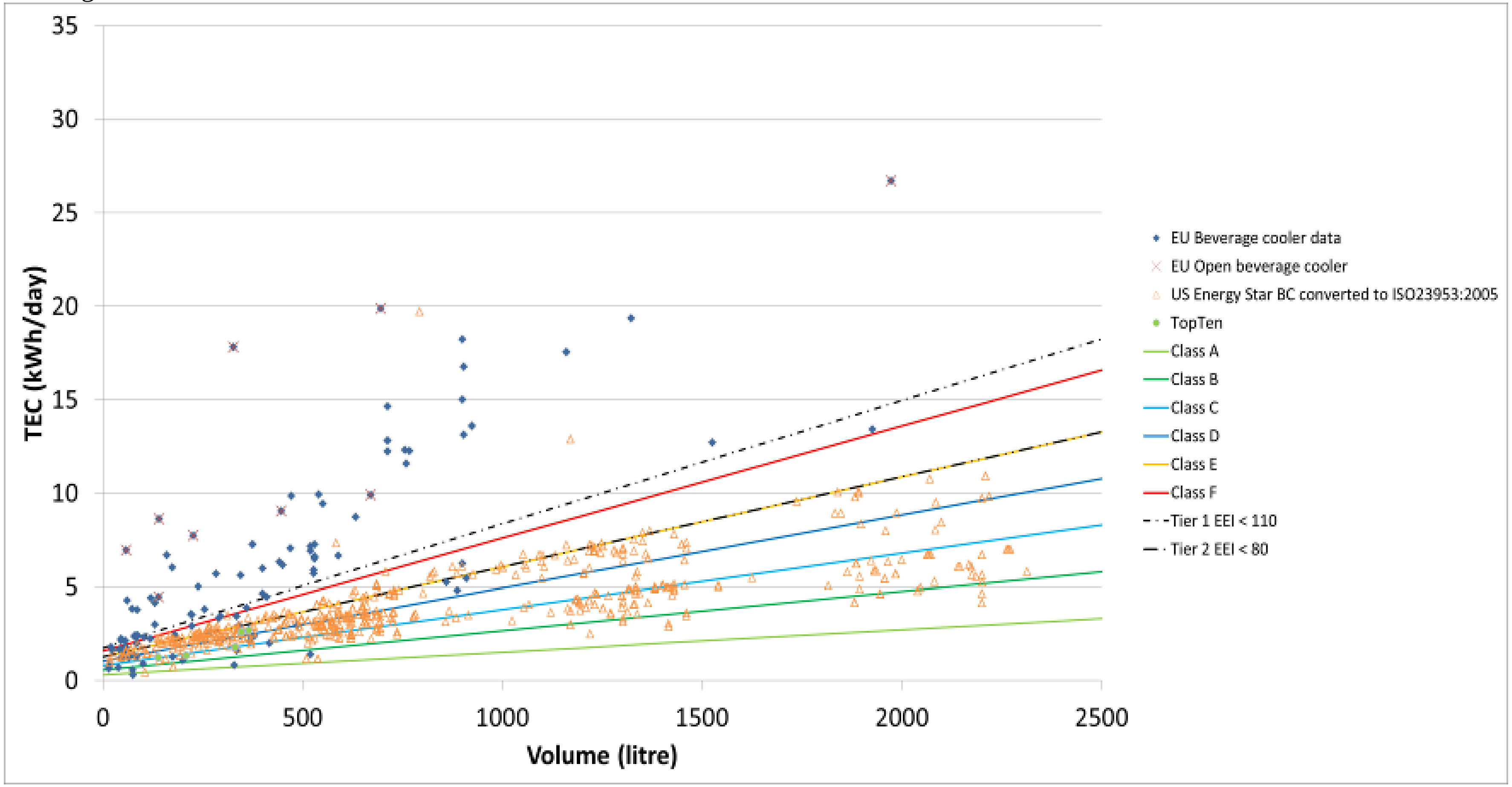


Figure 22 Data points of EU beverage cooler data and the US Energy Star data converted to the ISO 23953 measurement protocol, together with some TopTen data points for a volume ranging from 0 – 2500 litre. The tiers EEI < 80 and EEI < 110, and the energy labelling classes are presented as well.

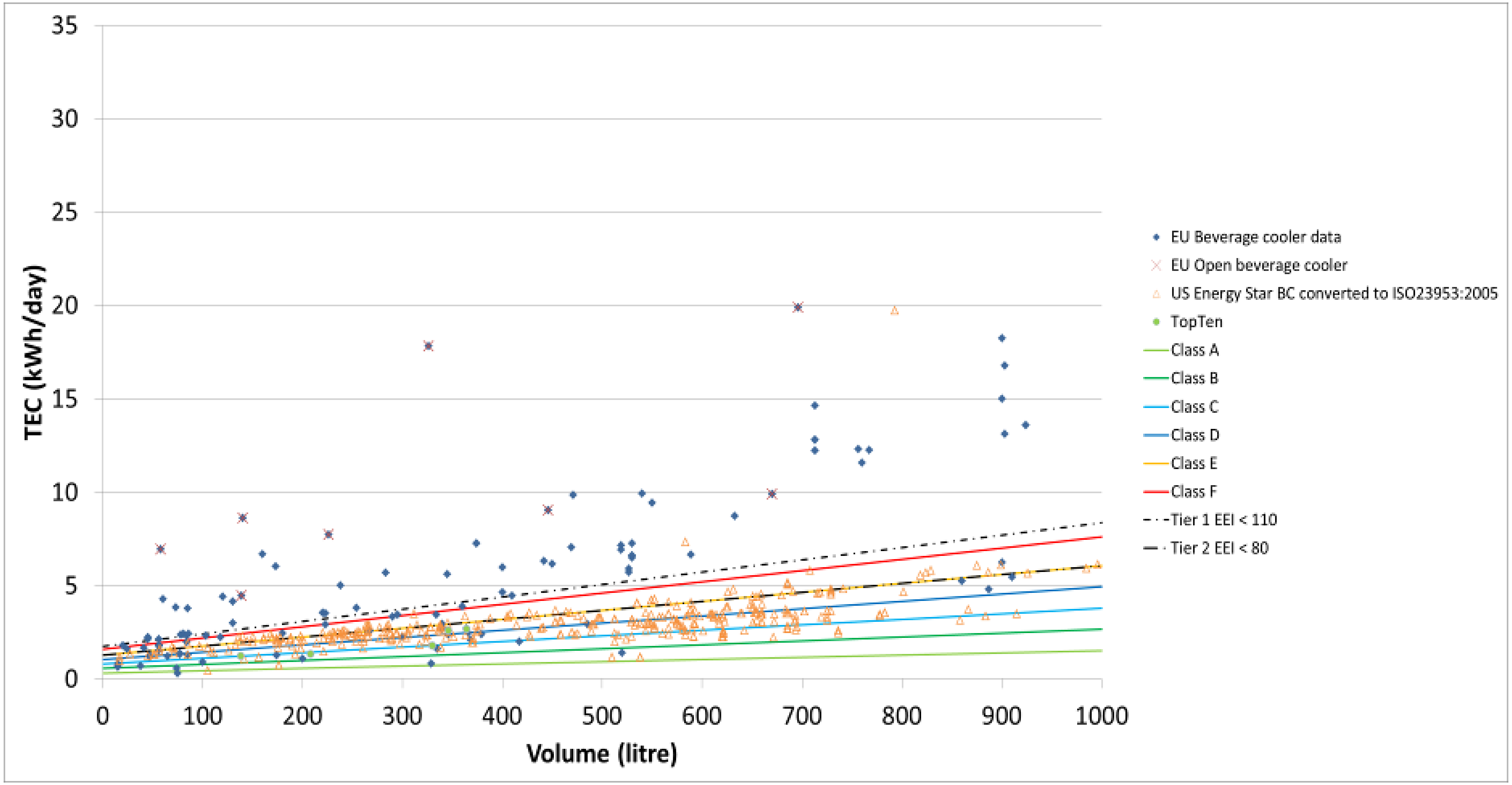


Figure 23 Data points of EU beverage coolers and the US Energy Star data converted to the ISO 23953 measurement protocol, together with some TopTen data points for a volume ranging from 0 – 1000 litre, The tiers EEI < 80 and EEI < 110, and the energy labelling classes are presented as well.

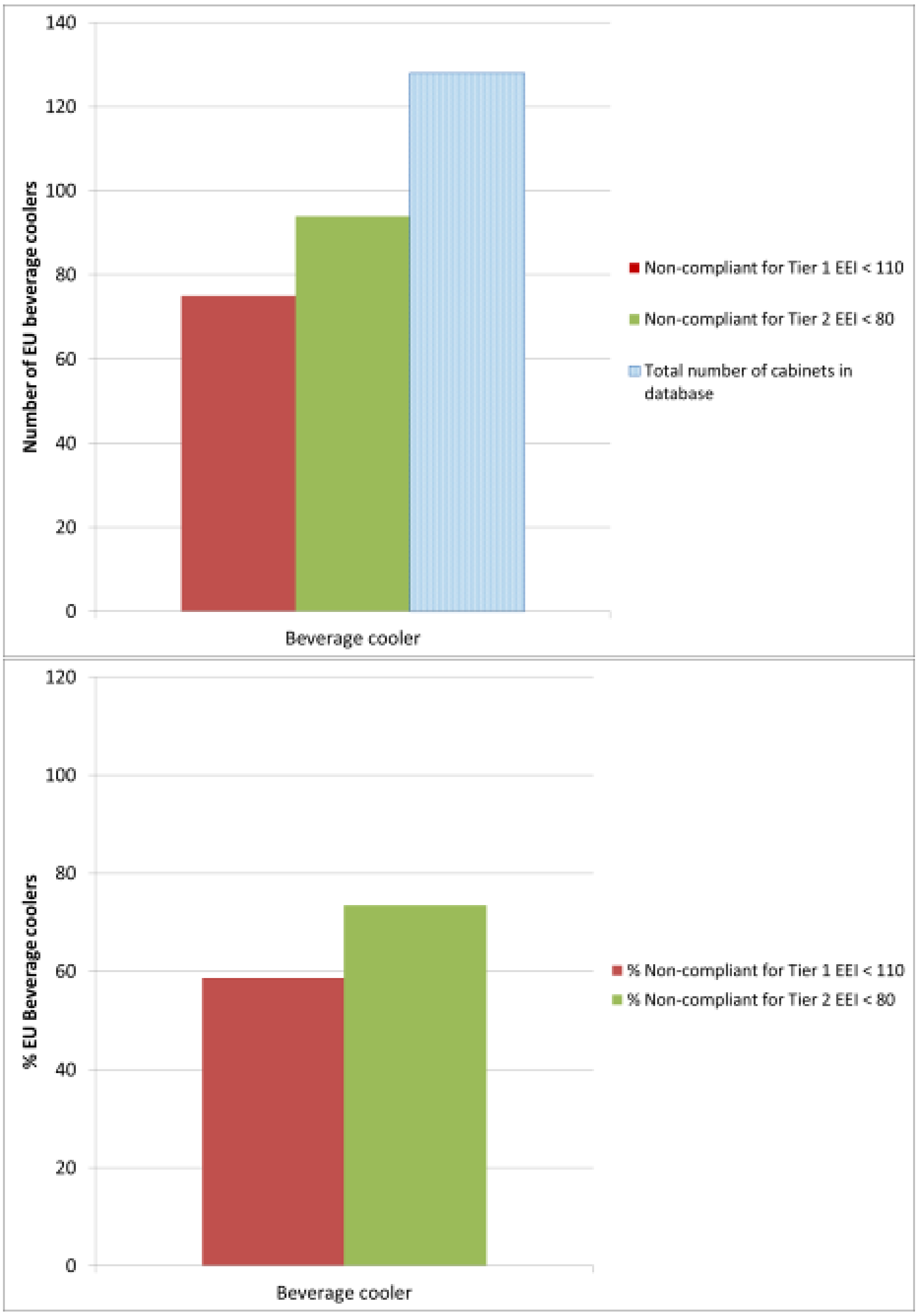


Figure 24 Number and percentage of data points of EU beverage coolers non-compliant with EEI < 110 or EEI < 80.

The data analysis shows that about 59% of the data points of current vertical refrigerators would not comply with EEI < 110. About 73% would not comply with a tier at EEI < 80. The US Energy Star data shows that improvement options are possible. Note that these Energy Star data points have not been included in the analysis, but are presented for comparison only. From the figure it can be noticed that open beverage coolers will have difficulties to stay on the market.

Note that the reference line to define EEI for the beverage coolers is based on the US Energy Star data (converted to ISO 23953).

Small ice-cream freezers

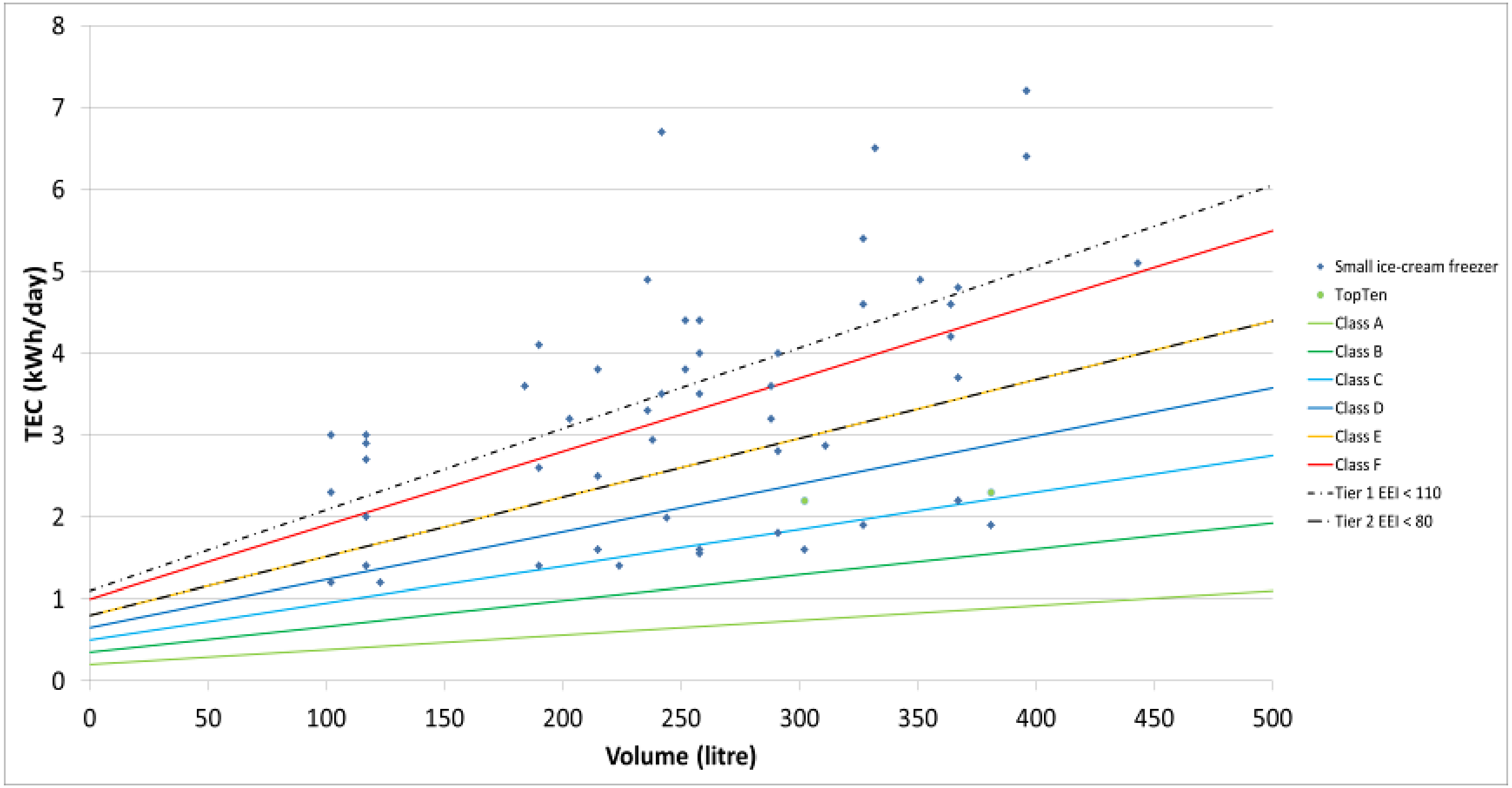


Figure 25 Data points of small ice-cream freezers , together with two TopTen data points, The tiers EEI < 80 and EEI < 110, and the energy labelling classes are presented as well.

This figure shows the available data for small ice-cream freezers and TopTen data for small ice-cream freezers together with the proposed labelling classes and tiers at EEI < 110 and EEI < 80.

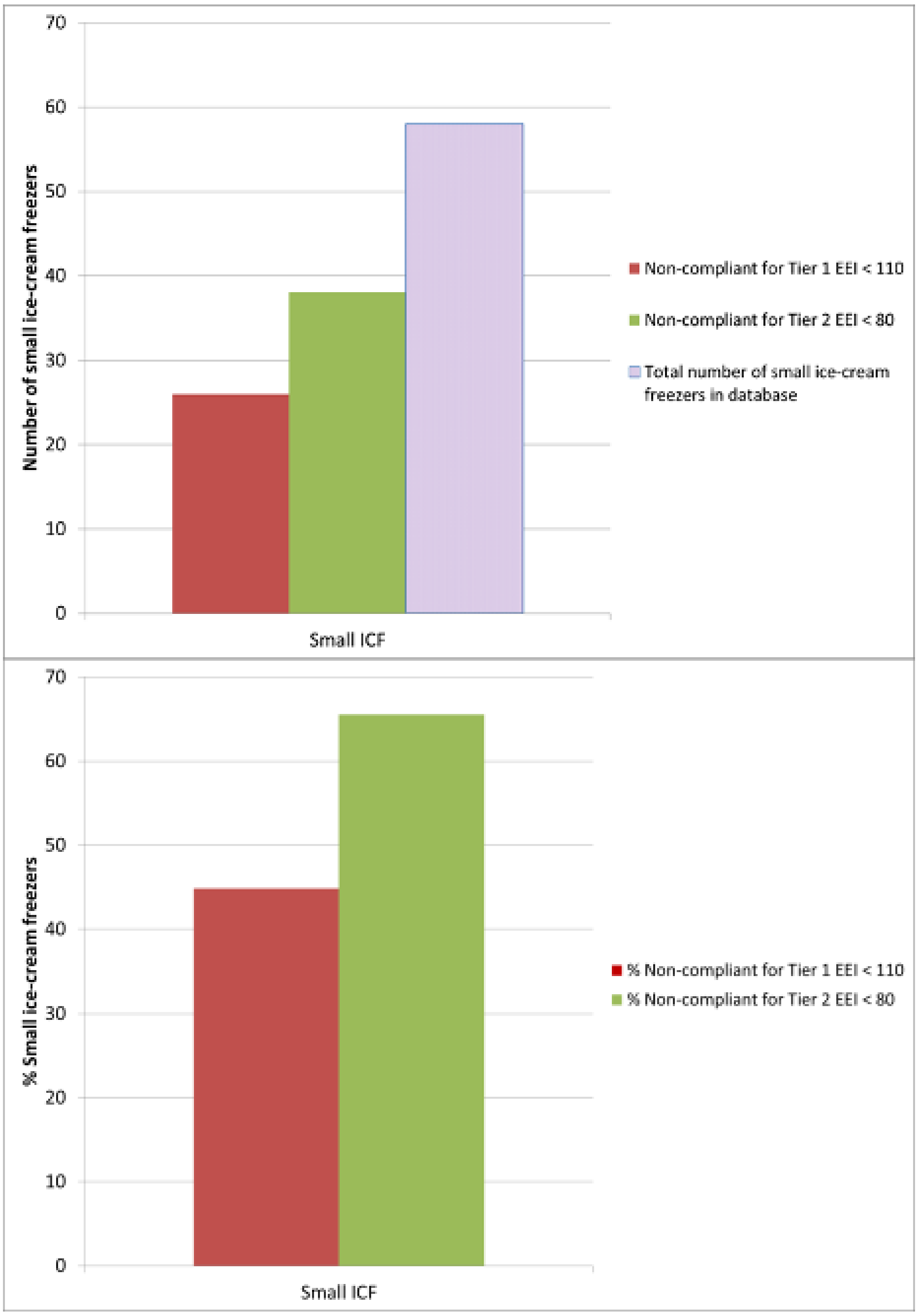


Figure 26 Number and percentage of data points of small ice-cream freezers non-compliant with EEI < 110 or EEI < 80.

The data analysis shows that about 45% of the data points of current vertical refrigerators would not comply with EEI < 110. About 66% would not comply with a tier at EEI < 80. TopTen data have not been included in the analysis, but are presented for comparison only.

9.10.2. Refrigerated vending machines

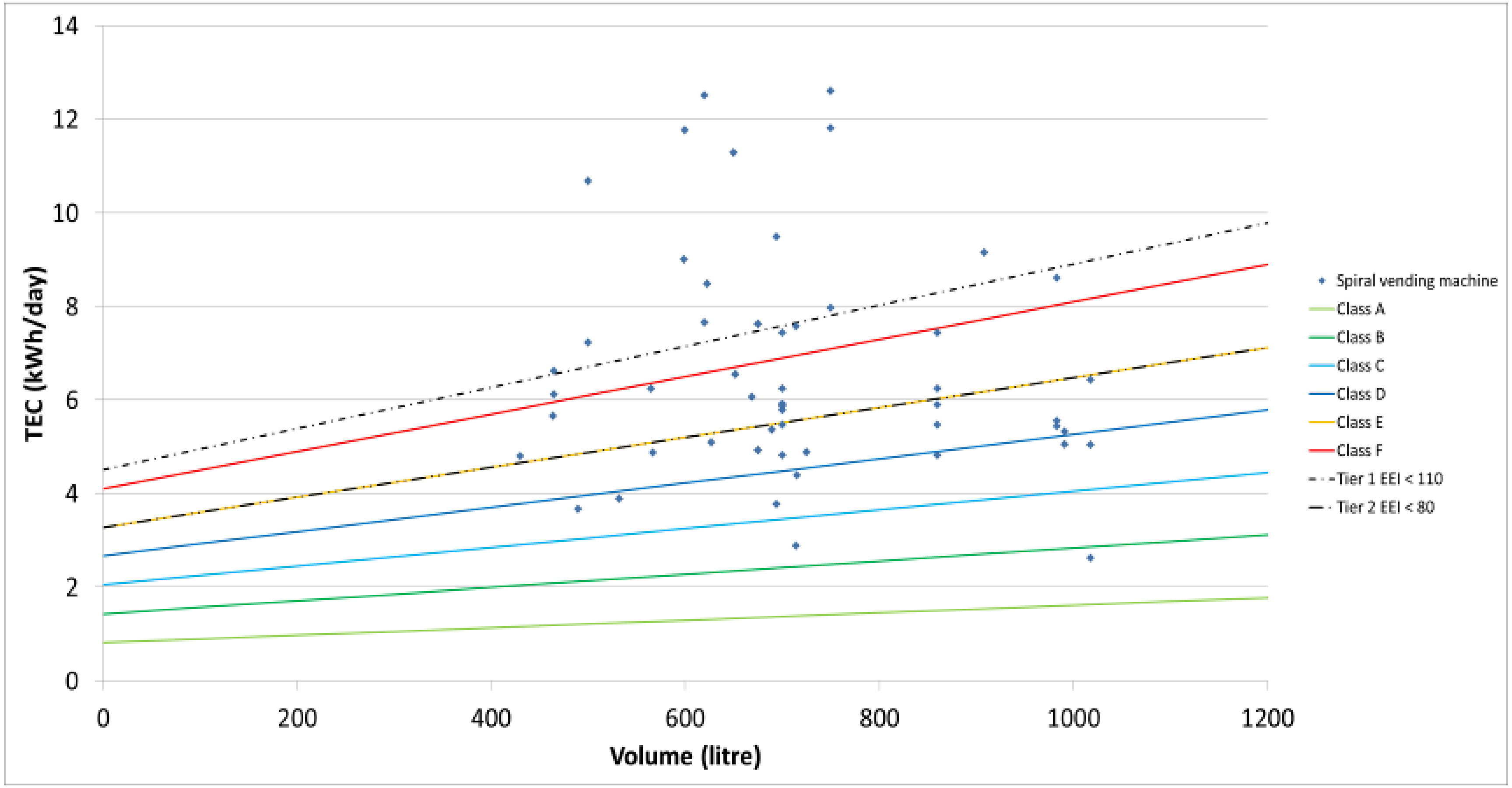


Figure 27 Data points of refrigerated spiral vending machines. The tiers EEI < 80 and EEI < 110 and the energy labelling classes are presented as well.

This figure (26) shows the available data for refrigerated spiral vending machines together with the proposed labelling classes and tiers at EEI < 110 and EEI < 80.

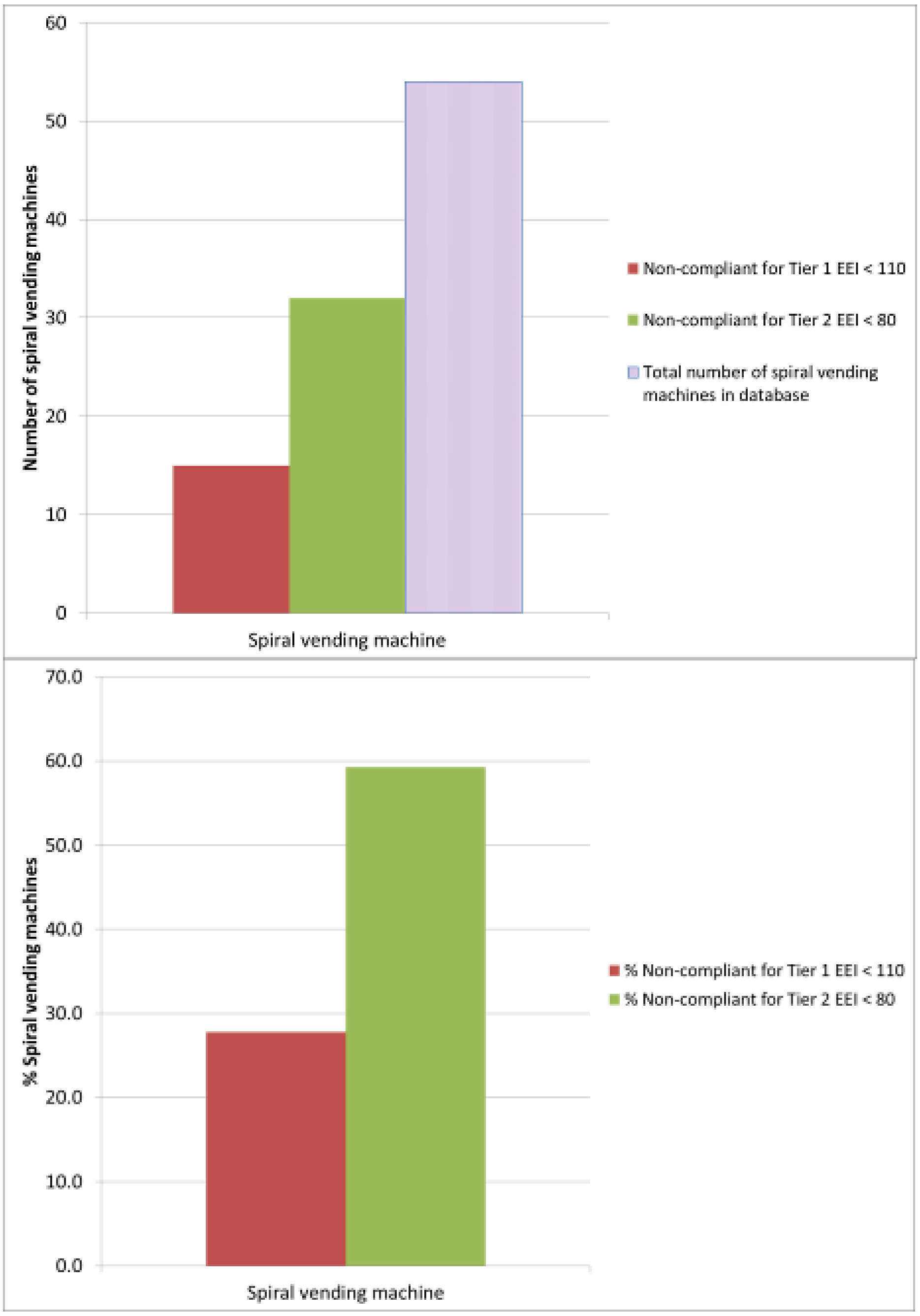


Figure 28 Number and percentage of data points of refrigerated spiral vending machines non-compliant with EEI < 110 or EEI < 80.

The data analysis shows that about 28% of the data points of current vertical refrigerators would not comply with EEI < 110. About 59% would not comply with a tier at EEI < 80. The data analysis is for spiral vending machines. Other types of refrigerated vending machines such as can and bottle machines would have fewer difficulties to comply with the MEPS as they are usually more energy efficient.

9.11. Annex XI: Splitting of supermarket segment remotes vs. plugins

In theory, plug-in appliances are less energy efficient than remote appliances because of several reasons:

- the COP (coefficient of performance) of small compressors is lower than the COP of big compressors if a higher condensation temperature is assumed
- plug-ins are usually smaller cabinets which allow higher impacts from boundary effects, even though some boundary effects are already reflected in a TEC per TDA reference energy consumption

In practice however, testing plug-ins and remotes with the ISO 23953 standard results in similar energy consumption figures. This is related to the conversion factor in that standard to calculate the electricity consumption of remote cabinets, *i.e.* convert the refrigeration energy in electricity consumption (REC[55]). The use of this conversion factor inflates artificially the energy consumption of remote cabinets compared to plugins.

If the MEPS and labels are to be linked to a methodology, then the proposed MEPS and EL will be linked to the conversion factor of REC of the ISO 23953. If this value is updated, then the MEPS and EL shall be too.

A splitting between plug-in and remote could thus be desirable, even with the same reference energy consumption for the moment, *i.e.* the same M and N values. This would allow a swifter adaptation of a future review of the Regulation, in case the conversion factor in the ISO standard is updated/adjusted or if future changes in energy efficiency technology would only affect one of the two types of cabinets (remotes/plugin).

The pros and cons identified are presented below.

Table 29 Pros and cons for splitting between plug-in and remote supermarket cabinets.

PROS of splitting	CONS of splitting
Practical simplicity. While conceptually simple and in theory allowing retailers to better understand and integrate the costs/benefits of remotes vs. plugins, non-splitting is difficult in practice because it requires developing a conversion factor to enable cross-comparisons. This is not straightforward, as such factor would depend on a number of factors (climatic conditions, indoor climate prescriptions, size of store and HVAC demands, size and efficiency of compression pack serving	Conceptual simplicity. Would allow retailers to better understand and integrate the costs/benefits of remotes vs plugins. Would convey literally the functionality approach.

55 REC = Refrigeration Electrical energy Consumption

several cabinets, and not included in ISO 23953 measurements) which are difficult to generalise or else parameterise across the EU.	
Gives flexibility to future changes in energy efficiency technology that only affect one of the two types (e.g. efficiency improvements of condensation, that will be recorded in ISO 23953 measurements of plug-ins but not in remotes, unless the REC conversion algorithm is also adapted accordingly).	This does only to an extent convey the functionality approach, which would make evident (e.g. by worse labelling) that plugins are less efficient than remotes. This would, however, require that the conversion coefficient of REC in ISO 23953 is representative, and robust. This is difficult, as it represents a very aggregated average of climatic conditions of the remote modules (condensation side) across the EU.
There is no rationale in restricting the use of any of these types. Remotes are in theory more efficient. However, they are physically fixed to a position, and do not allow the flexibility needed in retailers to move location. Plugins are thus necessary as they provide flexibility, and it is not possible for physical reasons in smaller stores to install remote units.	
The testing of plugins is less expensive and less complex. As the testing of remotes is more complex, expensive, and prone to manipulation, alternatives for reducing the testing burden may be proposed. These do not need to affect the plugins	

9.12. Annex XII: Functionality approach

Table 30 Pros and cons of a functionality approach, compared to a full breakdown of product subcategories.

PROS	CONS
Simplicity	May restrict the development options of new designs, potentially conveyors of large sales, as the MEPS classification options are more restricted if the functionality approach is used. If a larger breakdown was provided, there would be more options for a manufacturer to classify a new high consumption design under the less strict possible MEPS subcategory.
Emphasis is on the function (display). This may have as effect avoiding the use of display cabinets for storage, when this is not needed (e.g. low turnover products), as storage volume is penalised and dedicated storage cabinets are more efficient in delivering this function.	In prioritising the display function (operationalised by means of the associated metric of TDA) vs other functions (*e.g.* storage, volume metrics) in the same cabinet, this approach may restrict the development of designs that exceed the energy use thresholds because of the metrics used (*e.g.* cabinets that keep cool higher volumes, but are tested per TDA). This is especially critical for the cabinets that contain products of large turnover (*e.g.* dairy), where either larger storage capacity or larger reposition rates is needed. In regions with high wages, cabinets that combine large storage volume and display may be favoured. Designs may move in the direction of increasing the TDA for similar volumes, or increasing unnecessarily the volume of cabinets. Some degree of creative trickery (such as provision of display area or volumes of little practical use) in designs may be a side effect of using energy/TDA or energy/volume as the metrics for this policy.
A split into too many categories would endorse the use of certain very inefficient cabinet designs (*e.g.* open vertical freezers) that provide the same functionality at a much higher energy cost.	
Encourages the uptake of proven, known and available efficient designs, able to deliver the same function with less energy use.	

9.13. Annex XIII: Comments of stakeholders on expected positive and negative impacts

Table 31 Comments of stakeholders on expected positive and negative impacts.

Positive impacts	Identified by JRC	Comments from stakeholders
	Higher revenues for the more efficient appliances, which include more costly components, and on average have a higher price.	Manufacturers: Not evident, higher price levels will quickly go down. There will be no acceptance of higher prices. Retailers will soon press for more efficient products at the same price. It may be difficult to pass on higher component cost to final cabinet price, and no realiable monitoring, control or verification is possible to counterbalance it.
	Short term: lower demand because of higher price. Long term: demand increases once the labelling is well established and users realise that all prices increase on average as a result of higher quality (energy efficiency) requirements.	Manufacturers: The views within the industry vary on this topic, also because there is limited experience with business-to-business energy labelling. Some believe labelling is a powerful tool to promote energy efficiency and to convince non-technical decision makers in supermarkets. Some believe this is not true because of the negotiation power of supermarkets that will neglect labelled products.
	Gradual pressure on EU/non-EU manufacturers specialized in low-end appliances	Manufacturers: In theory, yes, but in practice there is no reliable market surveillance to enforce this.
	Competitive image and market push opportunity for the companies investing in high efficiency appliances	Manufacturers: Better image yes, but if there is no market surveillance and no differentiation amongst the cabinets this would not apply.
	Market transparency. Clarity on mid and long term product performance.	Retailers: Some see no value added, as they know well life cycle costing, some welcome the labelling, as it will facilitate better informed purchase.
	The regulation may likely result	Manufacturers:

	in a significant uptake of closed cabinets, as this is a simple, low cost measure to reduce energy consumption	It is fine to install doors, as long as it is not made compulsory and other designs are possible. Retailers: Doors are believed to contribute to better preservation of the food, and lower food wastage. Short term (2-4 months) sales decay are reported, but this is known to gradually recover after an adaptation time. The gain in energy efficiency and thus energy cost usually outweighs the decrease in sales. Some retailers have also indicated a more positive customer experience which could even increase sales.

Negative impacts	**Identified by JRC**	**Comments from stakeholders**
	The more efficient appliances include more costly components, and on average have a higher price, sometimes totaling a 20-30% increase in purchase price.	Retailers: Higher purchase prices are assumable if the LCC and payback time is low (max. 3 yr), also including maintenance. Additional challenges and costs (physical difficulties in accessing the products, larger width of corridors) are acknowledged, but they will adapt if the whole business is treated equally.
	Adaptation of machinery and production lines to installation of new components (doors, fans, compressors, of more efficient refrigerants, electronic steering)	Manufacturers: This impact is low or insignificant. No bottlenecks identified.
	Adaptation of supply chains (*e.g.* more orders of doors, new suppliers of doors, more efficient fans and compressors)	Manufacturers: This impact is low or insignificant
	Adaptation to updated F-gas Regulation	Manufacturers: Manufacturers claim that a double effort is needed, on one hand the transition to low GWP refrigerants and on the other hand complying with energy efficiency thresholds. Difficulties with compliance

		with the proposed MEPS are not indicated, but it could be more difficult to be positioned in the best energy labelling classes.
	Additional costs of training of staff	Manufacturers: Mainly training of salesmen on regulation, label, calculation of energy efficiency etc., not that much the production staff.
	EoL: additional costs of preparation and provision of technical information for dismantlers (e.g. video with location of electronic steering unit)	Manufacturers: This is entirely new and difficult to assess
	Additional cost of preparation of labelling information	Manufacturers: This can be a considerable impact related to testing, packaging and related logistics.
	Additional cost of testing and/or calculation of energy use of all product ranges	Manufacturers: This will have an important impact. Depends on how it is finally formulated, as if applying to each model will be very costly, as it requires to prepare technical files for each cabinet, a test report, calculations, etc. Many SMEs will need to invest in laboratory capacity, some may not be able to afford this.
	The regulation may likely result in a significant uptake of closed cabinets, as this is a simple, low cost measure to reduce energy consumption	Retailers Some retailers report no savings of door installation in peak hours, especially in retailer concepts based on large throughtput (*e.g.* discount) or product types (dairy). In these cabinets, the largest savings of doors take place off-peak hours and at night.
	Closed doors result in larger shelf replacement time (and the associated costs) and larger costs of maintenance (cleaning and repair of doors). Doors and lids need in some cases anti-condensation equipment (heat), which uses	Retailers: Higher purchase prices are assumable if the LCC and payback time is low (max. 3 yr), also including maintenance. Additional challenges and costs (physical difficulties in accessing the products, larger width of corridors) are

	energy	acknowledged, but they will adapt if all the business is treated equally. Additional energy use for anti-condensation is reported to not be larger than the energy saving obtained by closing the cabinet.

9.14. Annex XIV. Sensitivity analysis

9.14.1. Different temperature classes

The temperature at which the reference energy consumption for supermarket cabinets is measured shall be declared. For this purpose, it is proposed to use L1 for freezers and M2 for refrigerators.

In case a different temperature has been used for the testing, the energy consumption of the appliances would still be defined at L1 working temperatures for frozen appliances and M2 working temperatures for refrigerated appliances, and consumption conversion factors can be used and shall also be declared to ensure reproducibility, *e.g.* for market surveillance purposes.

For the other commercial refrigeration appliances, the test temperature shall be described in the standardized measurement protocol and correspond to the lowest working temperature of the appliance.

Some supermarket cabinet types can be used to work at a range of temperatures, including different temperature classes as defined in the ISO 23953 standard. Energy performance varies with the operating temperature. Therefore, cabinets shall be tested at a specified temperature class, *e.g.* M2 for chillers and L1 for freezers, allowing for cross-comparability. For a given product, the temperatures of testing would be chosen as the most demanding within the range where the product is declared to be suited for. The risk exists that conversion factors are not accurately defined because of lack of sufficient representative data.

Differentiation according to market share of different temperature classes of different cabinet types has been modelled, and has resulted in insignificant differences on impact, *i.e.* < 1% difference. Table 32shows these differences of annual energy consumption of the supermarket cabinets under the scope of the policy, with temperature class splitting, and using alternatively sales-weighted average energy use values per cabinet subcategory.

Table 32 Estimation of the effect of temperature class subdivision. The tables present the differences of annual energy consumption of the supermarket cabinets under the scope of the policy, with temperature class splitting, or using alternatively sales-weighted average energy use values per cabinet subcategory.

REMOTES -SPLIT							
	Temp class	Main types	% Family	kwh/day m2	TWh/yr - 365d	kwh/day m2	TWh/yr - 365d
chilled semiverticals	3H	RVC1	0.12	11.17	0.05	14.63	0.52
	3M2		0.59	13.60	0.29		
	3M1		0.18	17.50	0.11		
	3M0		0.12	18.94	0.08		
chilled vertical open	3H	RVC2	0.12	8.54	0.17	10.86	1.81
	3M2		0.59	10.40	1.02		
	3M1		0.18	12.30	0.36		
	3M0		0.12	13.31	0.26		
chilled roll-ins	3H	RVC3	0.33	11.13	0.13	12.31	0.44
	3M2		0.67	12.90	0.31		
frozen semivertical	3L3	RVF1	0.13	21.06	0.04	20.75	0.33
frozen vert glass door	3L1	RVF4	0.88	20.70	0.28		
closed vertical chilled	3H	RVC4	0.00	5.36	0.00	7.03	0.18
	3M2		0.17	6.50	0.03		
	3M1		0.50	6.90	0.09		
	3M0		0.33	7.50	0.06		
chilled serve over	3H		0.00	5.18	0.00	5.73	0.16
	3M2		0.59	5.60	0.09		
	3M1	RHC1	0.39	5.40	0.06		
frozen serveover	3L3	RHF1	0.02	16.00	0.01		
chilled horizontal open	3H		0.15	5.00	0.02	4.94	0.05
	3M2		0.15	4.70	0.02		
	3M1	RHC3, RHC4	0.05	5.50	0.01		
chilled horizontal closed	3H			3.91	0.00	4.23	0.02
	3M2		0.04	3.81	0.01		
	3M1	RHC5, RHC6	0.08	4.44	0.01		
frozen horizontal open	3L1		0.02	13.08	0.01	11.67	0.14
	3L2		0.08	12.21	0.04		
	3L3	RHF3, RHF4	0.22	11.34	0.09		
frozen horizontal closed	3L1		0.10	10.15	0.03	9.70	0.07
	3L2		0.08	9.48	0.03		
	3L3	RHF5, RHF6	0.03	8.80	0.01		
frozen combined open bottom	3L2		0.35	23.00	0.12	21.47	0.32
	3L3	RYF3	0.35	21.00	0.11		
frozen combined closed bottom	3L2		0.15	20.55	0.04		
	3L3	RYF4	0.15	19.90	0.04		
				TOTAL	4.01	TOTAL	4.02
						diff to non-sales	0.249%

INTEGRALS -SPLIT	Temp class	Main types	% Family	kwh/day m2	TWh/yr - 365d	kwh/day m2	TWh/yr - 365d
chilled semiverticals	3H		0.41	16.4	0.03	18.96	0.09
	3M2		0.41	20.0	0.04		
	3M1		0.12	21.9	0.01		
	3M0	IVC1	0.06	23.6	0.01		
chilled vertical open	3H		0.41	10.6	0.09	12.23	0.26
	3M2		0.41	12.9	0.11		
	3M1		0.12	14.1	0.04		
	3M0	IVC2	0.06	15.2	0.02		
chilled roll-ins	3H		0.67	12.4	0.04	13.30	0.06
	3M2	IVC3	0.33	15.1	0.02		
frozen semivertical	3L3	IVF1	0.01	26.5	0.00	26.08	0.15
frozen vert glass door	3L1	IVF4	0.99	26.1	0.15		
closed vertical chilled	3H		0.15	6.2	0.01	7.69	0.07
	3M2		0.31	7.5	0.02		
	3M1		0.46	8.1	0.03		
	3M0	IVC4	0.08	8.8	0.01		
chilled serve over	3H		0.15	6.4	0.01	7.00	0.06
	3M2		0.59	6.9	0.04		
	3M1	IHC1	0.24	6.7	0.01		
frozen serveover	3L3	IHF1	0.02	20.2	0.00		
chilled horizontal open	3H		0.15	4.1	0.02	4.27	0.06
	3M2		0.15	4.3	0.02		
	3M1	IHC3, IHC4	0.05	4.6	0.01		
chilled horizontal closed	3H		0.00	3.2	0.000	2.54	0.01
	3M2		0.04	2.4	0.004		
	3M1	IHC5, IHC6	0.08	2.6	0.01		
frozen horizontal open	3L1		0.02	17.2	0.02	19.30	0.29
	3L2		0.08	18.4	0.07		
	3L3	IHF3, IHF4	0.22	19.8	0.21		
frozen horizontal closed	3L1		0.10	9.8	0.04	10.30	0.10
	3L2		0.08	10.5	0.04		
	3L3	IHF5, IHF6	0.03	11.3	0.02		
frozen combined open bottom	3L2		0.35	20.7	0.013	19.51	0.04
	3L3	IYF3	0.35	21.4	0.014		
frozen combined closed bottom	3L2		0.15	15.7	0.004		
	3L3	IYF4	0.15	16.2	0.004		
				TOTAL	1.19	TOTAL	1.19
							0.213%

9.14.2. *System perspective*

In an average large distribution store in Central Europe, roughly 40-60% of energy is used for refrigeration, while 10-20% is used for air conditioning (HVAC). Some industry stakeholders have argued that retailer stores are complex systems with a variety of HVAC demands, and that a holistic approach is needed when developing ecodesign regulations. It is also known that remote refrigeration appliances help lower the average temperature of stores (especially when they are open), while plug-ins can contribute to increase it.

The need of having a holistic perspective is indeed justified, and is actually considered. These arguments have been discussed extensively with stakeholders in the TWG meetings and the CF. However, it is important to point out that having a holistic perspective does not limit the need to also propose requirements for the individual part of the system, as an efficient system can only be obtained if its different parts are also efficient. The following cases can be considered as generic examples:

	Plug-in	Remote
Effect on air conditioning (summer season in Europe, especially in Southern Europe)	Negative. Plug-ins are net heat releasers, so air conditioning is needed to compensate for this.	Positive. Remotes could contribute to cool down the stores, so less heating is needed. However, refrigeration appliances are less efficient in cooling the store than air conditioning systems. The commercialisation of inefficient cabinets to deliver this additional function is thus not justified.
Effect on heating (winter season in Europe, especially in Northern Europe)	Positive. Plug-ins are net heat releasers, so the heating need of the store is reduced. However, refrigeration appliances are less efficient in heating store air than air conditioning systems. The commercialisation of inefficient cabinets to deliver this additional function is thus not justified.	Negative. Remotes could contribute to cool down the stores, so heating is needed to compensate for this.

The table above offers a generic representation of the contributions, and serves to illustrate that each appliance type is optimised in design to deliver most efficiently their main function, that is, cabinets to refrigerate products for display, and HVAC systems to cool/heat the store air. In other words, an inefficient plug-in shall not be used to heat the store, because there is HVAC equipment that can deliver that function much more efficiently.

Moreover, the table above intends by no means to indicate which cabinets type (plug-in/remote) is most suited in each region or climate. As example, the negative effects that remote systems may have in winter or Northern climates is a minimal side-effect compared to the overall energy benefits that remote systems provide in stores compared to plug-ins (especially in the winter, as remotes work against the outdoor temperature and plugins against the higher in-store temperature).

The problem of space cooling in summer can be very important[56]. The figure below shows the evolution of humidity and temperature of a store over 21 days in summer. The

[56] Best Environmental Management Practice in the Retail Trade Sector. JRC-IPTS, Report EUR 25998 EN . 2013.

implementation of glass doors in the refrigeration equipment changes the water content in the store air and the humidity increases by about 20 %. This leads often to condensation over the glass panes and/or the products. The thermal balance of the store is also affected. The average temperature in the store also changes. The air conditioning system is then undersized.

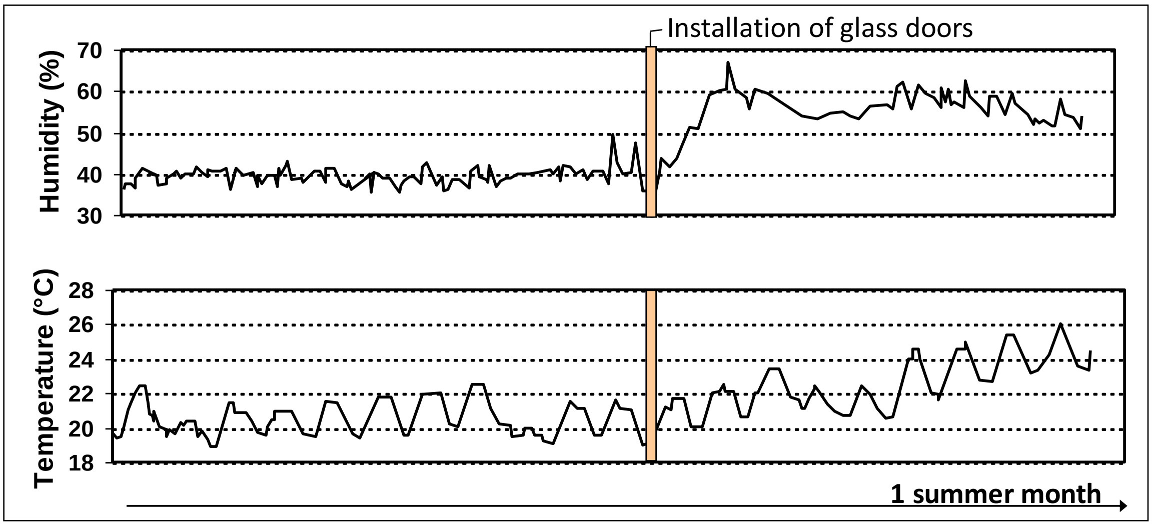


Figure 29 Humidity and temperature charts for a store in a 21-day period with and without glass doors in the refrigeration display cases. Source: footnote Error! Bookmark not defined.**.**

On top of the arguments above, it shall also be born in mind that the condensation pack of remote refrigeration systems and the HVAC system can be coupled (often in middle-sized retailers, less often in small shops or hypermarkets).

9.14.3. Plug-in versus remote

If measured according to the ISO 23953 standard, the energy consumption results will be similar between plug-in and remote supermarket cabinets. However, this is the result of a calculation, and it does not reflect real efficiency deifferences, meaning that energy consumption values of remotes shall only be compared with remotes, and not plugins, and viceversa.

In the impact analysis, remotes and plugins have been modelled independently, to allow for the possibility of introducing improvement options on only one of them, if this information is available. However, no such information has been recorded. It has only been assumed for testing purposes that remote supermarket cabinets, because of the lower flexibility of the systems they are integrated in, would have 2% less improvement potential than their plug-in counterparts.

9.14.4. System Frequency controllers

NGOs suggested in the CF of 2 July 2014 to request the introduction of system frequency controllers. Some manufacturers are familiar with the use of these devices, while others not. Thus, there may be large differences in the speed at which companies could in the future introduce the use of such appliances. Normally, companies also involved in manufacturing of professional cabinets have experience with testing these components, but for the management of demand peaks in the context of professional food processing and meal making environments such as kitchens. Nevertheless, the conclusions from the interviews held with manufacturers is that the use of these controllers in commercial appliances to protect the energy network is not yet much known by manufacturers.

9.14.5. Assumptions for retrofitting initiatives for retailers- Door installation

Payback time is reported as the key element in the decision-making process of retrofitting for energy saving. Generally, retailers do not accept payback times higher than 3 years for energy saving measures. The JRC's EMAS best practice report for the retail sector**Error! Bookmark not defined.** analysed the average cost-benefit curves for door retrofitting, as reproduced in the figure below:

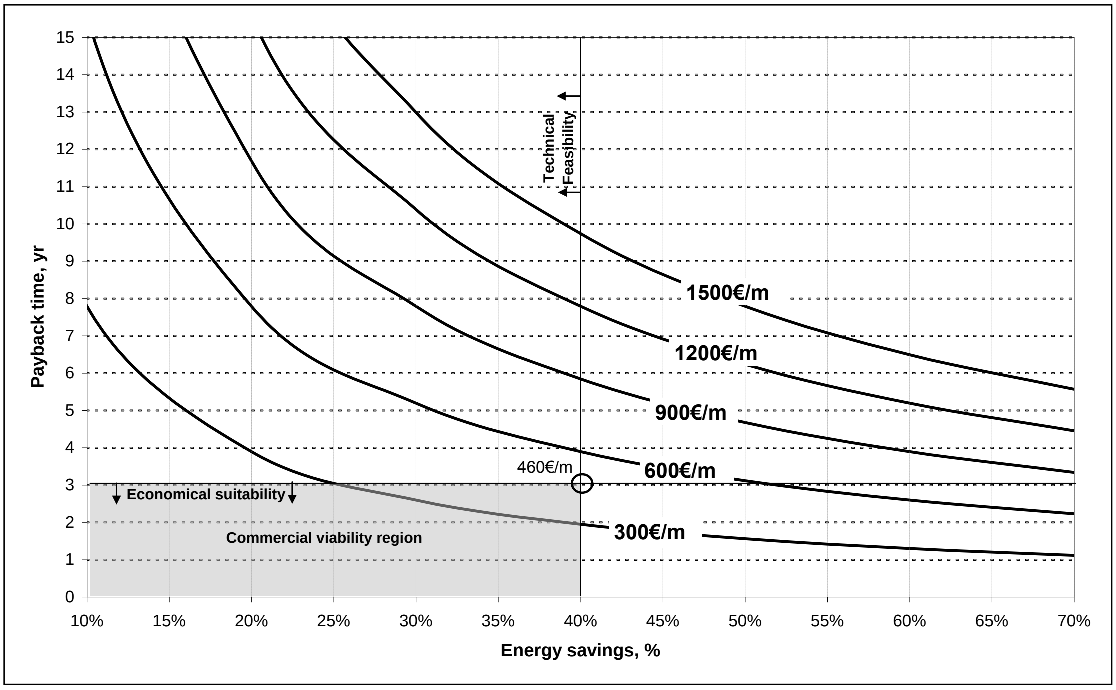


Figure 30 Payback time vs. energy savings for several retrofitting costs with glass lids on vertical open refrigeration cabinets. Source: footnote Error! Bookmark not defined.

Payback time is low when energy savings are high, but there is a limit for the technical feasibility of the energy savings. Retailers report 40 % as the highest saving feasible. In order to target a 3 years payback time, the cost for retrofitting has to be approximately lower than EUR 460 per metre of retrofitted open display case.

Some retailers look further ahead. The best energy performance makes the company ready for future energy prices. Retailers can improve their reputation through CO_2 savings. Also, fulfilment and going beyond future legal requirements is an important issue, as extra costs and resources can be derived from the lack of preparation to more restrictive regulations.

9.14.6. Refrigerant leakage

The direct emissions related to refrigerant leakage for the base cases has been estimated, using the assumptions in Table 33.

Table 33 Assumptions for calculating the direct emissions of the base cases related to refrigerant leakage.

Base case	**GWP kg CO_2/kg** (avg. refrigerant mix, source: VHK/BIO IS)	charge in kg	loss in %/a	kgCO_2/ a
RVC2	2280	20	8.5%	3876
RHF4	2280	20	8.5%	3876
Beverage Cooler	1300	0.32	4.5%	19
Small ice-cream freezer	2550	0.22	4.5%	25
Vending machine	1300	0.55	4.0%	28

These assumptions, together with the stock figures, would result in the total emissions provided in Table 34.

Table 34 Direct CO_2 emissions related to the base cases

	GWP emissions ($MtCO_2$/a)		
Base case	**2010**	**2020**	**2030**
RVC2	3.33	3.44	3.51
RHF4	0.35	0.36	0.37
Beverage Cooler	0.13	0.14	0.15
Small ice-cream freezer	0.08	0.08	0.09
Vending machine	0.04	0.04	0.04
Total	3.93	4.06	4.15

These figures are conservative, as the highest GWP values of refrigerants in the market have been used. However, the leakage percentages are directly extracted from VHK(2014) and BIOIS (2007).

The preparatory study for the update of the F-gas regulation estimates also the HFC emissions of commercial refrigeration, as shown in . This study estimates total annual emissions of about 20 Mt CO_2 eq. The differences to the estimations above are due to differences in assumptions of stocks, lifetime, leakage rates, GWP values of the stocks, and collection rates in EoL. After reductions in 2010-2015, constant long term levels for HFC emissions are projected.

9.15. Annex XV. EoL requirements considerations

The following sections analyse the economic, environmental and social impacts related to two requirements on EoL: design for recycling of appliances (also called 'DfR requirement') and marking of the blowing agent(s) used into insulations (also called 'Blowing agent requirement'). This analysis is based on the findings of the preparatory study and on discussions with stakeholders.

9.15.1. Economic impact

Impact on Design / Manufacturing

The DfR requirement will stimulate designers to systematically address dismantlability criteria during the design process of newer devices.

The design activities and provision of documentation (and hence associated costs) might be slightly impacted by the DfR requirement. However, this requirement does not imply major technological changes in the design of the products but rather imply rationalisation of the design and of the assembly. Moreover, the requirement is mainly an 'information requirement' and it requires manufacturers to arrange in a structured way information already available at the design stage of the product. The aspects of the requirement related to the absence of gluing/welding fastening techniques can be addressed at the design stage as any other design objectives and therefore efforts and costs related to this are judged as small.

Confidentiality issues related to this provision of information are judged as not very relevant, since the requested information is not classified as technologically sensitive.

Regarding the blowing agent, standard CEN 60335 describes the marking of flammable insulation blowing agent used in these appliances. In particular the standard established that the marking shall declare the chemical name of the principal component of the insulation blowing agent(s) and should include the related risk sign.

Although some manufacturers declared that they are already applying the marking of blowing agent(s), this is still done on a voluntary basis. The generalisation of this practice to all appliances thanks to the requirement could imply some additional efforts/costs for some manufacturers. However, according to some interviewed manufacturers, these additional costs are judged as very small.

Annex XII of the Preparatory Study for Ecodesign of commercial refrigeration proposes a template for the marking of the blowing agent. The marking has been formulated closely looking at the standard CEN 60335, and at examples of labels already developed and applied by manufacturers. This type of marking would be also easily checked by market surveillance authorities (MSA).

Impact on EoL treatment / recycling

The requirement for the DfR of the appliances is in line with the European policy on "Tackling the challenges in commodity markets and on raw materials[57]" and in line with the Critical Raw Materials (CRM) initiative[58]. The requirement, in fact, focused the attention on target components which are also containing several critical raw materials. Those materials are generally contained in small amounts and therefore they would be dispersed in the various waste flows when treated by unsorted shredding. A proper DfR of these target components

[57] COM(2011) 25 final

[58] DG Enterprise. Report on critical raw materials for the EU. Report of the Ad hoc Working Group on defining critical raw materials. May 201.

would allow their extraction and separation from other waste during the pre-processing and would allow their appropriate allocation to selective treatments for the recovery of CRM.

The DfR requirement will support/improve pre-processing at the recycling facilities and it will increase the efficiency and productivity of recycling processes. It will also contribute to increase the profitability of recycling processes, due to reduction of the time and costs for pre-processing at the recycling facilities.

The blowing agent requirement will help recyclers to sort and allocate the waste equipment to the proper treatment line, increasing the efficiency of the processes (e.g. dosing properly the nitrogen in the shredders) and reducing costs for processing.

Impact on Market Surveillance Authorities (MSA)

Due to the novelty of this DfR requirement, its enforcement and verification could initially cause some difficulties for the manufacturers and MSA, mainly related to the provision and assessment of the requested technical documentation (e.g. sketches on the location of target components to be dismantled; sequence and descriptions of the dismantling operations and fastening techniques)[59]. On such purpose, some industrial standards do already exist[60] and propose some templates for the communication of information. In addition, some manufacturers already voluntary implemented this requirement in their design and already provided the required documentation. All these experiences could be used to build a common template to communicate relevant information to standardized in the near future (e.g. in the context of the mandate to CEN/CENELEC concerning material efficiency), and using other on-going standardisation processes (e.g. WEEELabex project[61]).

The verification of the correctness of the documentation on the EoL requirements and on the absence of gluing/welding fastening techniques for the dismantling of key components might require in the future the development of new skills by MSA. Contacts with several MSA show that such verification is technically feasible, and that checks could be done during inspections of products (without needing to purchase the product).

Therefore, it is estimated that the difficulties mentioned above about application of this requirement will decrease with time, once the requirement will be enforced and common practises will be established.

With respect to the declaration of the blowing agent(s), the verification of correctness might also need the development of additional skills by MSA. Contacts with several MSA show that such verification is technically feasible, and might imply the need to cooperate with other agencies.

Both the EoL requirements have been formulated so that relevant information is available on the product, on the booklet or on a free-access website, allowing relevant stakeholders (MSA, recyclers, purchasers interested in the performances of the products) to have easy access to it.

Discussions with several Market Surveillances authorities show that they welcome both the EoL requirements because of their perceived potential effectiveness, with still limited administrative burdens for manufacturers and MSA.

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59 See Annex II, section 2.(a) (viii) of the draft regulation

60 For example, the IEC TR 62635 'Guidelines for End of Life information provision from manufacturers and recyclers' (2011).

61 WEEElabex project aims at building a set of standards with respect to the collection, sorting, storage, transportation, preparation for re-use, treatment, processing and disposal of all kinds of WEEE (http://www.weeelabex.org/).

In conclusion, the proposed EoL requirements will not have significant impact on the competitiveness of industry, will not imply additional costs for the consumers, will not drastically increase administrative burdens in particular for manufacturers and Member States, while they should slightly increase the competiveness of the recycling industry.

9.15.2. Environmental Impacts

As highlighted by the Roadmap to a Resource Efficient Europe[62], sustainable consumption and production should be further promoted through the "setting requirements under the Ecodesign directive, to boost the material resource efficiency of products (e.g. reusability/recoverability/recyclability). The DfR requirement has been developed for such purpose. This will grant that newer designed products will be suitable with the treatments foreseen in the waste legislation. A better design for recycling of the appliance allows larger amounts of recycled / recovered materials with a higher quantity and quality of recyclates. This requirement will be in line with the European Flagship initiative under the Europe 2020 Strategy[63], since "increasing recycling rates will reduce the pressure on demand for primary raw materials, help to reuse valuable materials which would otherwise be wasted, and reduce energy consumption and greenhouse gas emissions from extraction and processing".

Moreover the DfR requirement will contribute to improve coherence between Ecodesign Directive and WEEE Directive[64]. In particular it will facilitate the proper treatment of some target components in the waste appliances, avoiding that hazardous substances potentially contained by them would be dispersed in the waste flows. Both the requirements on EoL represents a novelty in the European product policies: they imply the provision of some structured information, which is going beyond the generic information requirements on EoL as enforced in the implementing measures of other products[65]..

The DfR requirement will improve the efficiency of the treatment / recycling processes, and avoid significant losses of scarce, precious and critical materials. Due to the large variability of the appliances and the different content of materials, it was not possible to estimate the additional amount of recycled materials that could be obtained through the enforcement of this requirement. However, studies performed on other product groups proved that a manual extraction of key components (thanks to 'DfR') can raise up to 90% the recycling rate of several scarce, precious and other relevant materials, compared to a recovery of 11-25% if shredding is applied [66].

Also the blowing agent requirement will contribute to the improvement of resource efficiency of the recycling treatments: it will help recyclers to preventively sort the waste appliances and allocate to the proper treatment line, increasing the efficiency of the processes (e.g. dosing properly the nitrogen in the shredders) and improve the efficiency of recycling /recovery.

Besides the significant environmental benefits for the EoL treatment / recycling described above, the EoL requirements will not have any negative environmental impact.

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62 COM(2011) 571

63 COM(2011) 21

64 On such purposes it is mentioned the need of strengthening the synergies among these two policies, as highlighted is the WEEE Directive (as in recital n. 11 and articles 4 and 15) and the Ecodesign Directive (as in recital 35).

65 For example the product information requirements as set for circulators (Commission Regulation n. 641/2009), and for electric motors (Commission Regulation n. 640/2009),

66 Ardente, F., Mathieux, F. Identification and assessment of product's measures to improve resource efficiency: the case-study of an Energy using Product. Journal of Cleaner Production (83) 2014: pp 126–141.

9.15.3. *Social impacts*

The blowing agent requirement has been specifically designed to preventively inform recyclers about the content of potentially dangerous substances, especially flammable substances. As shown in the preparatory study following analysis of real practices, due to the risk of explosion, nitrogen is inflated in the shredding chamber during the treatments[67]. As the type and amounts of blowing agent is generally not known before shredding, nitrogen is generally overdosed to avoid possible explosions. The proposed marking would allow recyclers to plan and implement the appropriate safety procedures concerning the reduction of the risk of fire/explosions, and optimizing the efficiency of treatments for the recovery of blowing agents.

The CEN 60335 establishes that, for appliances which use flammable blowing agents in the insulation, recommendations regarding the treatment and/or disposal of the appliance insulation shall be included in the instruction booklet.

The marking of blowing agent(s) has been already applied by some manufacturers in compliance with the CEN 60335. However this is not systematically done for all appliances in the market and, furthermore, some refrigerated commercial display cabinets are specifically excluded from the scope of the CEN 60335. The enforcement of such requirement of the labelling through ecodesign cabinets to be WEEE compliant.

The blowing agent requirement will also allow to monitor the use of blowing agent(s) in the products and to support/document possible future measures (e.g. on restriction of potentially dangerous blowing agents).

The DfR requirement will also facilitate the dismantling of dangerous components, therefore reducing safety risks for workers during the pre-processing of waste (e.g. the risk of contact with hazardous substances, or the risk related to the breakage of components during the treatment).

67 Potential risks associated to the use of flammable hydrocarbons as blowing agents have been highlighted by the UK Environment Agency in the study "Flammability of fridge insulation foam produced with a hydrocarbon blowing agent" (December 2012).

9.16. Annex XVI: Acronyms and abbreviations

B2B	Business to Business
BAT	Best Available Technology
BAU	Business As Usual
BC	Beverage Cooler
BIO IS	BIO Intelligence Service
CEN/TC	European Committee for Standardization/Technical Committee
CLASP	Collaborative Labeling and Appliance Standards Program
COP	Coefficient Of Performance
DG	Directorate General
ECA	Enhanced Capital Allowance
ED	Ecodesign Directive
EEE	Electrical and Electronic Equipment
EEI	Energy Efficiency Index
EMD	Energy Management Device
EoL	End Of Life
ErP	Energy-related Product
EVA	European Vending Association
EVA-EMP	European Vending Association - Energy Measurement Protocol
GWP	Global Warming Potential
HC	HydroCarbon
HFC	HydroFluoroCarbon
HS/CN reference	Harmonized System/Combined Nomenclature
ICF	Ice-Cream Freezer
IEC	International Electrotechnical Commission

IES	Institute for Environment and Sustainability
IPTS	Institute for Prospective Technological Studies
IA	Impact Assessment
IAB	Impact Assessment Board
ISO	Organisation internationale de normalisation (International Organization for Standardization)
JRC	Joint Research Centre
LCA	Life Cycle Analysis
LCC	Life Cycle Cost
LLCC	Least Life Cycle Cost
LED	Light Emitting Diode
MEErP	Methodology for the Ecodesign of Energy-related Products
MEPS	Minimum Energy Performance Standard
RDC	Refrigerated Display Cabinet
REC	Refrigeration Electrical energy Consumption
RH	Relative Humidity
RHF4	Remote, open island freezer
RoHS	Restriction of Hazardous Substances
RVC2	Remote, chilled, open multideck
TDA	Total Display Area
TEC	Total Energy Consumption
TWG	Technical Working Group
UK	United Kingdom
US	United States
VM	Vending Machine
WEEE	Waste Electrical and Electronic Equipment

9.17. Annex XVII: Consultation of the RSB

The present impact assessment report was submitted to the Regulatory Scrutiny Board (RSB) on 20/05/2015. Following a meeting on 15 July 2015, the RSB delivered a positive opinion[68] and recommended to improve some aspects. The table below shows how those recommendations are addressed in this revised impact assessment report.

RSB Opinion 15.07.2015	**Where and how the comments have been taken into account**
(1) The expected energy savings from this particular initiative should be compared to the energy savings that have been delivered by the regulation of other products in order to gauge their relative significance.	Section 7 is expanded accordingly.
(2) The characterisation of the market should be better explained and the different positions and roles of cabinet suppliers, cabinet purchasers and cabinet leasers/takers including their relative size and market power/positions. This should be complemented with: (a) more evidence as to why market failures exist and why professional users are myopic regarding energy use in their business to business dealings and a clearer explanation of how the proposed measures would address such issues; (b) relevant experience from other jurisdictions where regulation of commercial refrigerated cabinets already exists.	For (a): explanations are added in Sections 3.3.3 and in the Sections that present the scenarios (namely Sections 5.5. 5.6, 5.7 and 5.8). A new Section 3.3.6 is added. For (b): see Annex 9.3.
(3) The report should clarify that the "ecodesign" measures will not oblige consumers to replace prematurely their existing refrigerated cabinets. In addition, the impacts for affected parties need to be better explained for the various actors in the chain and for SMEs in particular who may be hardest hit by increases in the cost of a new refrigerated cabinet. In particular, the expected impacts on prices of new cabinets should be better explained and the report clarified regarding any mitigation measures for SMEs.	Clarification is added in Section 6 and 6.3.1.
(4) The report should further differentiate views between different stakeholder groups/subgroups (e.g. large/small retailers) and explain if SMEs were consulted.	Section 6.1.4 is expanded. See also Annex 9.1.

68 Ref. Ares(2015)3021016 - 17/07/2015