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IMPACT ASSESSMENT

Accompanying the document

COMMISSION REGULATION (EU) .../... laying down ecodesign requirements for refrigerating appliances pursuant to Directive 2009/125/EC of the European Parliament and of the Council

and repealing Commission Regulation (EC) No 643/2009

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

and repealing Commission Delegated Regulation (EU) No 1060/2010

{C(2019) 1806 final} - {C(2019) 2120 final} - {SEC(2019) 333 final} -
{SWD(2019) 342 final}

Table of contents

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

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

This impact assessment relates to the review of Commission Regulation (EC) No 643/2009[1] on the ecodesign requirements for household refrigerating appliances and Commission Delegated Regulation (EU) No 1060/2010[2] on the energy labelling requirements for household refrigerating appliances.

1.1. Benefits of Ecodesign and Energy Labelling

Ecodesign and energy labelling are ***recognised globally*** *as one of the most effective policy tools in the area of energy efficiency. They are central to making Europe more energy efficient, contributing in particular to the 'Energy Union Framework Strategy'*[3]*, and to the priority of a 'Deeper and fairer internal market with a strengthened industrial base'*[4]*. Firstly, this legislative framework pushes industry to improve the energy efficiency of products and removes the worst-performing ones from the market. Secondly, it helps consumers and companies to reduce their energy bills. In the industrial and services sectors, this results in support to competitiveness and innovation. Thirdly, it ensures that manufacturers and importers responsible for placing products on the European Union* (EU) *market only have to comply with a single* EU*-wide set of rules.*

It is estimated that by 2020, ecodesign and energy labelling regulations will deliver around 175 Mtoe (i.e. about 2035 TWh) of energy savings per year in primary energy in comparison to if there were no measures in place. This is roughly equivalent to Italy's energy consumption in 2010, close to half the EU *20 % energy efficiency target by 2020 and about 11 % of the expected* EU *primary energy consumption in 2020*[5].

The average household will invest in more expensive and efficient products, but in return saves about € 500 annually on its energy bills by 2020. Although the cost for industry, service and wholesale and retail sectors will increase, it will result in EUR 55 billion per year of extra revenue by 2020.

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1 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, OJ L 191, 23.7.2009, p. 53–68. (ecodesign regulation)

2 Commission Delegated Regulation (EU) No 1060/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household refrigerating appliances, OJ L 314, 30.11.2010, p. 17–46. (energy labelling regulation)

3 Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee, The Committee Of The Regions And The European Investment Bank - A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy. COM/2015/080 final. (Energy Union Framework Strategy)

4 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Upgrading the Single Market: more opportunities for people and business COM/2015/550 final. 28 October 2015. (Deeper and fairer internal market)

5 Ecodesign impact accounting – Overview report for the European Commission DG Energy, VHK December 2016 (Ecodesign Impact Accounting 2016)

*This legislative framework benefits from **broad support** from European industries, consumers, environmental non-governmental organisations (NGOs) and Member States (MSs), because of its positive effects on innovation, increased information for consumers and lower costs, as well as environmental benefits.*

Household refrigerating appliances have been subject to EU energy labelling measures since 1995 and minimum energy efficiency requirements since 1999. Since then, the energy consumption and carbon emissions have reduced with more than 60% compared to business as usual (BAU), the administrative burden has been modest and market actors are positive on the impact of these instruments on the market[6].

1.2. Legal framework

*In the EU, the **Ecodesign Framework Directive**[7] sets a framework requiring manufacturers of energy-related products to improve the environmental performance of their products by meeting minimum energy efficiency requirements, as well as other environmental criteria such as water consumption, emission levels or minimum durability of certain components before they can place their products on the market.*

*The **Energy Labelling Framework Regulation**[8] complements the Ecodesign Framework Directive by enabling end-consumers to identify the better-performing energy-related products, via an A-G/green-to-red scale[9]. The energy label is recognised and used by 85% of Europeans[10].*

*The legislative framework builds upon the **combined effect** of the two aforementioned pieces of legislation. See Figure 1 for a visualisation of this effect.*

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6 Impact Assessment report for the revision of household refrigerating appliances. VHK March 2018. (Impact Assessment Study 2018)

7 Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products. OJ L OJ L 285, 31.10.2009, p. 10 (Ecodesign Framework Directive)

8 Regulation (EU) 2017/1369 of the European Parliament and of the council of 4 July 2017 setting a framework for energy labelling and repealing Directive 2010/30/EU. OJ L 198, 28.7.2017, p. 1 (Energy Labelling Framework Regulation)

9 Under the old Energy Labelling Framework Directive 2010/30/EU, energy labels were allowed to include A+ to A+++ classes, the new framework regulation requires a rescaling of existing energy labels, back to the original A to G scale (See also Section 1.3).

10 Study on the impact of the energy label – and potential changes to it – on consumer understanding and on purchase decisions - . LE London Economics and IPSOS, October 2014

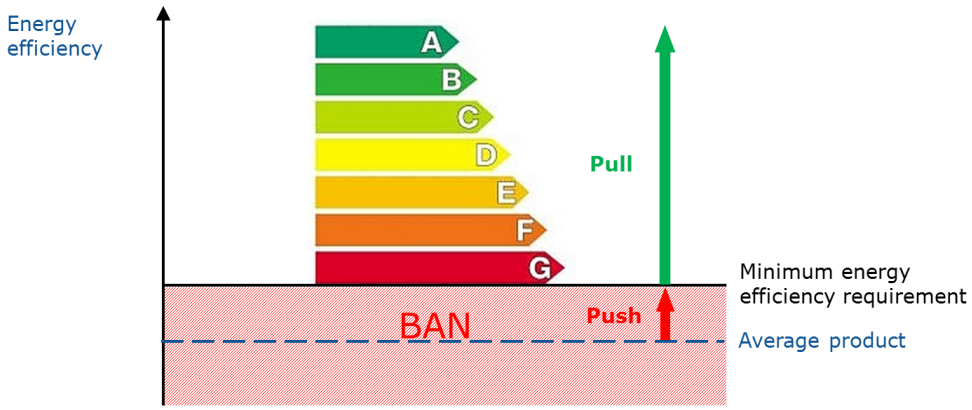

Figure 1: Synergetic effect Ecodesign and energy labelling

For those consumers that do not use the energy label to select a product and for consumers in a tenant-landlord situation (where the landlord buys the refrigerating appliance and the tenant pays the bill), ecodesign requirements are important, as it safeguards consumers from the worst performing products.

The Ecodesign framework Directive and the Energy Labelling framework Regulation are implemented through product-specific implementing and delegated regulations. To be covered, the energy-related products must (i) represent a significant volume of sales (more than 200000 units a year), (ii) have a significant environmental impact within the EU *and (iii) represent a significant energy improvement potential without increasing the cost excessively, see also Article 15.2 of the Ecodesign Framework Directive.*

As an alternative to the mandatory ecodesign requirements, voluntary agreements or other self-regulation measures can be presented by the industry, see also Article 17 of the Ecodesign Framework Directive. If certain criteria are met the Commission formally recognises these voluntary agreements[11]*. The benefits are a quicker and more cost-effective implementation, which can be more flexible and easier to adapt to technological developments and market sensitivities*

For more details about the legal framework, including a full list ecodesign and energy labelling measures, see Annex 7.

Under this framework, **household refrigerating appliances are regulated by Commission Ecodesign Regulation (EC) No 643/2009** and **Commission Delegated Energy Labelling Regulation (EU) No 1060/2010**. The scope of these measures are:

- household refrigerating appliances with a volume smaller than or equal to 1500 l (including wine storage appliances and mini-bars).

Included in the scope are also:

- household refrigerating appliances sold for non-household use, e.g. chest freezers, or for the refrigeration of items other than foodstuffs, e.g. refrigerating appliances used for storage of medicine;
- electric mains-operated household refrigerating appliances that can be battery-

[11] Commission Recommendation (EU) 2016/2125 of 30 November 2016 on guidelines for self-regulation measures concluded by industry under Directive 2009/125/EC of the European Parliament and of the Council; OJ L 329, 3.12.2016, p.109

operated, e.g. mini fridges that can be powered by electricity from the gird or by battery.

The EU Ecolabelling Regulation (Regulation (EC) 66/2010[12]) complements ecodesign and energy labelling. It is a voluntary scheme that awards products with the best environmental performance throughout their lifecycle. Products that fulfil the criteria can bear the EU ecolabel, see Figure 2.

Since 2011, household refrigerating appliances are no longer covered by the Ecolabelling Regulation[13], because the ecolabel did not bring clear benefits in comparison to the energy label.

An overview of existing policies, legislations and standards affecting household refrigerating appliances in the EU and outside is given in Annex 8.

Figure 2: The EU Ecolabel

1.3. Legal context of the reviews

Article 7 of the **Ecodesign and Energy Labelling Regulations for household refrigerators** requires both regulations to be reviewed in the light of technological progress no later than five years after their entry into force. This review should in particular assess the verification tolerances of Annex V and the possibilities for removing or reducing the values of the correction factors of Annex IV.

Moreover, the **Ecodesign working plan 2016-2019**[14] also includes the review of both regulations, requiring in particular to examine how aspects relevant to the circular economy can be assessed and taken on board. This is in line with the Circular Economy Initiative[15], which concluded that product design is a key in achieving the goals, as it can have significant impacts across the product life cycle (e.g. in making a product more durable, easier to repair, reuse or recycle).

Finally, in August 2017, the new Energy Labelling framework Regulation (EU) 2017/1369 entered into force, repealing Directive 2010/30/EU[16]. Under the repealed Directive, energy labels were allowed to include A+ to A+++ classes to address the

[12] Regulation (EC) No 66/2010 of the European Parliament and of the Council of 25 November 2009 on the EU Ecolabel. OJ L 27, 30.1.2010, p. 1 (EU Ecolabel Regulations)

[13] http://ec.europa.eu/environment/archives/ecolabel/product/pg_refrigerators_en.htm

[14] Communication from the Commission Ecodesign Working Plan. COM(2016) 773 final, Brussels, 30 November 2016. (Ecodesign Working Plan 2016-2019)

[15] Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions Closing The Loop - An EU Action Plan For The Circular Economy (Circular Economy Initiative)

[16] Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products. OJ L 153, 18.6.2010, p. 1.

overpopulation of the top classes. Over time, due to technological development, also the A+ to A+++ class became overpopulated, thereby reducing the effectiveness of the labels significantly. To resolve this, the new framework regulation requires a rescaling of existing energy labels, back to the original A to G scale. Article 11 of the Energy Labelling framework Regulation lists 5 priority product groups for which new delegated acts with rescaled energy labels must be adopted at the latest on 2 November 2018. Household refrigerating appliances *is one of the priority product groups.*

1.4. Political Context

Several new policy initiatives indicate that ecodesign and energy labelling policies are relevant in a broader political context. The main ones are the ***Energy Union Framework Strategy,*** *which calls for a sustainable, low-carbon and climate-friendly economy, the* ***Paris Agreement***[17]*, which calls for a renewed effort in carbon emission abatement, the* ***Gothenburg Protocol***[18]*, which aims at controlling air pollution, the* ***Circular Economy Initiative***[19]*, which amongst others stresses the need to include reparability, recyclability and durability in ecodesign, the* ***Emissions Trading Scheme*** *(ETS)*[20]*, aiming at cost-effective greenhouse gas (GHG) emissions reductions and indirectly affected by the energy consumption of the electricity using products in the scope of ecodesign and energy labelling policies, and the* ***Energy Security Strategy***[21]*, which sets out a strategy to ensure a stable and abundant supply of energy.*

2. PROBLEM DEFINITION

2.1. Problem 1: Outdated energy efficiency requirements

The problem: The current ecodesign requirements for household refrigerating appliances **no longer capture cost-effective energy savings**, and the current energy label **no longer allows consumers to effectively differentiate** sufficiently between the appliances on the market.

Since the entry into force of the current Ecodesign and Energy Labelling Regulations in 2009 and 2010 respectively, the energy efficiency of household refrigerating appliances has increased significantly. In the period 2010-2015, the average energy use of a household refrigerating appliance decreased from 242 kWh/a to 201 kWh/a[22] (see also Annex 12.2). Today, they can easily[23] achieve the existing ecodesign limits and all models reside in the top 3 classes of the energy label.

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17 Global agreement in response to climate change of 2015 (Paris Agreement)

18 Protocol to abate acidification, eutrophication and ground-level ozone of 1999 (Gothenburg Protocol)

19 Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions Closing The Loop - An EU Action Plan For The Circular Economy (Circular Economy Initiative)

20 https://ec.europa.eu/clima/policies/ets_en (ETS)

21 Communication of the commission to the European Parliament and the Council European Security Strategy. Com/2014/0330 final.

22 Impact Assessment report for the revision of household refrigerating appliances. VHK March 2018. (Impact Assessment Study 2018)

23 In 2016, the base case (the average product in the market) had an Energy Efficiency Index (EEI) of 36 compared to the maximum allowed EEI of 42.

The total electricity consumption of EU household refrigeration appliances decreased significantly from 120 TWh/a in 2005 to 86 TWh/a in 2015 (40 %)[24]. This decrease happened notwithstanding the fact that the net volume of refrigerating appliances increased with 1.2 % per year and number of refrigerating appliances in the market has increased from 291.4 million units in 2005 to 303.2 million units in 2015 (4% increase).

Despite the reduction in energy consumption, refrigeration appliances are still one of the largest electricity consumers in households (after electric water heaters and lighting, but before televisions, electric ovens, washing machines, dishwashers, etc.), see also Figure 3.

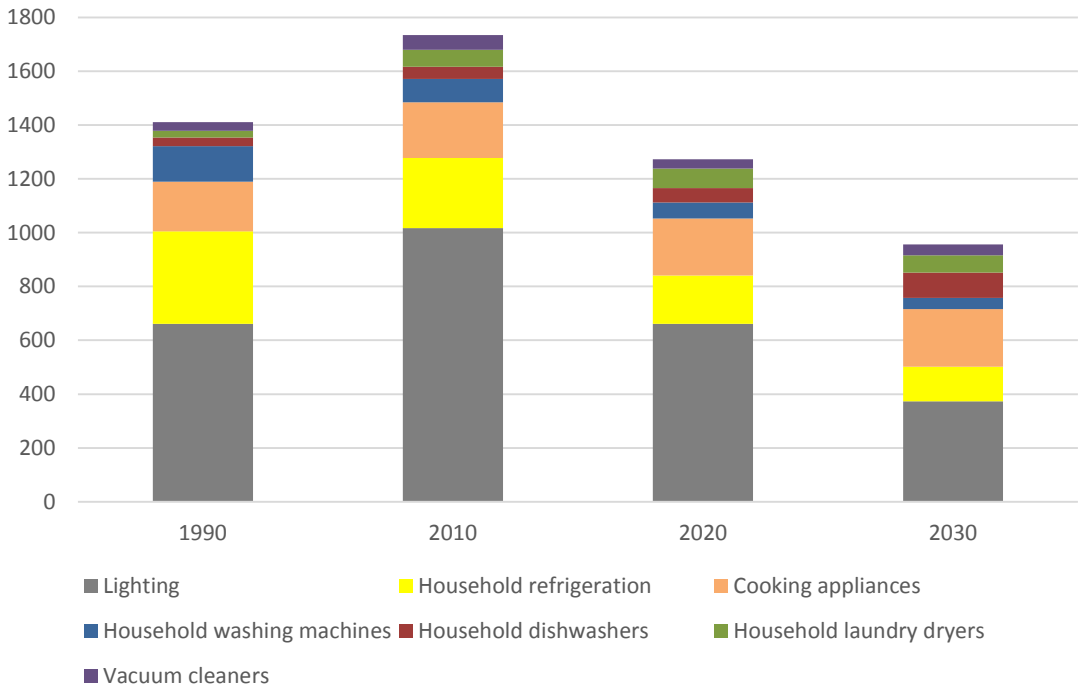

Figure 3: The energy consumption of household appliances versus other household appliances and lighting (Ecodesign Impact Accounting 2016)[25]

The energy consumption of refrigerating appliances in comparison to the other ecodesign regulated products is shown in Figure 4.

In 2009, it was projected that the electricity consumption of household refrigeration appliances in a BAU scenario in 2030 would decrease to 57 TWh/a, assuming that the regulations are at least periodically updated, to ensure their effectiveness.

The 2016 Review study suggested that the electricity consumption of household refrigerating appliances could further decrease by an additional 10 TWh/a in 2030 to a level of 47 TWh/a by setting the Ecodesign requirements at the level of the Least Life Cycle Cost (LLCC).

[24] Preparatory/review study on Commission Regulation (EC) No. 643/2009 and Commission Delegated Regulation (EU) No. 1060/2010, Final report. VHK, March 2016. (Review Study 2016)

[25] The figure shows the ECO scenario, which is derived from the policy scenarios that come closest to the existing measures.

Without an update of the energy label and ecodesign measures, they will lose their effectiveness. In addition, the search cost for energy conscious consumers will increase and the incentives for the industry to develop more energy-saving products will be lower.

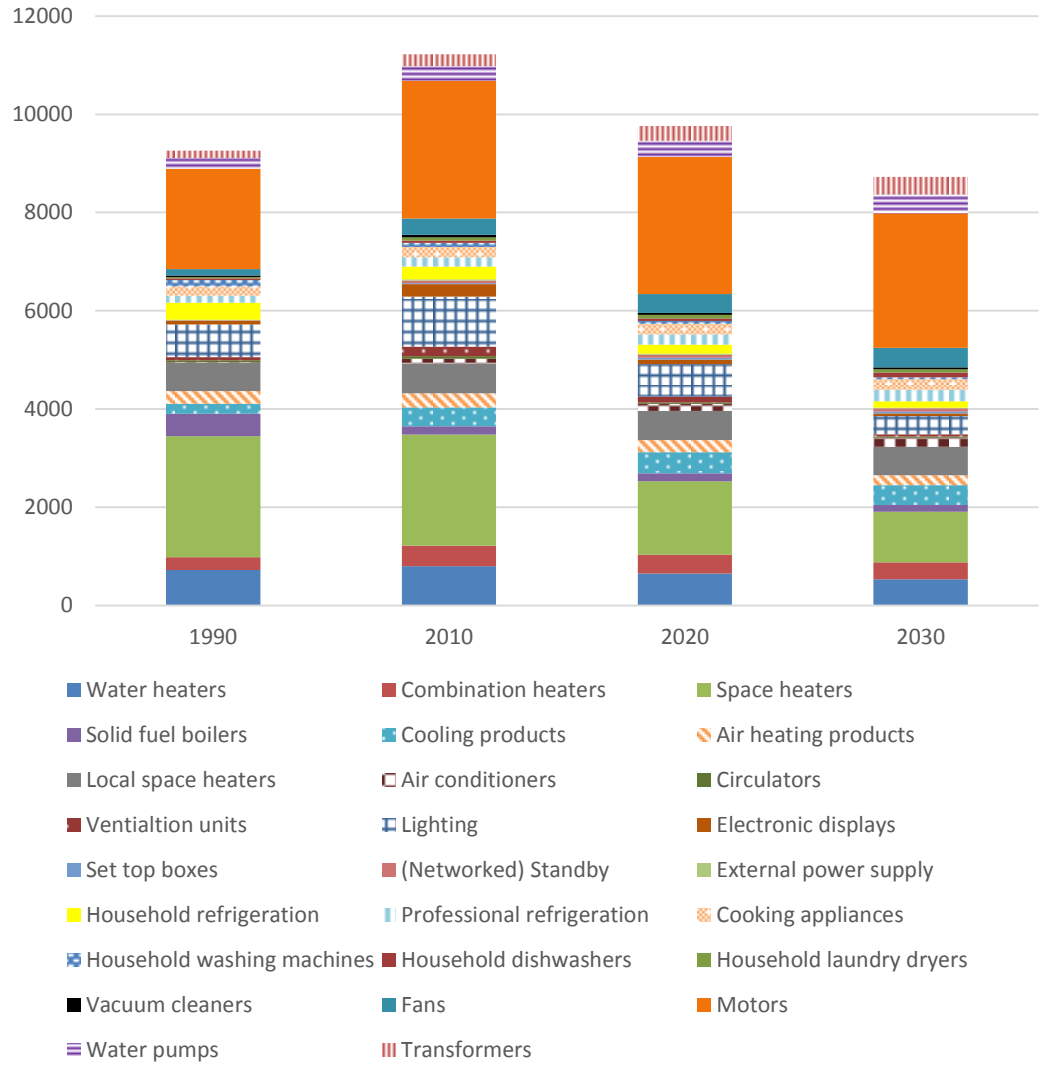

Figure 4: The energy consumption of household appliances versus all ecodesign regulated products (Ecodesign Impact Accounting 2016)[26]

The drivers of the problem:

Problem driver 1: Technological progress - Technology for household refrigerating appliances keeps evolving, thereby improving energy efficiency. At the time of entry into force, no models qualified for the A+++ energy efficiency class and the share of models qualifying for the A++ energy efficiency class was less than 10%. Today, the top 3 energy efficiency classes are overpopulated, with the share of models in the A+++ label being more than 11 %, and more than 40 % in the A++ class[27]. This makes it more difficult to distinguish between models. Moreover, the "A+", "A++" and "A+++" classes

[26] The figure shows the ECO scenario, which is derived from the policy scenarios that come closest to the existing measures.

[27] Home Appliances Europe, formerly CECED (APPLiA) database 2016

introduced by the Energy Labelling Framework Directive (Directive 2010/30/EU)[28] have shown to be less effective in persuading consumers to buy more efficient products than the A to G scale.[29]

Problem driver 2: Outdated calculations - The existing energy efficiency calculations do not or no longer properly account for the real-life performance of modern refrigerating appliances. This is because some of the correction factors used in the metrics are outdated, others are used as loopholes and several cloud the real energy efficiency of the appliances.

Problem driver 3: New global standard - A new International Electrotechnical Commission (IEC) standard for household refrigerating appliances, IEC 62552:2015, was published in 2015. This standard aims to be universally applicable, more efficient, more accurate and more reliable than the one currently used in the regulations, and the requirements applicable to products sold in the EU should be updated to take this new standard into account.

2.2. Problem 2: Poor 'Circular Economy' performance

The problem: The current Ecodesign and Energy Labelling Regulations lack requirements that contribute to Circular Economy objectives, such as for **reparability**, **recyclability** and **food waste prevention.** The existing requirements focus mainly on energy efficiency improvements as the most significant environmental impact during the life-cycle of household refrigerating appliances.

Better design can make products more durable or easier to repair, upgrade or remanufacture. It can help recyclers to disassemble products in order to recover valuable materials and components. Overall, it saves resources. The current market signals appear insufficient to make this happen, in particular because the interests of producers, users and recyclers are not aligned. In addition, reparability can be important to consumers, and products can contain valuable materials that should be made easier to recycle (e.g. rare earth elements in electronic devices). It is therefore essential to provide incentives for improved product design, while preserving the single market and competition, and enabling innovation through Ecodesign.

Improved reparability will maintain or extend the useful product life, but can also contribute to the product's energy efficiency throughout its life.

It should however be noted that for refrigerating appliances the impact of the energy consumption is still the largest environmental impact with still enough potential for improvement.

[28] Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products. OJ L 153, 18.6.2010, p. 1. (Energy Labelling Framework Directive)

[29] Commission Staff Working Document Impact Assessment Accompanying the document Proposal for a Regulation of the European Parliament and of the Council setting a framework for energy efficiency labelling and repealing Directive 2010/30/EU. SWD/2015/0139 final - 2015/0149. (Impact Assessment Energy Labelling Regulation)

Table 1 shows data about the failure rates in the UK and Germany[30]. For Germany the 13% is a significant increase from the 7% reported in the past. Thermostats/thermistors and electronics are the most frequent components to fail, while compressor failure is relatively rare (4% of repairs). (Review Study 2016)

Table 1: Failure rate of household refrigerating appliances in Germany (2012-2013) and the UK (2012)

	Failure rate	**Period**
Germany	13%	First 5 years
UK	38%	First 8 year

The energy efficiency of a refrigerator or freezer diminishes by some 10% over a 15-16 year product life. This is caused by the aging of insulation foam material (diminished insulation value over time) and the wear and tear of door gaskets[31] (leading to ice build-up) and interior elements. Insulation foam materials cannot be replaced as they are integrated in the cabinet of the appliance. Door gaskets, on the other hand, could be replaced, but they are often fully integrated into the door and spare gaskets are often not available. (Review study 2016)

Recycling of household refrigerating appliances is regulated by the WEEE Directive[32]. Article 8(2) of this Directive includes a list of materials which need to be collected separately during the recycling process. Today, the design of household refrigerating appliances does not completely facilitate this process.

Another element relevant for material efficiency is food waste caused by spoilage and bad planning. Food production 'from farm to fork' constitutes almost 20% by weight of the EU's total Domestic Material Consumption (DMC). End-users, i.e. private households and food services, waste 18% of those resources. Of this end-use waste, 60% is due to food spoilage and bad planning and thus avoidable.

Refrigerating appliances store two-thirds of food and drinks prior to their consumption. They play an important major role in preventing food spoilage and could contribute to better planning by being designed for optimised food preservation. Over 85% of fridges only include a standard fresh food compartment at a temperature of +4 to +5°C (possibly next to a freezer compartment). For about half of the fresh food (and drinks) this is either too warm or too cold for optimal food preservation. The presence of a chiller (−1 to 0°C) and a cellar compartment (8-14°C) could increase the shelf-life, in days, with on average a factor 3 or 4.

The Complementary Study 2017[33] indicated that refrigerating appliances that are

[30] These are the only countries for which data is available. The UK usually has higher failure rates than the EU average, Germany's failure rates are considered to be average to slightly lower than average (external expertise VHK 2018). In a conservative approach, it is assumed that Germany's failure rates are representative for the rest of the EU.

[31] A door gasket is a mechanical seals which fills the space between the door and the interior cabinet of the refrigerating appliance to prevent leakage.

[32] Directive 2012/19/EU Of The European Parliament And Of The Council Of 4 July 2012 On Waste Electrical And Electronic Equipment. OJ L 197 of 27-07-2012, p 38 (WEEE Directive)

[33] Preparatory/review study on Commission Regulation (EC) No. 643/2009 and Commission Delegated

designed for optimised food preservation consume at least 20% more electricity than the average refrigerating appliance on the market today. To compensate for a 20% higher electricity consumption, it would be sufficient to save 2% on end-use waste[34,35].

The current lack of requirements on Circular Economy aspects means that cost-effective improvements to the 'circularity' of these products are not captured and that consumers do not benefit from better reparable and more durable appliances that contribute to reducing food waste.

Without an update of the requirements, the problem is expected to remain as described above.

The drivers of the problem:

Problem driver 1/ Availability and replacements of spare parts: Currently no measures exist which regulate the availability of spare parts. The Review study 2016 suggests that a minimum availability of those spare parts that fail most frequently (i.e. thermostats and temperature sensors) or cause an efficiency loss (i.e. door gaskets) would be useful, also after the end of production of a model. If spare parts are available, it is often not clear to end-users where to order them and how to replace them. In some cases broken parts can simply not be replaced because they cannot be removed without damaging (e.g. the lamp and the lamp cover) or replacing a significant part of the appliance (e.g. the door gaskets versus replacement of the complete door). Consequently, appliances are often not repaired at all.

Problem driver 2/ Design for recycling: The recycling requirements in Article 8(2) of the WEEE Directive are not directly applicable to product manufacturers, they are applicable to recyclers. Hence manufacturers are not always incentivised to design their products in view of this requirement.

Problem driver 3/ Design for optimised food storage: When buying a refrigerating appliance, consumers make their decisions based on energy efficiency and price (Review Study 2016). For appliances with optimised design for food storage the energy consumption and price will be higher than for a comparable unit with only a fresh food storage compartment (at a temperature of +4 to +5°C). Hence, without taking action, the market uptake of these products will remain low.

2.3. Problem 3 – Loopholes and less appropriate requirements for some technologies

The problem: The current regulations suffer from an unclear and technology-prescriptive scope, creating uncertainty as to whether some products are in or out of the scope of the

Regulation (EU) No. 1060/2010 – complementary research on optimal food storage conditions in refrigeration appliances – VHK, February 2017. (Complementary Study 2017)

[34] Based on the primary energy consumption related to food production.

[35] Of the food that is stored in the household refrigerating appliances in the scope 11% is thrown away. By throwing away 2% less, i.e. 9% waste instead of 11% waste, we compensate for the 20% higher energy consumption.

current regulations, creating possible loopholes, and resulting in less appropriate requirements. This causes an unlevel playing field for industry, and Market Surveillance Authorities (MSAs) have difficulties to evaluate the scope and perform proper market surveillance.

For example, **professional chest freezers**, i.e. chest freezers not used in a household environment, are identical in practical terms to household chest freezers. By declaring these chest freezers as "professional", manufacturers obtain that they are excluded from the scope of the regulations. Given that professional chest freezers are specifically excluded from the Ecodesign Regulation for Professional Refrigeration[36], they are not in the scope of any ecodesign or energy labelling regulation, thereby creating a loophole. The total energy consumption of chest freezers sold in Europe is around 0.4 TWh/a[37].

Mini bars are typically equipped with absorption refrigeration generators. These low noise refrigerating appliances are specifically designed to be installed in hotel rooms where guests sleep. The EU market for low noise refrigerating appliances including mini-bars amounts to 0.2-0.3 million units, consuming in total around 0.6 TWh/a.

While all mini-bars were intended to be in the scope of the current Regulation, the use of mini bars in a 'commercial' context (i.e. a hotel room) has led to confusion about their inclusion. Moreover, a German court[38] ruled in 2014 that they should not be considered household refrigerating appliances and hence are out of the scope of the current Regulations, creating further confusion.

Furthermore, the regulations categorise products on the basis of different technologies, e.g. 'compressor' or 'absorption and other' technology. This means that certain technologies, including new ones, are covered (e.g. thermo-electric) but with less appropriate requirements (i.e. making it too easy or too difficult to comply).

Without an update of the requirements, the problem is expected to remain as described above.

The drivers of the problem:

Problem driver 1: Unclear scope - the ambiguities in the scope of the current regulations result in uncertainty about the inclusion of certain products thereby creating potential loopholes.

Moreover, since the entry into force of the current Ecodesign and Energy Labelling Regulations for household refrigerating appliances, other ecodesign and energy labelling regulations have been published, or are in preparation, which have refrigerating

[36] Commission Regulation (EU) 2015/1095 of 5 May 2015 implementing Directive 2009/125/EC of the European Parliament and of the Council with regards to ecodesign requirements for professional refrigerated storage cabinets, blast cabinets, condensing units and process chillers. OJ L 177, 8.7.2015, p. 19 (Ecodesign Regulation for Professional Refrigeration)

[37] www.applia-europe.eu

[38] There has been a dispute where the German court decided that minibars did not fall within the scope. Ref.: Landgericht Düsseldorf, 37 O 58/13, 20th February 2014.

appliances in their scope. Possible overlap or gaps between these regulations exist. Figure 5 shows the different Regulations with refrigerating appliances and the products in their scope which potentially overlap.

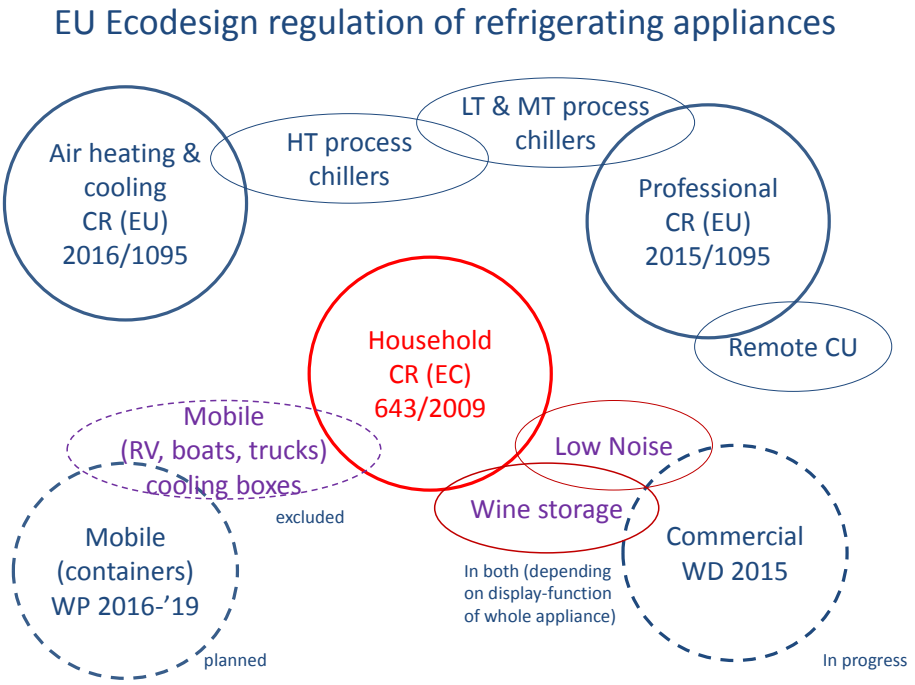

Figure 5: Existing and planned EU Ecodesign regulation of refrigerating appliances. Legend: CR=Commission Regulation, HT=High Temperature (+7°C), MT=Medium Temperature (-10°C), LT=Low Temperature (-35°C), CU=Condensing Units, WP=Ecodesign Working Plan, WD=Working Document presented to the Consultation Forum in 2015.

Problem driver 2: Technological progress - New technologies have been developed and are being developed in respect of refrigerating. Some of these have lower efficiencies, but have functional characteristics (e.g. they are mobile or are very silent) which justify their continued placing on the market. This technological progress results in technologies being covered but with less appropriate requirements.

A more detailed description of the problems and problem drivers is given in Annex 10. An evaluation of the regulatory measures is presented in Annex 9.

2.4. General market failures

In addition to the product specific problem drivers described in Sections 2.1, 2.2 and 2.3, some general market failures have been identified:

***Myopic behaviour** - Without up to date energy efficiency requirements and energy labels, economic actors (both business and private) will not choose the product that is the most cost-effective over the product's life-time. This is because economic actors are limited by the information they have, their knowledge about products, and the finite amount of time they have to make a decision.*

***Split incentives** – Without up to date energy efficiency requirements, the guarantee that the products will be cost-effective over their life-time is lost. This is especially important for a certain group of consumers, in particular those in a landlord-tenant situations, in*

where the landlord buys the appliance and the tenant pays the energy bill.

Price reflection *– The price of the products does not fully reflect the real environmental costs to society. Hence, without setting requirements that will improve the environmental performance of the product, the different actors in the life cycle of the appliance will not be incentivised to improve these aspects of the appliance.*

2.5. Who is affected?

2.5.1. Household refrigerating appliances' manufacturers and retailers

For **manufacturers and retailers**, the energy label is one of the main market drivers and an important quality feature[39]. Globally, the household refrigerating appliance industry is highly competitive, with Asian manufacturers rapidly expanding their global market share. For these latter manufacturers, product price is the main selling point. The energy label allows EU industry to distinguish itself based on quality and innovation rather than solely on price.

In 2015, the total employment in the household refrigerating sector in the EU was estimated at 166 000 jobs, around 19.4 million units were sold in the EU and the EU turnover was EUR 10.1 billion in consumer price. More information about employment and the size of the market of household refrigerating appliances can be found in Annex 6.

Important manufacturers with EU production facilities are Electrolux[40], BSH[41], Whirlpool[42], Candy and Liebherr. Rapidly growing importers are Arcelik/BEKO of Turkey, and Samsung and LG of South Korea.

Household refrigerating appliances manufacturers usually make the main cabinet-components in-house (i.e. the blow-formed inner-liner, insulation, the folded steel coil cabinet, the roll-bonded or Z-bonded evaporator and the condenser). Refrigerator/freezer doors require a special production line, which may be made in-house or by an external supplier. Other parts, like interior-elements (glass-shelves, containers, lamps, etc.), compressors and electronics are likely to be bought from external suppliers, also outside the EU.

Almost all manufacturers are large companies. **Small and Medium-sized Enterprises** (SMEs) are only found in niche markets, such as wine storage appliances and related luxury refrigeration/conditioning (for cheese, chocolate, fur-coats; also humidors). Examples are Eurocave, Groupe FRIO (brands: Climadiff, Avintage, La Sommeliere), these SMEs compete with the large manufacturers such as Liebherr, Bosch and Haier. There is one large manufacturer (Dometic) for absorption appliances and a few SME-manufacturers in the minibar market with thermo-electric devices[43]. The European

[39] The energy label class distribution and EEI of household refrigerating appliances in a BAU scenario is given in Table 43.

[40] Brands: Electrolux, Zanussi, AEG, Rex, etc.

[41] Brands: Bosch, Siemens, etc.

[42] Whirlpool brands: Whirlpool, Bauknecht, Ignis, Maytag, Laden, Polar and Privileg. Indesit brands: Indesit, Hotpoint / Hotpoint-Ariston and Scholtès.

[43] Inefficient Peltier solutions or relatively efficient 'smart' compressor refrigerators with large

industry association is APPLiA.

In the traditional **retail** sector the position of larger retail chains such as Metro (Media Markt) and Carrefour is increasing. For built-in appliances (29 % of the market) kitchen suppliers are important. Internet sales exist but the growth rate, especially for the more expensive no-frost appliances, is not higher than for the other distribution channels of this product group. The European association for retailers are Independent Retail Europe and EuroCommerce.

2.5.2. Recycling industry

For **recyclers**, design requirements that facilitate the separate collection of the materials listed in Article 8(2) of the WEEE Directive would reduce the time needed and cost to disassemble and shred a household refrigerating appliance.

Recycling companies are situated all over the EU. Some of the bigger recyclers are Coolrec in the Netherlands and Belgium, SIMS in the UK and Derichebourg in France.

The recycling industry is represented by the European Recycling Industries' Confederation (EURIC).

2.5.3. Consumers

*For **consumers**, the energy label offers a unique opportunity to make an informed choice as to which products offer the best environmental and energy performance allowing them to save money in the long run. Ecodesign requirements safeguard consumers from the worst performing products.*

Spare part availability improves the reparability of household refrigerating appliances. This ensures that consumers can have their appliances repaired, at least until the appliance reaches a lifetime equal to the simple payback period (6-7 years on average, see Annex 4.8) when the higher investment cost in a more efficient appliance is recuperated through lower electricity bills.

Avoiding food waste by improving functionality not only gives consumers the opportunity to contribute to a more sustainable society but could also save them on average EUR 125/year (Complementary study 2017).

Consumers are represented by the Bureau Européen des Unions de Consommateurs (BEUC) and the European Association for the Co-ordination of Consumer Representation in Standardisation (ANEC).

2.5.4. Society as a whole

*For **society as a whole**, ambitious policies in the area of energy efficiency are important tools to mitigate climate change. Effective and efficient energy labelling and ecodesign regulations contribute to achieving goals set in the Paris Agreement and they help*

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accumulators that only operate when the guest is not in the room. Companies include SMI, Vitrifrigo and others.

achieve the 2030 EU climate goal.

Environmental organisations are represented by the European Environmental Citizens Organisation for Standardisation (ECOS), the European Environment Bureau (EEB), TopTen, the Collaborative Labelling and Appliance Standards Program (CLASP).

3. WHY SHOULD THE EU ACT?

3.1. Legal basis

The legal basis for acting at EU *level through the* Ecodesign framework Directive *and the Energy Labelling framework Regulation is Article 114 and Article 194 of the Treaty on European Union and the Treaty on the Functioning of the European Union (TFEU)*[44] *respectively. Article 114 relates to the "the establishment and functioning of the internal market", while Article 194 gives, amongst others, the* EU *the objective "in the context of the establishment and functioning of the internal market and with regard for the need to preserve and improve the environment" to "ensure security of energy supply in the Union" and "promote energy efficiency and energy saving and the development of new and renewable forms of energy".*

The Ecodesign Framework Directive *and* Energy Labelling Framework Regulation *include a built-in proportionality and significance test. For the* Ecodesign Framework Directive*, Articles 15(1) and 15(2) state that a product should be covered by an ecodesign or a self-regulating measure if the following conditions are met:*

- *The product should represents a significant volume of sales;*
- *The product should have a significant environmental impact within the EU;*
- *The product should present a significant potential for improvement without entailing excessive costs, while taking into account:*
    - *an absence of other relevant Community legislation or failure of market forces to address the issue properly,*
    - *a wide disparity in environmental performance of products with equivalent functionality;*

The procedure for preparing such measures are described in Article 15(3). In addition, the criteria of Article 15(5) should be met:

- *No significant negative impacts on user functionality of the product;*
- *No significant negative impacts on Health, safety and environment*
- *No significant negative impacts on affordability and life cycle costs*
- *No significant negative impacts on industry's competitiveness (including SMEs see Section 6.5.3).*

The Energy Labelling Framework Regulation includes similar criteria for products covered by an energy label:

- *The product group should have significant potential for saving energy and where*

[44] Consolidated version of the Treaty on the Functioning of the European Union. OJ C 326, 26.10.2012, p. 47 (TFEU)

relevant, other resources;

- *Models with equivalent functionality should differ significantly in the relevant performance levels within the product group;*
- *There should be no significant negative impact as regards the affordability and the life cycle cost of the product group;*
- *The introduction of energy labelling requirements for a product group should not have a significant negative impact on the functionality of the product during use.*

During the review process (Review study 2016), it was established that household refrigeration appliances fulfil the above eligibility criteria.

3.2. Subsidiarity: Necessity of EU action

Action at EU *level gives end-users the guarantee that they buy an energy efficient product and provides end-users with harmonised information no matter in which* MS *they purchase their product. This is becoming all the more relevant as the online trade increases. With ecodesign and energy labelling at* EU *level, energy efficient products are promoted in all* MS*, creating a larger market and hence greater incentives for the industry to develop them*.

It is essential to ensure a level playing field for manufactures and dealers in terms requirements to be met before placing an appliance on the market and in terms of the information supplied to customers for sale across the EU *internal market. For this reason* EU*-wide legally binding rules are necessary.*

Market surveillance is carried out by the MSAs appointed by MS*. In order to be effective, the market surveillance effort must be uniform across the EU to support the internal market and incentivise businesses to invest resources in designing, making and selling energy efficient products.*

Finally, Regulation (EU) 2017/1369 requires the Commission to update the current energy labelling regulation for fridges, in particular as regards rescaling the label to remove the A+ to A+++ classes.

3.3. Subsidiarity: Added value of EU action

There is clear added value in requiring minimum energy efficiency levels and energy label class limits at EU*-level.*

Without harmonised requirements at EU *level,* MS*s would be incentivised to lay down national product-specific minimum energy efficiency requirements in the framework of their environmental and energy policies. This would undermine the free movement of products. Before the existing ecodesign and energy label measures were implemented, this was in fact the case for many products.*

4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1. General objectives

Following the legal basis in the TFEU, the general objectives are to:

1. *Facilitate **free circulation** of efficient* refrigeration appliances *within the internal market;*
2. *Promote **competitiveness** of the* EU refrigeration appliances *industry through the creation or expansion of the* EU *internal market for sustainable products;*
3. *Promote the **energy efficiency** of* refrigeration appliances;
4. *Contribution to the Commission's objective to reduce energy consumption by at least 30 % and domestic greenhouse gas (GHG) emissions by 40 % by 2030; implement the energy efficiency first principle established in the Commission Communication on Energy Union Framework Strategy; and*
5. *Increase **energy security** in the* EU *and reduce energy dependency through a decrease in energy consumption of household refrigeration appliances.*

There are several synergies between these objectives. Reducing electricity consumption (by increasing the energy efficiency) leads to lower carbon, acidifying and other emissions to air. Tackling the problem at EU *level enhances efficiency and effectiveness of the measure.*

4.2. Specific objectives

The specific objectives of the policy options considered in this impact assessment are to correct the problems identified in the problem definition (Section 2):

1. **Update the energy efficiency requirements and the energy label** in line with international and technological developments, and the revised Energy Labelling framework Regulation, to achieve cost-efficient energy savings;
2. **Contribute towards a circular economy** in the EU by including requirements on spare part availability, recyclability and food waste reduction;
3. **Redefine the scope** to close potential loopholes and adopt a technology neutral approach.

These objectives will drive investments and innovations in a sustainable manner, increase monetary savings for the consumer, contribute to the Energy Union Framework Strategy and the Paris Agreement, contribute to the Circular Economy Initiative and strengthen the competitiveness of EU industry.

5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

The procedure for identifying policy options follows from the Better Regulation Toolbox[45]. Specific measures in the policy options are the result of a combination of initiatives mentioned in the Review study 2016, the evaluation in Annex 9, the Inception Impact Assessment[46], and inspiration taken from the Ecodesign Framework Directive and

[45] https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-17_en_0.pdf (Better Regulation Toolbox)

[46] Inception impact assessment -Regulatory measure on the review of ecodesign requirements for household cold appliances - (EC) No 643/2009 and Inception impact assessment -Regulatory measure on the review of energy labelling for household cold appliances - (EU) No 1060/2010

the Energy Labelling framework Regulation. They are aimed at addressing the issues identified in Section 3 and achieving the policy objectives defined in Section 4.

The policy options are listed in Table 2.

Table 2: Policy options

Option	Name	Short name	Description
Option 1	Baseline	BAU	No further action, the household refrigeration appliances regulations currently in place remain unchanged
Option 2	Least Life Cycle Cost	LLCC	Ecodesign limits at the LLCC level of EEI* =30 (based on the harmonised standard), circular economy requirements, A-G energy rescaled label
Option 3	Ambitious	Ambi	The LLCC scenario, with EEI + 25%
Option 4	Lenient	Lenient	The LLCC scenario, with EEI – 20%

*Energy Efficiency Index (EEI)

Figure 6 shows the link between the problems, the drivers, the objectives and the measures proposed in this Section.

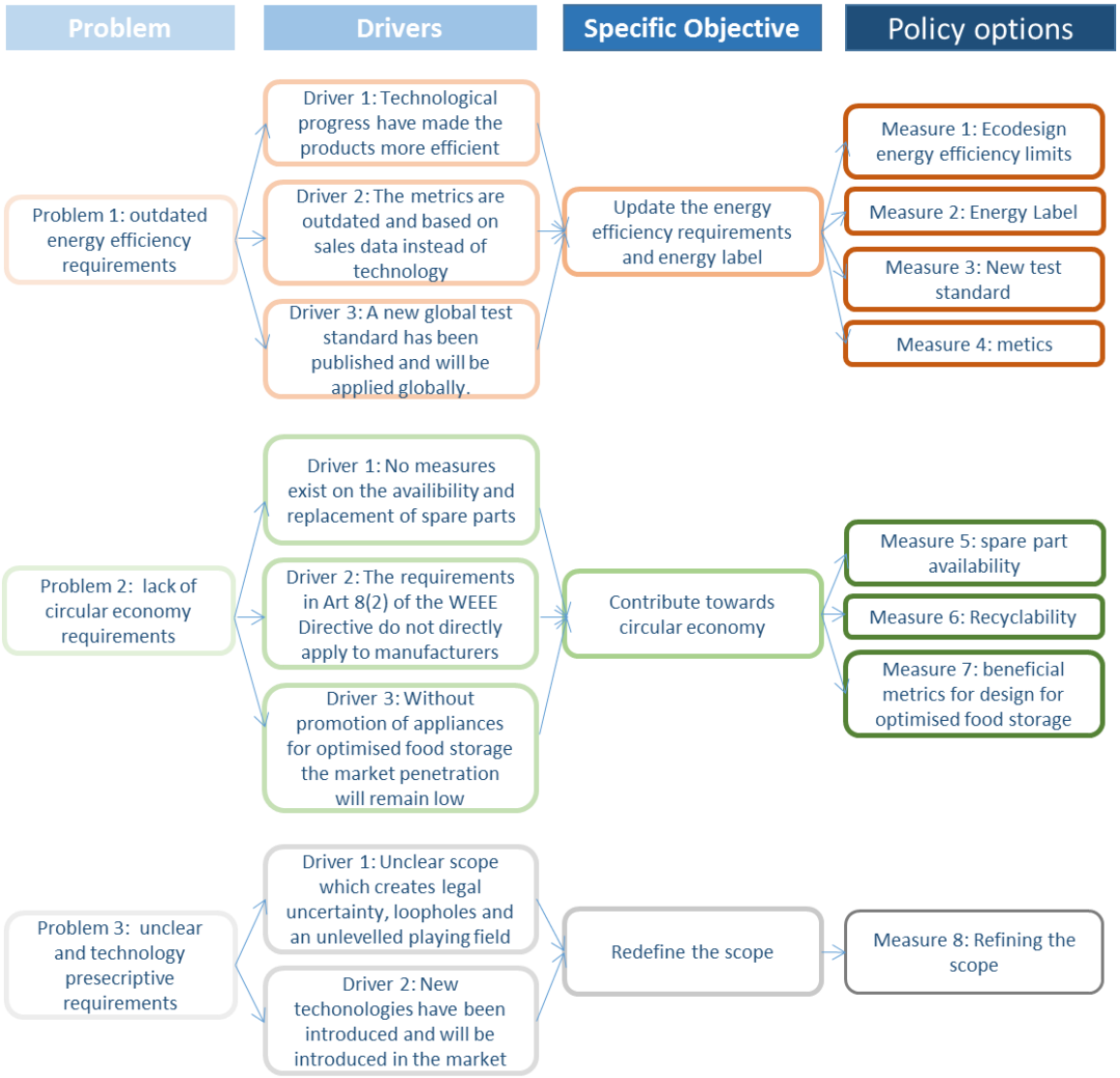

Figure 6: Link between the problems, drivers, objectives and the measures

5.1. What is the baseline from which options are assessed?

In the baseline, the current Ecodesign *and* Energy Labelling Regulations and all *other relevant* EU-*level policies and measures are assumed to continue.*

From 2020 onwards, lamps and electronic displays in household refrigerating appliances may be subject to ecodesign and energy labelling regulations. The impact assessment for the ecodesign and energy labelling regulations for both product groups[47,48] is ongoing. Hence, today it is too early to take the impact into account in the baseline.

According to the Energy Labelling framework Regulation, products have to be registered in the product database from 1 January 2019 onwards, for all products belonging to models placed on the market after 1 January 2019; and by 30 June 2019 for products

[47] Inception Impact Assessment - Regulatory measure on the review of ecodesign requirements for lighting products - (EU) No 1194/2012 and Inception Impact Assessment - Regulatory measure on the review of energy labelling requirements for lighting products ((EU) No 244 & 245/2009 + 874/2012)

[48] Inception Impact Assessment - Regulatory measure on the review of ecodesign requirements for computers and computer servers - (EU) No 617/2013 and Inception Impact Assessment - Regulatory measure on energy labelling requirements for computers and computer servers – (EU) No 1062/2010

belonging to models placed on the market between 1 August 2017 and 1 January 2019.

The requirement in the ETS to reduce emissions (from amongst other electricity production) will impact refrigerating appliances *in a baseline scenario*. *Indeed, inefficient* refrigerating appliances *lead to more energy consumption. More electricity consumption increases the demand for ETS allowances. This either leads to higher ETS prices (which could in turn increase electricity prices) or to the need for additional emission reductions in ETS sectors (higher renewable energy targets or more reductions in industry).*

International policies are being developed for household refrigerating appliances, based on the new global test standard (see Annex 10). This will impact household refrigerating appliances in the EU. If the EU lags behind, the competition in the EU might change focus from innovation and quality to price. In addition, the use of the global standard in ecodesign and energy labelling regulations will enhance global competition for EU manufacturers. The use of the EU standard in ecodesign and energy labelling will result in double testing of the products (according to the EU standard and the global standard), in which case EU manufacturers will be able to compete globally at an increased costs (due to increased testing). Alternatively, it will result in testing of the products according to the EU standard only, in which case they will not be able to compete on the global market. In the baseline, the impact of the new global test standard has been taken into account.

Sections 2.1, 2.2 and 2.3 describe how the situation will evolve in a baseline scenario in terms of energy savings, circular economy and scope.

5.2. Description of the policy options

5.2.1. Option 1 – Baseline

Option 1 forms the baseline for the impact assessment and is described in Section 5.1.

5.2.2. Option 2 – Least Life Cycle Cost ("LLCC")

The LLCC scenario includes the following measures for the Ecodesign and Energy Label scope, test standard and metrics, energy efficiency limits and circular economy.

Table 3 shows the proposed measures under Option 2.

Table 3: Proposed measures under Option 2

Identified problems	Corrective measures
Problem 1: Outdated energy efficiency requirements	1. Ecodesign energy efficiency limits
	2. Updated Energy Label
	3. Test standard
	4. Updated metrics
Problem 2: Poor 'Circular Economy performance	5. Reparability
	6. Recyclability
	7. Food waste
Problem 3: Loopholes and less appropriate requirements for some technologies	8. Scope

Measures related to problem 1

Measure 1: Ecodesign energy efficiency limits - The LLCC scenario requires household refrigerating appliances to achieve maximum EEI levels as shown in Table 4. The EEI level applicable from 1 April 2024 corresponds to the LLCC point as determined in the Review Study 2016.

Table 4: LLCC - Overview of the maximum EEI values

	Maximum new EEI (current EEI) values			
	1 April 2021 (Tier 1)		1 April 2024 (Tier 2)	
	Solid door	Glass door	Solid door	Glass door
Refrigerating appliances, except low noise refrigerating and wine storage appliances	125 (38)	-	100 (30)	-
Low noise refrigerating appliances	300 (90)	360 (108)	250 (75)	300 (90)
Wine storage appliances	155 (47)	190 (58)	140 (42)	172 (51)

According the Ecodesign Framework Directive, the level of energy efficiency or consumption must be set aiming at the life cycle cost minimum to end-users for representative product models, taking into account the consequences on other environmental aspects. This is level corresponds to the maximum EEIs in Table 4.

Measure 2: Updated energy Label – The Energy label will apply from 1 April 2021 onwards. The efficiency classes are set out in Table 5. The G class will be empty for standard household refrigeration appliances, but will be used for wine storage and low noise appliances that will have more lenient limit values. The A class is expected to be empty in 2021, this is in line with the new Energy Label Framework Regulation.

Table 5: LLCC - Energy efficiency classes

Energy efficiency class	New EEI (current EEI)
A	EEI ≤ 41 (13)
B	41 (13) < EEI ≤ 51 (16)
C	51 (16) < EEI ≤ 64 (20)
D	64 (20) < EEI ≤ 80 (24)
E	80 (24) < EEI ≤ 100 (30)
F	100 (30) < EEI ≤ 125 (38)
G	EEI > 125 (38)

Table 6 gives an overview of the action that needs to be undertaken.

Table 6: LLCC, Energy efficiency requirements and Energy label - Who, what and by when

	Action	Who	By When
Ecodesign	Redesign products to meet the maximum EEI limits	Manufacturer or importer	1 April 2021
Energy Label	Provide the updated energy labels with the product	Supplier	1 December 2020
	Provide the updated energy labels with the product	Dealer	1 April 2021

The increase of the energy efficiency requirements will result in 5% of the products currently on the market in being removed 2021 and 18% in 2024, compared to a BAU

scenario (see Annex 12). This option is feasible in the given time frame. In return these requirements are expected to result in more business revenue for industry.

Stakeholder views – During the consultation forum, a stricter timing was proposed for the application of the stricter requirements, see Section 5.3.2. Some MSs and APPLiA commented that the combination of the ambition level and timing was too demanding. Most asked to postpone the application rather than to lower the ambition level. APPLiA was in favour of a lower ambition level[49]. Environmental NGOs and Switzerland requested for more ambitious efficiency levels[50]. All agreed that the timing for the measures should be sufficient to allow manufacturers to retest their appliances. When presenting this option to APPLiA, they agreed.

Measure 3: Test Standard - The test methods are in accordance with the European version of the IEC 62552:2015 standard. Table 7 gives an overview of the action that needs to be undertaken.

Table 7: LLCC, test standard – Actions: what, who and by when

	What	**Who**	**By When**
Ecodesign	Retest appliances' EEI according to this new test method	Manufacturer or importer	1 April 2021
Energy Label		Supplier	1 December 2020

Industry calculated that the total workload based on the available test capacity amounts to 14 months[51]. Assuming an entry into force on 1 April 2019, the proposed timing gives 24 months to retest. As such, the actions to be undertaken are feasible within the given time frame. In addition, this test standard aims to be universally applicable, faster and less costly, more accurate and more reliable. The use of the same standard in ecodesign and energy labelling will reduce the burden on the industry, improve the quality of the products and enhance global competitiveness.

Stakeholder views: None of the stakeholders were opposed to using of the new test standard. Although the new standard reflects real life conditions better, consumer and environmental NGOs would like to improve this even more. Some Member States were concerned that the new test conditions do not allow optimal food preservation; this was countered by APPLiA in a comprehensive way.

Measure 4: Updated metrics[52] - The reference lines[53] are made more flexible in design and are based on technology instead of sales and marketing. In addition, correction factors have been eliminated or reduced. The details, including the metrics, the full calculation method and a stochastic conversion table for the conversion from EEI values

[49] In response the lenient scenario was proposed, see Section 5.2.4

[50] In response the ambitious scenario was proposed, see Section 5.2.3

[51] Estimate of manufacturer workload related to the introduction of a new energy label, efficiency and performance test standard. Technical note in response to the working documents for the Consultation Forum. APPLiA - January 2018.

[52] Method to evaluate the performance of the appliance, including determination of the need and value of the correction factors.

[53] Reference lines represent the average energy consumption of an appliance with the same characteristics as the appliance for which the EEI needs to be determined. They are used in the calculation of the EEI to normalise the energy consumption of the appliance for which the EEI needs to be determined

according to the harmonised standard (current EEI) to values according to the new global standard described in this Section (new EEI), are given in Annex 10.2.2. Table 8 gives an overview of the action that needs to be undertaken.

Table 8: LLCC, metrics - Actions: what, who and by when

	What	Who	By When
Ecodesign	Recalculate appliances' EEI according to the new metrics	Manufacturer or importer	1 April 2021
Energy Label		Supplier	1 December 2020

The introduction of the new standard requires a recalculation of the EEI even without a change to the metrics. Therefore, the introduction of the new metrics is not an additional burden on the manufacturers, importers and suppliers. The new metrics reflect technological progress and improve the transparency.

Stakeholder views: The Open Public consultation (OPC) showed that stakeholders' opinions are almost equally divided between the pros and the cons concerning the use of correction factors. In general, environmental and consumer NGOs prefer not to use them as they prefer full transparency. However, they welcomed the deletion of some and the reduction of other correction factors as did the other stakeholder. Most of the MSs that participated to the OPC are in favour of the correction factors. According to APPLiA the correction factors help consumers make sustainable choices in finite amount of time they have to make a decision.

Measures related to problem 2

Measure 5: Improved reparability - A requirement is added to ensure that spare part thermostats, temperature sensors and printed circuit boards are available[54] for a minimum period of 7 years (lifetime equal to the simple payback period) and that spare part door gaskets are available for a minimum period of 10 years. Table 9 gives an overview of the action that needs to be undertaken.

Table 9: LLCC, reparability - Who, what and by when

	Actions	Who	By When
Ecodesign	Ensure the availability of spare part thermostat, temperature sensors and printed circuit board for a period of minimum 7 years; of spare part door gaskets for a period of minimum 10 years	Manufacturer or importer	1 April 2021

Manufacturers or their component suppliers will have to foresee more storage place for spare parts and/or foresee the possibility to produce them for a longer time. Industry indicated[55] that many EU manufacturers already ensure the availability of the necessary spare parts for white goods today. The impact for EU manufacturers is mainly expected on the models that are no longer produced. For non-EU manufacturers no information is available. In general, the impact is not expected to be big. Having spare parts available

[54] Available means can be obtained from the manufacturer or supplier either for free or after payment.

[55] CECED comments following the Consultation Forums on dishwashers, washing machines and washer dryers of 18-19 December 2017. APPliA January 2018.

ensures that the appliance's lifetime is at least sufficiently long to ensure that the higher investment cost in a more efficient appliance is recuperated through lower electricity bills and that the appliances remain efficient throughout their life.

Stakeholder views: All stakeholder are in favour of setting requirements on the availability of spare part door gaskets. With regards to the other spare parts, environmental and consumer NGOs, and some Member States, are in favour. For APPLiA, a declaration of the spare parts availability should be sufficient, as this is a driver for competition. This was also confirmed by the results of the OPC, where NGOs and individual citizens raised concern about the poor reparability of appliances, and where companies were cautious or negative about the requirements.

Measure 6: Enhanced recyclability - A requirement is added to ensure that key components (as per Article 8(2) of the WEEE Directive) can be safely and readily removed, and that lamps can be removed without permanent damage to the appliance. Table 10 gives an overview of the action that needs to be undertaken.

Table 10: LLCC, recyclability – Who, what and by when

	Actions	**Who**	**By When**
Ecodesign	Adapt the design of refrigerating appliances so that the material are removable	Manufacturer or importer	1 April 2021

In general, the EU household refrigerating appliance manufacturers work closely together with their recycling partners to fulfil the requirements laid down in the WEEE Directive. Therefore the impact of these requirements on the manufacturers is not expected to be onerous.

The benefits from improving the efficiency of recycling, on the other hand, reduces its costs and makes it more attractive. This is of benefit to all stakeholders, including industry who finances the collection, treatment, recovery and environmentally sound disposal of WEEE from private households. The requirements for lighting are included in this regulation instead of in the regulation lighting[56] to reduce the burden on manufacturers and make sure that different requirements on the refrigerating appliances apply at the same time.

Stakeholder views: Environmental and consumer NGOs, recycling industry and some Member States, strongly recommend including requirements in the regulation on recyclability. This was confirmed by the OPC. For APPLiA the proposed requirement is an acceptable.

Measure 7: Prevention of food waste - To prevent food waste, beneficial metrics for appliances that optimise their design for food preservation have been proposed. See Annex 11.2 for the full calculation method and Annex 11.3 for the changes to the metrics with regards to food waste, i.e. the use of a correction factor and the change in the target

[56] Review of Regulation (EU) No 617/2013 and (EU) 1062/2010

temperature of chill compartments. Table 11 gives an overview of the action that needs to be undertaken. To ensure that consumers are properly informed about correct food storage, requirements that inform consumers about the impacts of food waste, optimal food storage and the presence of compartments that optimise food preservation have been added. Those are:

(a) compartments should be marked with a symbol marking the type of food that should be stored in that compartment;

(b) instruction manuals for end-users and installers and free access website should include:

- clear guidance about where and how fresh food should be stored for the best preservation over the longest period;
- the recommended setting of temperatures in each compartment for optimum food preservation;
- an estimation of the impact of temperature settings on food waste;

(c) the energy label makes a differentiation between different compartments of the appliance, including those compartments that improve the food storage.

Table 11: LLCC, food waste – Who, what and by when

	Action	**Who**	**By When**
Ecodesign	Recalculate appliances' EEI according to these new metrics	Manufacturer or importer	1 April 2021
Energy Label		Supplier	1 December 2020

The introduction of the new standard requires a recalculation of the EEI even without a change to the metrics. Therefore, the introduction of the new metrics is not an additional burden on the manufacturers, importers and suppliers. These metrics, on the other hand, will promote an optimised design for food preservation which could help prevent food waste. The additional information requirements and the markings on the energy label will not create an additional burden, because measure 1 and 2 already require an update of the information requirements and energy labels. The marking of the compartments will create an additional burden, but the impact is not expected to be big, as most manufacturers already mark their compartments.

Stakeholder views: Most environmental NGOs, except for CLASP, and the consumer NGOs are not in favour of favourable metrics for appliances that potentially reduce food waste, because believe that there is not enough proof that an improved design guarantees food waste reduction. Several Member States and APPLiA are in favour and see it as a first step to tackle this problem. This was also confirmed by the OPC.

Measures related to problem 3

Measure 8: **Refined scope -** The present ambiguity in the scope is removed, firstly by defining the main functional (i.e. refrigerating appliances) and technology-neutral categories (i.e. low noise appliances and mobile refrigerating appliances), and secondly by expanding on what is in the scope and what is not. See Annex 11 for a more detailed description. This proposal clarifies was the intended scope, but does not change it. However, some manufacturers of professional chest freezers and mini-bars, including

some SMEs, will have to make their products compliant. Table 12 gives an overview of the action that needs to be undertaken.

Table 12: LLCC, scope – Actions: what, who and by when

	What	Who	By When
Ecodesign	Make products comp	Manufacturer or importer	1 April 2021
Energy Label		Supplier	1 December 2020

Most of the products produced by EU manufacturers, including SMEs active in the manufacturing of mini-bars, already comply with the regulations. Therefore, the impact is assumed to be moderate. Including these products in the scope will ensure that EU SMEs who invested in making their products compliant are protected, which reduces the unlevelled playing fields for all manufacturers.

Stakeholder views: All stakeholders agreed that the scope should be clarified. Environmental NGOs and some MSs requested to include professional chest freezers in the scope. The main manufacturers of mini-bars requested to clarify the scope for mini-bars. The OPC showed that most stakeholders are in favour of having mini-bars (low noise appliances) and appliances with glass doors in the scope.

5.2.3. Option 3 – Ambitious

The Ambitious scenario sets minimum energy efficiency limits at 25 % higher than LLCC-level for all refrigerating appliances except for low noise and wine storage appliances[57], see Table 13. Otherwise, the Ambitious scenario is the same as the LLCC scenario. The actions that need to be undertaken are as described in Section 5.2.2.

Table 13: Ambitious – Maximum EEI values

	1 April 2021 (Tier 1)	1 April 2024 (Tier 2)
Refrigerating appliances, except low noise refrigerating and wine storage appliances	100	75

The increase of the energy efficiency requirements will remove 48 % of the products from the market in 2021 and 20 % in 2024, compared to a BAU scenario behaviour (see Annex 12). This is feasible technologically, given that products with these EEI levels already exist in the market. However, the affordability for some European consumers may be affected. Business revenue for industry is expected to increase.

Stakeholder views: TopTen and other environmental NGOs have expressed interest in this ambitious scenario during the Review Study 2016. For example, Switzerland already applies the A++ level (current EEI=33) as a minimum requirement since 2014. Consumer NGOs requested a careful assessment of ambitious energy efficiency requirements to ensure that low income households can still afford household refrigerating appliances. In general, APPLiA is concerned about the number of products that would be removed from the market by setting ambitious EEI requirements. They presented the possible effects of

[57] This is to protect SMEs, they are mainly active in the production of wine storage appliances and low noise appliances (e.g. mini-bars), see Section 2.5.1 and Section 6.5.3.

the LLCC scenario with stricter timing (See Section 5.3.2) on MS with lower incomes to raise awareness about the effect of ambitious requirements.

5.2.4. Option 4 – Lenient

The lenient scenario sets minimum energy efficiency requirements 20 % lower than the LLCC scenario for all refrigerating appliances except for low noise and wine storage appliances[58], see Table 14. Otherwise, the lenient scenario is the same as the LLCC scenario. The actions that need to be undertaken are as described in Section 5.2.2.

Table 14: Lenient - Maximum EEI values

	1 April 2021 (Tier 1)	**1 April 2024 (Tier 2)**
Refrigerating appliances, except low noise refrigerating and wine storage appliances	135	110

The increase of the energy efficiency requirements will not remove additional units from the market as compared to the baseline (see Annex 12.1). As such, this will not result in additional business revenue.

Stakeholder views: Based on the proposal that was presented during the Consultation Forum (see Section 5.3.2), APPLiA argued for a more lenient level on the basis that costs were higher than originally estimated.

5.3. Options discarded at an early stage

5.3.1. Voluntary agreement by the industry

A voluntary agreement has to be given priority according to the Ecodesign Framework Directive, provided it meets the objectives in a quicker and more cost-effective manner. Today minimum mandatory requirements are already in force. Since no proposal has been put forward by industry, there is no voluntary agreement that meet the conditions of the Ecodesign Framework Directive. As a consequence, this option is discarded from further analysis. When substituting mandatory requirements by a voluntary agreement there would be a risk of free riders[59], in case not all actors present on the market would sign such an agreement and comply with it.

Stakeholder views: *None of the stakeholders are in favour of voluntary agreements for the reasons set out above.*

5.3.2. LLCC with stricter timing

This option is the same as the LLCC scenario, but the application of the requirements are brought forward by one year as indicated in Table 15. This option was presented to stakeholders during the consultation forum.

Table 15: Time table LLCC versus LLCC with stricter timing

	Tier 1	**Tier 2**

[58] This is to protect SMEs, they are mainly active in the production of wine storage appliances and low noise appliances (e.g. mini-bars), see Section 2.5.1 and Section 6.5.3.

[59] A free-rider problem occurs when those who benefit from resources, goods, or services do not pay for them, which results in an underprovision of those goods or services. (Baumol, William (1952). Welfare Economics and the Theory of the State. Cambridge, MA: Harvard University Press.)

LLCC	1 April 2021	1 April 2024
LLCC with stricter timing	1 April 2020	1 April 2023

Stakeholder views: Almost all stakeholders, including some environmental NGOs, agreed that the timing in combination with the minimum requirements was too demanding. The main reasons that were mentioned were the need to retest all appliances. With an estimated entry into force on 1 April 2019, the time to retest would only be 12 months, while APPLiA calculated the time needed to retest to 14 months (see Section 5.2.2).

6. WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

The analytical methods used to determine the impacts are described in detail in Annex 4. Details about the share of products that would be removed from the market as a result of the different scenarios can be found in Annex 12.1.

The reparability, recyclability and food waste requirements introduced in the LLCC, ambitious and lenient options will not be quantitatively discussed. Indeed, due to the relatively small monetary and energy impacts involved (Impact Assessment Study 2018), their possible influence on the outcomes of a quantitative analysis would be smaller than the error margin of such an analysis (estimated at ±5%). A qualitative assessment is made in Section 6.1.3.

6.1. Environmental impact

6.1.1. Final energy savings

The final energy (i.e. electricity) savings per product placed on the market are described in Annex 12.2. Figure 7 shows the EU final energy consumption of the total population of household refrigeration appliances for the different scenarios. This excludes wine storage and low noise refrigerating appliances (0.3 TWh/a energy savings, see Annex 4).

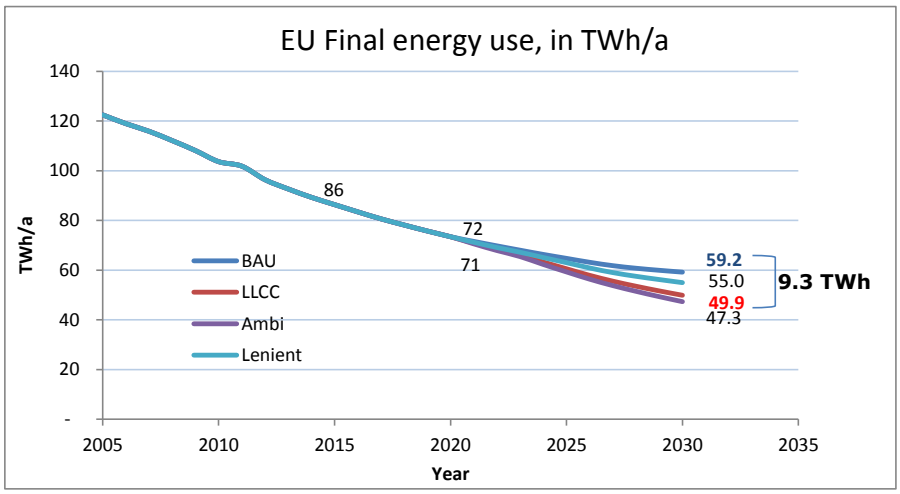

Figure 7: EU energy consumption over the period 2005-2030, in TWh/a electricity, for various scenarios (Impact assessment study 2018)

The average lifetime of refrigerating appliances is 16 years, which means that it will take some time before the whole stock of products has changed. As such, there is only a small

difference between the scenarios in 2020. The savings expected by 2030 for the different scenarios are given in Table 16. The savings of the baseline relative to 2015 are 14.3 TWh/a (16 %) in 2020 and 26.8 TWh/a (31 %) in 2030.

Table 16: Overview of the final energy consumption and savings, including from wine storage and low noise refrigerating appliances for each scenario in comparison to the baseline (Impact Assessment Study 2018)

	Energy consumption (TWh/a)	Savings in 2030 (TWh/a)	Savings in 2030 (%)	Savings compared to the remaining savings for the period 2016-2030 (%)
Baseline	59.2			
LLCC	46.9	9.6	15	0.68
Ambitious	47.0	11.9	20	0.84
Lenient	54.7	4.5	7	0.32

Active energy policies will reduce the ETS price. However, this is justified because the ETS only tackles the price reflection based market failures (for electricity using products); market failures such as myopic behaviour and split incentives can only be tackled by these active energy policies.

Stakeholder views – See stakeholder comments on the energy efficiency requirements in Sections 5.2.2, 5.2.3 and 5.2.4.

6.1.2. GHG-emissions

The transition towards low-global warming potential (GWP), non-ozone depleting (ODP) refrigerants and foaming agents is practically complete for this product group (> 98 % isobutane for refrigerant, cyclopentane as foaming agent). As such, the trends for GHG-emissions are similar to the energy consumption trends. The main difference is that for the energy scenarios, by convention, a primary energy factor[60] of 2.5 (according the Annex V of the Energy Efficiency Directive (Directive 2012/27/EU[61]), whereas for the projections of the GHG-emissions changes in carbon-intensity of electric power generation are taken into account.

Figure 8 shows the EU GHG-emissions of the total population of household refrigeration appliances for the different scenarios, this excludes wine storage and low noise refrigerating appliances (0.1 Mt CO2 eq./a GHG-abatement, see Annex 4).

[60] For the conversion from electricity to primary energy, it reflects the primary energy efficiency of electricity generation.

[61] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC. OJ L 315, 14.11.2012, p. 1

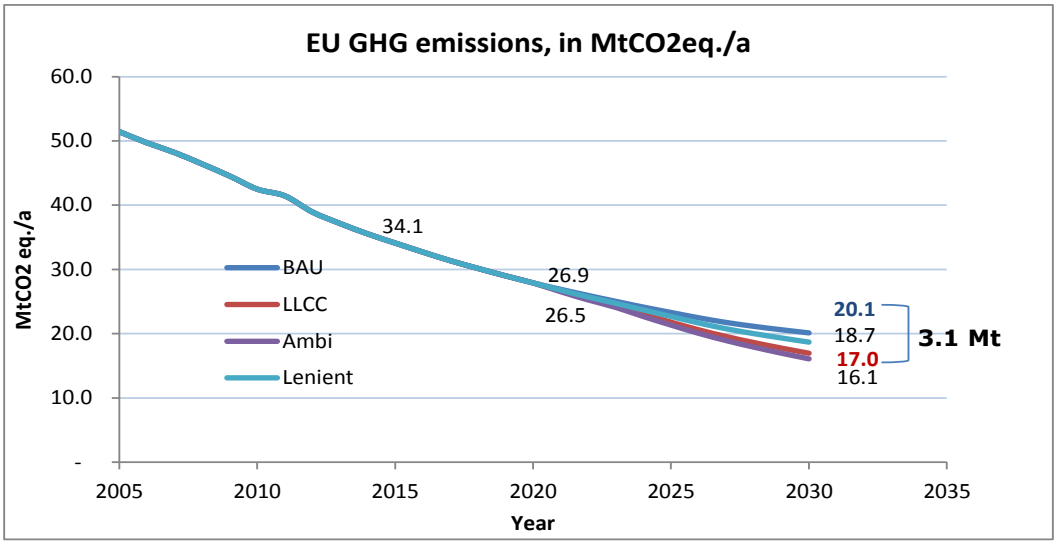

Figure 8: EU greenhouse gas over the period 2005-2030, in Mt CO2 equivalent, for various scenarios

The GHG emission savings expected by 2030 for the different scenarios are given in Table 17. The savings of the baseline relative to 2015 are 7.2 Mt CO_2 eq./a (21 %) in 2020 and 14 Mt CO_2 eq./a (41 %) in 2030.

Table 17: Overview of the GHG emissions and savings, including from wine storage and low noise refrigerating appliances for each scenario in comparison to the baseline (Impact Assessment Study 2018)

	GHG emissions (Mt CO_2 eq./a)	**Savings in 2030 (Mt CO_2 eq./a)**	**Savings in 2030 (%)**	**Savings compared to the remaining savings for the period 2016-2030 (%)**
baseline	20.1			
LLCC	16.9	3.2	16	0.30
Ambitious	16.0	4.1	21	0.38
Lenient	18.6	1.5	10	0.14

Stakeholder views – Comments on the GHG-emissions from energy use are included in the comments on the energy efficiency requirements Sections 5.2.2, 5.2.3 and 5.2.4. On the emissions from refrigerants, environmental NGOs requested to include a requirement to avoid that hydrofluoro-olefins (HFOs) would be used in household refrigerating appliances.

6.1.3. Circular Economy perspective

The environmental life-cycle assessments in the Review Study 2016 show that the energy consumption and the related emissions are the dominant environmental impacts for this product category. For this reason, the circular economy requirements are limited only to those requirements that make sense from a life cycle perspective.

Note that the options do not differentiate between these material resources measures, i.e. they are all part of all options, except the baseline option.

Design for optimised food storage - For material resources efficiency, reduction of food waste through better, more specific preservation is the most important element.

The beneficial metrics for appliances that optimise their design for food preservation lead to lower EEI values (higher efficiencies). However in reality, the energy consumption of

the appliances will be higher (at least 20 % higher, see also Section 2.2) and the real savings are expected through the reduction of food waste.

The Complementary Study on food waste concluded that with optimal storage conditions the current food waste due to 'not-used-in time', estimated at 23 Mt/year (EU 2011-2012), can be reduced by almost 60% (13 Mt). An additional 20-25% (7-8 Mt) can be saved on food waste from leftovers and too much food prepared or served (leftovers) etc. by better preservation.

However, it is clear that measure alone will not solve the food waste problem. Several other barriers need to be overcome:

- consumer behaviour
- current product specific legislation on food preservation[62]
- food labelling (e.g. expiry dates)

To steer the consumer behaviour some requirements have been added to inform them about the correct preservation of food, the impacts of food waste and the presence of compartments that optimise food preservation. Without a thorough study on consumer behaviour it is impossible to estimate whether these requirements are sufficient to trigger changes in consumer behaviour. Unfortunately, Ecodesign and Energy Labelling cannot regulate the influencing factors more than that. Therefore, it should be seen as a first step in that direction.

For these reasons, the beneficial metrics only conservatively decrease the EEI values (between 2 % and 5 %, depending on the number of doors, see Annex 11.3), they do not completely compensate for the 20 % increase in energy consumption.

In addition, the Complementary Study 2016 concluded that:

- it would be enough to only reduce the food waste with only 2% to compensated for the 20 % higher energy use (see also Section 2.2);
- the existence of different compartments ranging from -1 °C to 17 °C creates new energy savings opportunities, e.g. by capturing the 'waste-cold' from low-temperature compartments and defrosting;
- optimal food storage also keeps food healthier and tastier.

Hence, the measure makes sense from a broader environmental perspective.

Availability and replacement of spare parts - As a safeguard against the possible reduction of the product lifetime and also to maintain energy efficiency over time, the availability of spare part thermostats, temperature sensors, printed circuit boards and door gaskets is important.

[62] E.g: European Commission Regulation (EC) No 589/2008 of 23 June 2008 laying down detailed rules for implementing Council Regulation (EC) No 1234/2007 as regards marketing standards for eggs states: "Article 13. Indication of the date of minimum durability.

Life time extension, including from re-use, is not useful seeing the large energy saving potential that still remains for this product group. Such requirements would stagnate the entry of new, more efficient models on the market. A period of 7 years for safeguarding the reduction in product lifetime and 10 years for maintain energy efficiency over time, is expected not to extend the life time which is on average 16 years.

Design for recycling - Finally, to facilitate recycling, the removability of key components as per Article 8(2) of the WEEE Directive is important.

Stakeholder views – See stakeholder views on circular economy in Section 5.2.2.

6.2. Business impacts

6.2.1. Business revenue

To achieve energy and carbon savings, industry has to invest. As such, the cost will be higher. In retail, with average wholesale- and retail margins (and Value Added Tax (VAT) assumed fixed[63], the cost will also be higher. This will be translated into a higher price (in absolute euros) of the appliance, which will affect consumer expenditure. Consequently, the acquisition cost for the consumer will increase as a consequence of the policy scenarios (despite the assumption of a learning effect[64] of 1% for prices above the current base case level; see also Section 6.3 and Section 6.5.1). This investment leads to a higher revenue for the industry and retail sector, as indicated in Table 18.

Table 18: Overview business revenue per scenario, in billion Euro [2010] (Impact Assessment Study 2018).**

sector	INDUSTRY			WHOLESALE			RETAIL*			TOTAL			Increase
scenario	**2015**	**2020**	**2030**	**2015**	**2020**	**2030**	**2015**	**2020**	**2030**	**2015**	**2020**	**2030**	**2030**
Baseline	4.1	4.2	4.3	0.3	0.3	0.3	4.1	4.2	4.3	8.6	8.7	8.9	ref
LLCC	4.1	4.2	4.6	0.3	0.3	0.3	4.1	4.2	4.6	8.6	8.7	9.5	0.6
Ambitious	4.1	4.2	5.2	0.3	0.3	0.4	4.1	4.6	5.3	8.6	9.1	10.9	1.9
Lenient	4.1	4.2	4.3	0.3	0.3	0.3	4.1	4.2	4.3	8.6	8.7	8.9	0

**= includes repair (estimated 0.5 bn Euro/a) . ** inflation-corrected/recalculated in Euros 2010 at 2% inflation*

Option 1 - baseline - gives an increase of 0.3 billion Euros (Net Present Value[65] (NPV) 2010) in 2030 with respect to 2015. **Option 2 - LLCC** - gives an extra 7% in turnover (EUR 0.6 billion) in 2030. **Option 3 - ambitious** - gives an extra 21% (EUR 1.9 billion) in total business turnover. **Option 4 - lenient** - no increase with respect to baseline scenario.

Figure 9 shows the projected industry revenue for the different scenarios.

[63] Fixed means that the measure will not have impact on the average wholesale and retail margins. The introduction of ecodesign and energy labelling measures for white goods have not had an effect on these average margins in the past, therefore, it is assumed that it will not have an effect here.

[64] Learning effect meaning the reduction in price due to the increase in demand.

[65] Net present value (NPV) means the difference between the present value of cash inflows and the present value of cash outflows over a period of time

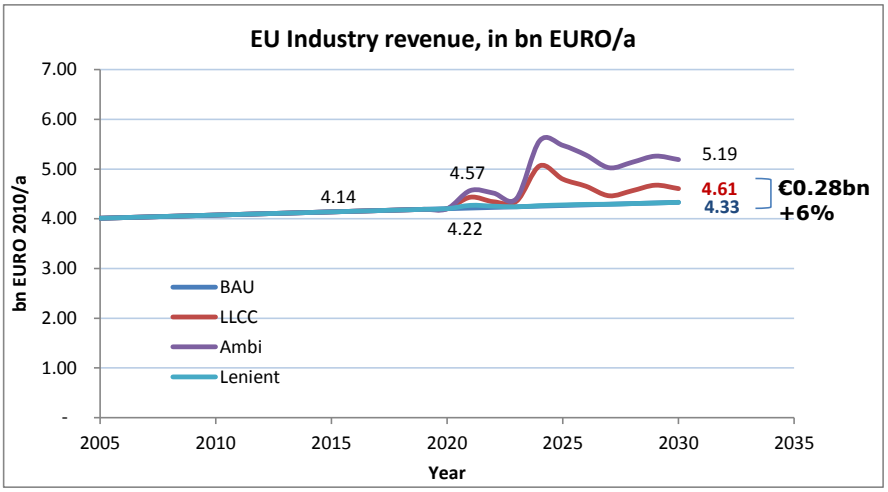

Figure 9: Projected industry revenue over the period 2005-2030, in Mt CO2 equivalent, for various scenarios (Impact assessment study 2018)

It is expected that the business revenue will not be impacted significantly by the rescaling, even with products in the A+ and the A++ class that will end up in the F and G class respectively.

This is because it is not the intention that manufacturers will keep on making the same products that will end up in the F and G class with competitive lower mark-ups. Today, due to the overpopulation of the top energy classes, energy efficiency improvement cannot be shown to the consumers and will therefore not be rewarded in the price of the model. It is expected that the measures will give sufficient incentive for manufacturers to improve the energy efficiency of their products (see also Section 6.2.2) as to reach the new A and B levels that can then be sold at a higher price.

The move toward more efficient appliances is also shown in Annex 12, Table 44, where in the period 2021 – 2025, the percentage of appliances in the F and G class are rapidly decreasing.

In addition, rescaling itself will have the same impact on all refrigerating appliances, their manufacturers and suppliers. All refrigerating appliances will bear the new energy label at the point of sales after the date of application without overlap. The impact assessment of the energy labelling framework regulation states that a period of overlap is likely to confuse consumers and lead to sales of less efficient appliances, although it is impossible to quantify by how much.

The introduction of the new energy labels will go together with information campaigns for consumers.

Stakeholder views – APPLiA commented that the disregarded scenario (see Section 5.3.2) would remove a large amount of products from the market. Such scenarios will require significant redesign which requires significant investment. Stakeholders did not comment on Business revenue.

6.2.2. Innovation, Research and Development, Competitiveness

The household refrigeration appliances industry spends approximately EUR 0.35 billion (3.8 % of its total turnover) on research and development (R&D) (APPLiA).

The revision of the household refrigeration appliance labelling regulation is expected to support innovation and drive market transformation, as was observed in the past. It is in line with ongoing market trends towards higher energy efficiency, where a high-energy label rating is a strong commercial driver (Review Study 2016).

However, it is not expected that the regulation will lead to any significant structural increase of R&D budgets, unless if the requirements do not take the normal pace of R&D into account. There is however a shift in priorities for the R&D budget, which is directed more towards e.g. energy efficiency improvements instead of e.g. new production techniques. The same goes for investments in new production lines for more efficient products. In addition, products meeting the requirements are already commercially available on the market.

Almost all manufacturers of refrigerating appliances are large companies. Hence, it assumed that they have the technological capabilities that allow them to reach the top label levels.

Impact will be most limited in **option 4 - lenient scenario** and most challenging in the **option 3 - ambitious scenario**. The **option 2 - LLCC scenario** is in line with the pace of innovation over the past period. To further keep the R&D expenditure at its normal pace, the proposed period between the application of the first and second tier of requirements is 3 years, whereas in the current Regulation this is 2 years.

The development of innovative energy-efficient technologies at competitive prices[66] will enhance the competitiveness of European manufacturers. This is important because Asian manufacturers are rapidly expanding their global market share. For these manufacturers, product price, rather than quality, is one of the main selling points.

The SMEs are protected by lower requirements for wine storage appliances and low noise appliances, these are the products they typically produce.

Stakeholder views – Stakeholders did not comment on Innovation, Research and Development, Competitiveness.

6.2.3. Compliance costs

Ecodesign and energy label requirements for refrigerating appliances in the scope have a strong influence on the market and have been in existence for the last 20 years.

Research and development as well as production investments are common practice in the industry. Redesign would happen with or without new measures. As a consequence, the compliance costs and amongst others, the cost for redesign, are not expected to increase.

[66] The development of innovative energy-efficient technologies at competitive prices has been observed with the introduction the current ecodesign and energy labelling regulation (See also Annex 9). It is assumed that this will be the case for a revised measure as well.

Any potential extra cost is expected to be absorbed by the industry. With or without the measures, manufacturers will be obliged to test their products according to the new test method, otherwise they will not be able to compete on the global market. Therefore, costs from testing according to the new standard will be the same for all options, including the baseline. As regards the SMEs operating in some niche markets, the Commission proposals have done their utmost to minimise the burden (see Section 6.5.3).

The administrative burden of current and proposed measures is further developed in Section 6.4.

Stakeholder views - The ecodesign requirements have not led to complaints on extra costs that were not repaid, in the short or long run, by extra revenue.

6.2.4. Intellectual Property Rights

The technologies considered in all scenarios are commonly available to all major manufacturers.

Stakeholder views - No concerns were raised that the options would impose proprietary technology on manufacturers.

6.2.5. Stranded investments

The risk of stranded investments could exist for the least energy efficient appliances such as combi appliances with a single thermostat design (Type I). However, these products and their components have been introduced in the market in the 1960s and production lines and other capital costs have long been depreciated (written off).

Therefore, there are no risks on stranded investments.

Stakeholder view - APPLiA did not raise the issue of stranded investments.

6.3. Consumer expenditure

Consumer expenditure consists of acquisition costs, maintenance/repairs and running costs. For refrigerating appliances, the repair costs are modest (estimated in the order of EUR 0.5 billion/year) and are assumed to be included in the acquisition costs. The running costs are equal to the energy costs. For a detailed analysis of the acquisition cost and the energy cost, see Annex 12.3. The overall consumer expenditure (= sum of the acquisition and running costs) for the different scenarios are shown in Figure 10.

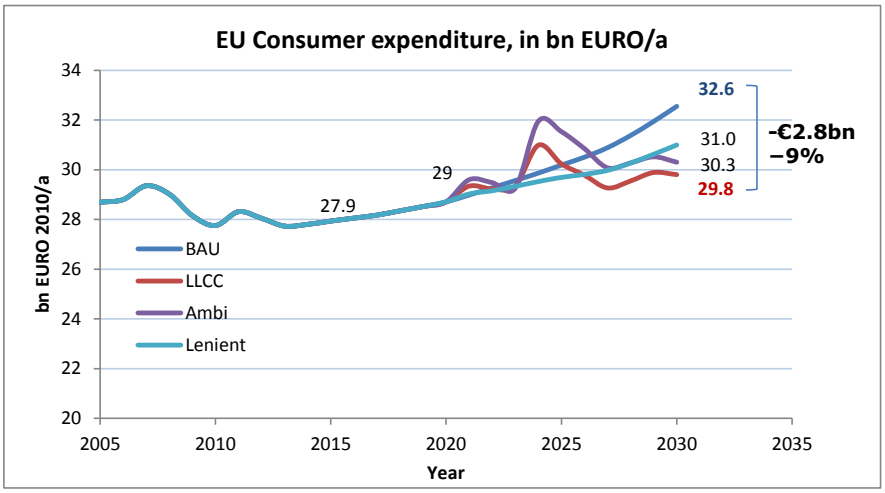

Figure 10: ***Projected consumer expenditure over the period 2005-2030, in billion Euros [2010] (Impact Assessment Study 2018).***

Option 1 - baseline - consumer expenditure rises by EUR 4.7 billion (17%) per year between 2015 and 2030. **Option 2 - LLCC** - saves the most in consumer expenditure, almost 3 billion Euros per year (9%) with respect to the baseline in 2030. **Option 3 - Ambitious** - The expenditure is considerably more than any other scenario over the period 2021-2030. Only in 2028 it drops below the baseline. In 2030 it drops to a level similar to the lenient scenarios in 2030. **Option 4 – Lenient** - The expenditure is lower than the baseline, but higher than the LLCC. A sensitivity analysis of the consumer expenditure is included in Annex 12.3.2.

Stakeholder views – APPLiA questioned the feasibility of the discarded scenario (see Section 5.3.2) in certain countries in terms consumer expenditure and affordability. Several eastern European MS also commented on the feasibility of this scenario with respect to consumer expenses and affordability. Consumer organisations stated that the ambitious option would eliminate a specific, very low-cost type of combi-appliance (Type I) which is believed necessary to serve low-income households.

6.4. Administrative burden

The administrative burden of new measures under the Energy Labelling Framework Regulation were calculated in the Impact Assessment for the Energy Labelling Framework Regulation. The costs for household refrigeration appliances are summarised in Table 19.

For ecodesign measures for products with an energy label, the above-mentioned impact assessment study considered that there was no additional administrative burden for industry, because there were vested commercial interests. More details are found in Annex 12.4

Table 19: Administrative burden in '000 euros (Impact Assessment Energy Labelling Regulation)

Administrative burden	one-off	annual	BAU
For the first 6 months provide a second label and supply extra labels on request to dealers	3300		-
Dealers re-labelling around 2.5% of products on stock/display or on the internet	600		-
Database, supplier costs		90	-
Database, EU budget	90	9	-

Joint support actions, EU budget (e.g. EEPLIANT)		33	x
Support joint surveillance actions (Horizon2020)		60	x
External laboratory costs (SMEs)		66	x
Market surveillance, Member State costs		330	x
Total business-as-usual (BAU)	**-**	**489**	
Total new costs of measures	**3990**	**99**	

Stakeholder views – No comments were made on the administrative burden.

6.5. Social Impact

6.5.1. Affordability

In this Impact Assessment, affordability is based on the simple payback time of the appliance. The life cycle costs and payback time are based on EU28 average price values for, amongst others, electricity. For Member States with lower than average electricity prices, the payback time will be higher than this EU28 average payback time. To be affordable in all Member States, the EU28 average payback time is kept lower or equal than half of the lifetime of the product.

A sensitivity analysis of the life cycle costs (LCC) based on the data in the Review Study 2016 and the electricity prices in Germany and Romania, which are at the higher and lower end respectively of electricity prices in the EU can be found in Annex 12.

For **option 2 – LLCC**, on average the prices are projected to go up by 10-12 %, whereas the annual energy costs go down by 23-25 %. At the projected energy prices this means a simple payback period of 6 -7 years for an appliance that lasts on average 16 years. In other words, also for consumers with below-average income this is economically a worthwhile investment.

The risk that consumers would postpone the purchase of a new appliance exits. However, this behaviour has not been observed with the introduction of the current Regulations, therefore it is not considered here.

Moreover, with the introduction of the previous regulations for refrigerating appliances, the purchase price of refrigerating appliances did not change much. The industry managed to maintain the same average prices over the last 15 years. Only in the first two years, when not all manufacturers were capable of producing the highest energy label levels, there was a slight price increase, which subsequently disappeared.

Only in the case where the purchaser (e.g. a landlord) is not the one paying the energy bill (e.g. a tenant) the economic considerations for the purchaser may be different. Ecodesign measures are intended for just those situations, i.e. to ensure that a landlord or a short-time-user buys an appliance that meets at least a minimum efficiency level.

Stakeholder views – See stakeholder comments consumer expenditure, Section 6.3.

6.5.2. Health, Safety and Functionality Aspects

There are no specific health and safety aspects related to the measures analysed. There

are no known negative impacts from using more efficient appliances as prescribed by the policy options.

Stakeholder views – Stakeholders did not report any negative impacts in this respect.

6.5.3. Employment

Total employment - The EU impact on employment is estimated from the increase in revenue and turnover per employee, this is the convention as per the MEErP methodology[67]. Table 20 gives an overview of the employment impact according to the boundaries described in Annex 12.5.

While there is some correlation between revenue and employment for a manufacturing industry, there are however other influencing factors (e.g. macro-economics, EU trade policy, strategy of EU companies to move workforce to low-cost countries outside the EU, etc.) which have not been taken into account in the impact modelling. Hence, the real job impacts are expected to be lower than indicated in the report.

Table 20: Overview direct employment per scenario, in '000 jobs (Impact Assessment Study 2018)

sector	INDUSTRY*			WHOLESALE**			RETAIL***			TOTAL			Increase
scenario	**2015**	**2020**	**2030**	**2015**	**2020**	**2030**	**2015**	**2020**	**2030**	**2015**	**2020**	**2030**	**2030**
BAU	83	84	87	1.2	1.3	1.3	82	83	86	166	169	174	ref
LLCC	83	84	92	1.2	1.3	1.4	82	83	91	166	169	185	11
Ambitious	83	84	104	1.2	1.3	1.5	82	91	106	166	177	212	38
Lenient	83	84	87	1.2	1.3	1.3	82	83	86	166	169	174	0
=33% manufacturer, 33% Original Equipment manufacturer (OEM) (of which 50% EU), 33% business services; EUR50k/job; **=EUR250k/job *=EUR60k/job*													

In **Option 2 - LLCC** and **Option 3 – ambitious**, approximately 11000 and 38000 jobs would be created, respectively, as compared to a baseline, equally divided between industry and trade. **Option 4 - lenient** - hardly any jobs would be created/retained as compared to the baseline.

SMEs - SME manufacturers of refrigeration appliances in the scope can only be found in niche markets such as minibars (low noise appliances) or customised wine storage appliances produced in one-off or small series for restaurants, bars or connoisseurs usually with glass doors, see also Section 2.5.1. Their market share in these niche markets may be 30-40%. Table 21 shows an overview of the estimated employment in SMEs involved in the production of refrigeration appliances in the scope.

Table 21: Overview of employment in SME industry involved in production, including suppliers (Impact Assessment Study 2018)

	SME Employment (number of jobs)
Wine storage appliances	500-800
Mini-bars	200

In order to retain these SME jobs, it is proposed to apply more lenient requirements for wine storage and low noise appliances. For wine storage and low noise appliances with

[67] MEErP 2011, Methodology Report - Part 1: Methods, COWI in association with VHK, prepared for the European Commission, DG Enterprise and Industry, Unit B1 Sustainable Industrial Policy. Brussels/Delft, 28 November 2011

glass doors even less stringent appliances are proposed, see also Section 5.2.2.

Stakeholder views – Stakeholders did not comment on the total employment. APPLiA and the MSs are in favour of more lenient requirements for wine storage and low noise appliances. For glass door appliances, this could be done either through a glass door correction factor (supported by several MS) or through separate requirements (supported by some MS and APPLiA). NGOs are not in favour of correction factors.

6.6. Linearity of the impacts in between the LLCC and ambitious options

In case that another option would be selected with an ambition level in between the LLCC and ambitious scenario, it should be noted that the impacts are not fully linear.

The expected cut off rate and the affordability for low income households are impacts that are only linear up to a certain point. According to industry and consumer associations, beyond a certain point (somewhere between the LLCC and the ambitious scenario), the impact is no longer linear.

The non-linearity originates from the need to increase R&D efforts and investments in new production lines higher than the normal development pace, see also Section 6.2.2 In this case, industry is confronted with considerably higher costs which they may or may not be able to carry. In addition, as regards to affordability, the price of refrigerating appliances will increase when the extra production costs can no longer be absorbed by a normal development pace. This risks that low-income families will no longer be able to afford a new refrigerating appliance. Instead, they will continue to use and repair their old energy inefficient refrigerating appliance longer than is environmentally responsible.

7. HOW DO THE OPTIONS COMPARE?

7.1. Summary of the impacts

Tables 22 and 23 summarise the impacts described in Section 0.

Table 22: Overview main annual impacts of the options. Best values (Bold), worst values (Italic) (Impact Assessment Study 2018)

Impact (unit)	2020	2030				2040			
	absolute	absolute	increment			absolute	increment		
	baseline	baseline	LLCC	Ambitious	Lenient	baseline	LLCC	Ambitious	Lenient
Unit electricity (kWh/a)	181	161	-47	**-59**	*-23*	122	-35	**-45**	*-17*
Electricity consumption (TWh/a)	73	59	-9.6	**-12**	*-4*	51	-15.6	**-19**	*-7*
GHG emissions (Mt CO2 eq./a)	27.9	20.1	-3.3	**-4.0**	*-1.4*	15.3	-4.6	**-5.7**	*-2.2*
Acquisition costs (EUR billion)	10.4	10.7	0.7	*2.6*	**0**	11.1	2.6	*3.9*	**0.7**
Energy costs (EUR billion)	18.3	21.8	-3.4	**-5.0**	-1.6	27.9	-8.26	**-10.86**	*-4.01*
Consumer expenditure (EUR billion)	28.7	32.6	**-2.7**	-2.2	*-1.6*	38.9	-5.6	**-6.7**	*-3.3*
Industry revenue (EUR billion)	4.20	4.33	0.28	**0.86**	*0*	4.46	1.06	**1.47**	*0.27*
Wholesale revenue (EUR billion))	0.31	0.32	0.02	**0.06**	*0*	0.33	0.08	**0.11**	*0.02*
Retail revenue (EUR billion)	4.17	4.30	0.27	**1.02**	*0*	4.42	1.05	**1.58**	*0.26*
Employment ('000jobs)	169	174	11	**38**	0	179	42	**61**	0

Table 23: Overview main accumulative impacts of the options. Best values (Bold), worst values (Italic) (Impact Assessment Study 2018)

Impact (unit)	2021-2030				2021-2040			
	absolute	increment			absolute	increment		
	baseline	LLCC	Ambitious	Lenient	baseline	LLCC	Ambitious	Lenient
EU electricity consumption (TWh/a)	660	-47	**-62**	*-21*	1250	-185	**-235**	*-85*
EU GHG emissions (Mt CO2 eq./a)	239	-17	**-22**	*-7*	424	-60	**-77**	*-28*
Consumer expenditure (billion Euros 2010)	305	**-7.7**	*-1.3*	-6.7	665	**-53**	-52	*-35*
Energy costs (billion Euros 2010)	199	-16	**-24**	*-7*	450	-80	**-112**	*-37*
Acquisition costs (billion Euros 2010, incl. VAT)	106	8	*23*	**0**	215	27	57	**2**
Industry revenue (EUR billion)	43	3.2	**7.7**	0.1	87	11	**20**	*1*
Wholesale revenue (EUR billion)	3	0	**1**	0	6	-3	-3	-3
Retail revenue (EUR billion)	42	3	**9**	0	86	11	**23**	*1*
Total revenue (EUR billion)	88	7	**18**	0	179	18	**40**	*-2*

7.2. Market Surveillance

All proposed policy options would be subject to Article 15(8) of the Ecodesign Framework Directive, as well as Article 8(1) and (3) of Energy Labelling Framework Regulation, which requires that MSAs can verify the conformity of a product with all regulatory requirements.

The cost for market surveillance organised by MSs is the same for all options, i.e. EUR 330.000 annually, see Section 6.4.

Stakeholder views – APPLiA and other industry associations, have emphasised the importance of securing a sufficient level of market surveillance to ensure that only compliant products are placed on the market. In this respect, they call for increased enforcement by MSAs.

7.3. Assessment in view of Article 15(5) of the Ecodesign Framework Directive

Pursuant to Article 15(5) of the Ecodesign Framework Directive, future implementing measures should fulfil a number of criteria, see Section 3.1. An assessment of the options in view of these criteria and on the basis of Tables 22 and 23 is shown in Table 24.

Table 24: Evaluation of policy options in terms of their impacts compared to the baseline (Impact Assessment Study 2018)

Significant impacts as stipulated in Article 15 of the Ecodesign Directive	baseline	LLCC	Ambitiouos	Lenient
No negative impacts on the functionality (Section 6.2)	✓	✓	✓	✓
No negative impacts on health, safety and environment (Section 0)	✓	✓	✓	✓
No negative impact on consumers (Section 6.3 and 0)	✓	✓	**X**	✓
No negative impacts on industry's competitiveness (Sections 6.2)	✓	✓	✓	✓
Not imposing proprietary technology (Section 6.2)	✓	✓	✓	✓
No excessive administrative burden on manufacturers (Section 6.2 and 6.4)	✓	✓	✓	✓

Although **option 3 - ambitious** has the best values in most of the categories in Tables 22 and 23, it cannot be retained as the option for a future implementing measure because it does not fulfil the criterion 'no negative impact on consumers' of Article 15(5). The consumer expenditure in the short term is too high for the average consumer in terms of affordability and life cycle cost, i.e. the simple payback time is higher than half the lifetime of the product (see also Section 6.5.1.). In addition, the 'x' also refers to the fact that the option would eliminate a specific, very low-cost type of combi-appliance (Type I) that according to the consumer organisation is believed necessary to serve low-income households. **Option 2 – LLCC** and **option 4 – lenient** fulfil all criteria.

7.4. Assessment in view of the objectives

An assessment of the options in view the objectives in Section 4, on the basis of Tables 22 and 23, is shown in Table 25.

Option 4 - lenient does not contribute to the general objectives and only contributes to two out of three specific objectives. It is therefore not seen as an appropriate policy option. **Option 1 – baseline** does not contribute to any of the objectives. **Option 3 – ambitious contributes** to all objectives in the same way as option 2 – LLCC, except for the specific objective 'Update the energy efficiency requirements and the energy label in line with international and technical developments'. Here the option goes beyond the international and technical developments. In any case, this option has been excluded based on the evaluation in Section 7.3. As a consequence **option 2 – LCCC** is the

preferred option. More information on the benefits of option 2 are included in the next paragraph.

Table 25: Score of impacts against objectives. No Change (0), limited improvement (+), significant improvement (++). (Impact Assessment Study 2018)

General Objectives	**baseline**	**LLCC**	**Ambitious**	**Lenient**
1. Ensure free circulation of efficient products within the internal market;	**0**	+	+	**0**
2. Promote competitiveness of the refrigeration industry through the creation or expansion of the EU internal market for sustainable products;*	**0**	+	+	**0**
3. Promote the energy efficiency of refrigeration appliances;**	**0**	+	++	**0**
4. Contribution to the Commission's objective to reduce energy consumption by 30 % and domestic GHG emissions by 40 % by 2030;***	**0**	+	+	**0**
5. Increase the security of energy supply in the Union through a reduction in energy consumption of household refrigeration appliances	**0**	+	+	**0**
Specific Objectives				
1. Update the energy efficiency requirements and the energy label in line with international and technical developments;	**0**	++	+	**0**
2. Contribute towards a circular economy in the EU by including requirements on spare part availability and food waste reduction	**0**	+	+	+
3. Redefine the scope to close potential loopholes and adopt a technical neutral approach	**0**	+	+	+

*Innovation will enhance competitiveness of the EU manufacturers; the effect on innovation is therefore included in this objective.

**The promotion of energy efficient appliances for the ambitious scenario will be significantly higher than for the LLCC scenario. However, we should take into account that the risk exists that the market uptake of these more efficient appliances might be slower because they are unaffordable for low-income families.

***The contribution to the 2030 target increases with 0.16% for energy efficiency and 0.08% for GHG emissions for the ambitious scenario in comparison to the LLCC scenario. This does not make the difference between limited improvement and significant improvements.

8. PREFERRED OPTION

8.1. Preferred option – Why?

Option 2 - LLCC fulfils the criteria in Article 15(5) of the Ecodesign Regulation and Article 16(2) of the Energy Labelling Regulation, see Section 3.1, and will achieve the objectives as set out in Section 5 in the best way, see Section 7.4.

By 2030, option 2 – LLCC will results in the following:

- Energy savings of 9.6 TWh/yr and GHG emission savings of 3.1 $MtCO_2eq./a$, i.e. 0.66% of the Union's 2030 target for final energy consumption savings and 0.25 % of the Union's 2030 target for GHG-emissions savings;
- Savings on annual end-user expenditure of EUR 2.8 billion and extra business

revenue of EUR 0.44 billion per year, which translates into around 11 000 jobs;

- An alignment with technological progress and global minimum energy efficiency requirements in other economies;
- Ensuring EU industry's competitiveness and leading role as high-quality manufacturers;
- Safeguarding of SMEs working in niche markets.

This option promotes innovation and medium-term cost reduction for more efficient household refrigeration appliances.

8.2. REFIT (simplification and improved efficiency)

This section will describe how the preferred option is expected to improve the efficiency of the existing measures.

The LLCC option will reduce the total consumer expenditure as compared to the baseline. This consumer expenditure includes the acquisition cost and the energy cost. The acquisition cost will be higher, but the energy cost will decrease significantly as compared to the baseline. In addition, this option will improve industry's revenues significantly.

Table 26 gives an overview of the increment in cost and as compared to the baseline.

Table 26: Increment in costs, revenue and administrative burden

		2030	**2040**	**Comment**
Acquisition costs (EUR billion) Energy costs (EUR billion) Consumer expenditure (EUR billion)		0.7 -3.4 -2.7	2.6 -8.26 -5.6	The acquisition cost increases, but the total consumer expenditure decreases.
Industry revenue (EUR billion) Wholesale revenue (EUR billion)) Retail revenue (EUR billion)		0.28 0.02 0.27	1.06 0.08 1.05	There is an increase in revenue industry, wholesale and retail
Administrative burden dealers (EUR '000) Administrative burden suppliers (EUR '000) Administrative burden EU (EUR '000)	600 3900 90	90 9	90 9	The increase in administrative cost is due to the introduction of the rescaled energy label and the database requirements

9. HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

The main monitoring element will be the tests carried out to verify compliance with the ecodesign and energy labelling requirements. This monitoring should be done by MS market surveillance authorities to ensure that requirements are met.

The main indicator for evaluating the impact of potential ecodesign and energy labelling regulations is the achievement of a market improvement towards household refrigerating appliances *with a smaller environmental impact. An analysis of the products on the market (sales figures, performance, etc.) will determine if the shift towards more resource efficient products has happened as estimated, in particular based on the following sub-indicators, which reflect the general and specific objectives:*

- *Reduction of the electricity consumption and related GHG emissions of household refrigeration appliances;*
- *Increasing the economic savings for European consumers;*
- *Safeguarding the competitiveness of the European household refrigeration appliances industry and the full value chain;*
- *Improving the regulatory effectiveness and efficiency of the regulation;*
- Compliance with energy efficiency requirements, i.e. maximum EEI for the different product categories;
- Compliance with material efficiency requirements
    - spare part availability,
    - disassembly of key-components,
    - food preservation;
- Compliance of those products that were potentially excluded due to loopholes.

The evaluation should therefore assess these sub-indicators.

Annex 1: Procedural information

1. LEAD DIRECTORATES GENERAL (DG), DECIDE PLANNING/CWP REFERENCES

DG ENER is the lead DG for the Ecodesign and Energy labelling regulation for household.

Decide number of the underlying initiative for the review of ecodesign requirements for household cold appliances is PLAN/2016/441 (inception impact assessment published on 23/01/2018 at https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-476272_en)

Decide number of the underlying initiative for the review of energy labelling for household cold appliances is PLAN/2016/445 (inception impact assessment published on 23/01/2018 at https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-476308_en)

The following DGs (Directorates General) have been invited to contribute to this impact assessment: ENER (Energy), SG (Secretariat-General), GROW (Internal Market, Industry, Entrepreneurship and SMEs), ENV (Environment), CNECT (Communications Networks, Content and Technology), JUST (Justice and Consumers), ECFIN (Economic and Financial Affairs), REGIO (Regional policy), RTD (Research and Innovation), CLIMA (Climate Action), COMP (Competition), TAXUD (Taxation and Customs Union) EMPL (Employment), MOVE (Mobility and Transport), TRADE (Trade) and the JRC (Joint Research Centre) were consulted on the draft IA in March 2018.

2. ORGANISATION AND TIMING

The last Ecodesign Working Plan 2016-2019, adopted in November 2016, confirms that household refrigeration appliances continue to be a priority product group. Furthermore, the recent Energy Label Regulation (EU) 2017/1369 stipulated that household refrigeration appliances are one of the five priority subjects for which the Commission should adopt a new energy label regulation in accordance with the said overall regulation by 2 November 2018.

Article 19 of the Ecodesign Directive foresees a regulatory procedure with scrutiny for the adoption of implementing measures. Subject to qualified majority support in the Regulatory Committee and after scrutiny of the European Parliament and of the Council, the adoption of the measure by the Commission is planned for the end of 2018.

3. CONSULTATION OF THE RSB

The Regulatory Scrutiny Board (RSB) delivered its opinion on a draft of the Impact Assessment on 7 May 2018 after the meeting on 3 May.

RSB Opinion 07.05.2018	Where and how the comments have been taken into account
(B) Main considerations	
(1) The report does not clearly explain how the general assessment criteria from the framework Ecodesign Directive on affordability and significant impacts apply to household refrigerating appliances. The affordability criterion is not discussed in the context of large income disparities across the EU.	An explanation was added in Section 6.5.1, 7.3 and 7.4 on how affordability and significance was assessed. In addition, a sensitivity analysis of the life cycle costs (LCC) based on the data in the Review Study 2016 and the electricity prices in Germany and Romania, which are at the higher and lower end respectively of electricity prices in the EU was included in Annex 12.
(2) The report does not discuss how the primary purpose of eco-labelling, to increase energy efficiency of household refrigerating appliances, could be weakened by including the objectives of the circular economy.	Some text was added to Section 5.2.2 and Annex 11.3 to give a better explanation on the correction factors for better food preservation. Section 6.1.3 now includes an explanation on the effect of the circular economy requirements on the energy consumption. In addition, it explains better requirements make sense in this respect.
(3) The methodology behind assessing the impacts of the proposed measures and the modelling results suggest the need to qualify the reported results.	Section 6.1.3 explains more on the availability of spare parts. Section 6.2.2 now explains the effect of rescaling on the business revenue. Section 6.5.3 now includes a paragraph qualifying the conversion between the revenue and employment.
(C) Further consideration and recommendations for improvement	
(1) The framework Ecodesign Directive and Energy Labelling Regulation postulate that certain criteria should be met when preparing product specific measures. They include 'no significant impacts on affordability and life cycle costs'. The report could usefully clarify the parameters it has used to approximate 'significant impacts' and 'affordability' in the context of household refrigerating appliances. Stakeholders have raised the issue of appliance affordability in some Member States. While the overall consumer expenditure is expected to be lower over the lifetime of a fridge, the higher acquisition costs may lead to affordability barriers in lower-income countries and for lower-income consumers. This issue would deserve a more detailed analysis.	See reply to (B)(1).
(2) The report should address potential trade-offs between energy efficiency and the objectives of the circular economy. As potential energy savings resulting from reducing food waste are not under control of the initiative, the report needs to better justify any measures proposed in this respect (correction coefficients). An	See reply to (B)(2).

improved fridge design with several compartments keeping different temperatures would increase energy consumption of fridges by 20%. It is not clear if the proposed correction coefficients are set in a way that would compensate for the 20% increase in electricity consumption and would incentivise the manufacturers to equip the fridges with compartments holding different temperatures. For certain cases, the application of correction coefficients may even lead to awarding a better energy efficiency label while the real energy consumption may be higher than for other fridges in the same class, which may confuse the consumers and undermine the transparency and effectiveness of the whole system. Similarly, the delay of the replacement of refrigerators due to measures serving the circular economy (such as longer availability of spare parts) may have a negative effect on energy efficiency.	
(3) The quantitative results of the proposed measures are based on Ecodesign Impact Accounting methodology, as for all other Ecodesign initiatives. While this provides a consistent approach to calculations across the different sectors, an oversimplification in specifications of the method may lead to the accumulation of errors, magnified by the fact that the results are aggregated to the whole Ecodesign sphere. As the legislative approach to ecodesign and energy labelling measures has been recently expanded to include also circular economy considerations, the current method to assess impacts of the proposed measures may no longer be fully applicable. Thus, the modelling results need to be qualified, in particular with respect to the expected employment effects, the assumptions on the up-take of fridges with an upgraded design or on the expected lifetime of devices in view of measures to guarantee the availability of spare parts.	See reply to (B)(3).
(4) The attached quantification tables of the various costs and benefits associated to the preferred option of this initiative need to cover all identified costs, including those related to annual surveillance.	Table 26 and Table 29 were updated to include all costs.

4. EVIDENCE, SOURCES AND QUALITY

For this impact assessment, the main supporting studies were as follows:

- Omnibus' review Study 2014[68], concluded that there was still significant energy savings potential for household refrigerating appliances. The Commission Ecodesign Consultation Forum decided in May 2014 that a more extensive preparatory review study was in order.
- Review study 2016 concluded that about 10TWh energy savings could be achieved by setting stricter ecodesign requirements. In addition, it proposed possible measures on spare parts to tackle circular economy aspects of household refrigerating appliances.
- Complementary study 2017 on the possible role of household refrigeration in reducing food waste.
- Impact Assessment Study 2018 by an external consultancy company, Van Holsteijn and Kemna (VHK)[69].

On the basis of this preparatory work, the Commission drafted the policy options presented in this IA.

Stakeholder input received during the above review studies, the Consultation forum and the consultation on the Inception Impact Assessment for Ecodesign and Energy Label have also been taken into account.

[68] Omnibus Review Study on Cold Appliances, Washing Machines, Dishwashers, Washer-Driers, Lighting, Set-top Boxes and Pumps – VHK, VITO, Viegand Maagøe and Wuppertal institute, March 2014. (Omnibus Review Study 2014)

[69] https://www.vhk.nl/

Annex 2: Stakeholder consultation

This Annex gives a brief summary of the consultation process. Details are given of how and which stakeholders were consulted. In addition, it explains how it was ensured that all stakeholder's opinions on the key elements relevant for the IA were gathered.

There has been extensive consultation of stakeholders during the review studies, and before and after the Consultation Forum meeting. Further external expertise was collected and analysed during this process. The results of the stakeholder consultation are further described in this section.

1. REVIEW STUDY AND STAKEHOLDER CONSULTATIONS

The Review Study 2016 started in January 2015 and was completed in February 2016. It followed the structure Methodology for Ecodesign of Energy related Products (MEErP)[70].

The review study covered household refrigeration appliances in the current scope of those regulations, including wine storage appliances which are currently in the scope of the energy labelling regulation, but not in the scope of the ecodesign regulation. A technical, environmental and economic analysis was performed. This assessed the need of updating the requirements for these products and to assess policy options. This was done as per the review clause of the regulations, and within the framework of the Ecodesign Directive and Energy Labelling Regulation.

The review study was developed in an open process, taking into account input from relevant stakeholders including manufacturers and their associations, environmental NGOs, consumer organisations and MS representatives. To facilitate communication with stakeholders, dedicated website was set up on which the interim results and other relevant materials were published. The study website http://www.ecodesign-fridges.eu is still open for download of the study documents and stakeholder comments (status March 2018). During the study, two open consultation meetings were organised at the Commission premises in Brussels on 1 July 2015 and 14 December 2015. During these meetings, the preliminary study were discussed and validated with results interested stakeholders.

2. WORKING DOCUMENT AND CONSULTATION FORUM

The Commission services prepared two Working Documents with ecodesign and energy labelling requirements based on the results of the Review Study. The Working Documents were circulated to the members of the Ecodesign Consultation Forum and for information to the secretariat of the ENVI and ITRE Committees of the European Parliament. The Ecodesign Consultation Forum consists of a balanced representation of MS' representatives, industry associations and NGOs in line with Article 18 of the Ecodesign Directive. On 6 December 2017, they were discussed in the Ecodesign Consultation Forum meeting.

The Working Documents and the stakeholder comments received in writing before and

[70] Kemna, R.B.J., Methodology for the Ecodesign of Energy-related Products (MEErP) – Part 2, VHK for the European Commission, 2011 (MEErP)

after the Consultation Forum meeting were posted on the Commission's CIRCA system. Minutes of the Consultation Forum meetings can be found in Annex 5. Around 20 written comments were received from 18 different MSs' representatives, industry associations and NGOs.

3. RESULTS OF STAKEHOLDER CONSULTATION DURING AND AFTER THE CONSULTATION FORUM

The comments of the main stakeholders on key features of the Commission services' Working Document received during and after the Consultation Forum can be summarized as follows:

- **Scope** – All stakeholders agreed that glass door appliances should be in the scope of the regulations. Lower EEIs should be set for these appliances or a correction factor should be introduced to make sure that these appliances are not eliminated.
- **EEI requirements** – Most stakeholders agreed that the limits are unfeasible in the proposed time frame. Either the limits should be lowered or the measure should be postponed. Most stakeholders agreed on postponing the application.
- **Circular Economy** – Environmental NGOs and some MSs preferred more requirements on the circular economy aspects of the refrigerating appliances in the scope of this measure. On the beneficial metrics for optimised food storage appliances, most stakeholder were in favour, though NGOs and some MSs were not.
- **Metrics** - Environmental NGOs are not in favour of the use of correction factors. They should at a minimum not be used in the energy label. The other stakeholders welcomed the reduction and agreed on the current values.
- **Standard** – Environmental NGOs requested that the regulation would require a modification of the new global test standard to represent real life conditions even better.
- **Energy label classes** – APPLiA requested a revision of the energy efficiency classes to allow more products to reside in the top classes. Most stakeholders requested to make sure that the G-class was populated.

4. OPEN PUBLIC CONSULTATION

An *online public consultation (OPC)*[71] took place from 12th February to 7th May 2018, with the aim to collect stakeholders' views on issues such as the expected effect of potential legislative measures on business and on energy consumption trends.

The OPC contained a common part on Ecodesign and Energy labelling, followed by product specific questions on (i) refrigerators, (ii) dishwashers, (iii) washing machines, (iii) televisions, (iv) electronic displays and (v) lighting.

1230 responses were received of which 67% were consumers and 19% businesses (of which three quarters were SMEs and one-quarter large companies). NGOs made up 6% of respondents, and 7% were "other" categories. National or local governments were under 1% of respondents, and 0.25% came from national Market Surveillance Authorities.

[71] https://ec.europa.eu/info/consultations/public-consultation-ecodesign-and-energy-labelling-refrigerators-dishwashers-washing-machines-televisions-computers-and-lamps_en

The countries of residence of the participants were predominantly the UK (41%) and Germany (26%), with a second group of Austria, Belgium, France, the Netherlands and Spain comprising together some 17%. Nine other Member States comprised another 9.5% of replies, but residents in 12 EU Member States gave either zero or a negligible number of responses. Non-EU respondents comprised around 5% of replies.

It should be noted that of the 1230 respondents, 719 (58%) replied only to lighting related questions as part of a coordinated campaign related to lighting in theatres. This was considered to significantly distort the replies, and for some questions the "lighting respondents" were removed from the calculation. Furthermore, as respondents did not have to reply to all questions, a high rate of "no answer" was observed (from 5% - up to 90%), in addition to those who replied "don't know" or "no opinion". To reflect better the actual answers, the number of "no answers" was deducted and the remaining answers treated as 100%.

4.1. Overall results

The first part of the questionnaire asked general questions aimed at EU citizens and stakeholders with no particular specialised knowledge of ecodesign and energy labelling regulations.

When asked regarding whether their professional activities related to products subject to Ecodesign or Energy Labelling, two-thirds (67%) of business respondents replied in the positive, and one-third (33%) in the negative, with no "no answer" replies. Almost the same percentages for "yes" (63%) and "no" (37%) were given when the business entities were asked whether they or their members knew of the Ecodesign requirements for one or more of the product groups concerned by the questionnaire, although this was reduced to 50% "yes" and 50% "no" when asked about Energy Labelling.

In reply to the question: "In your opinion, does the EU energy label help you (or your members) when deciding which product to buy?" 56% of the total respondents to the OPC gave a positive answer. Of the remainder, around 22% cited "don't know or no opinion", 3% did not reply and 19% responded negatively.

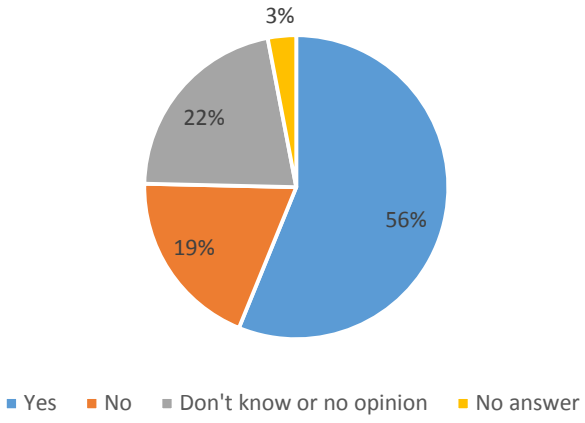

Figure 11: Consumer's views on Label – including lighting

However, looking only at the 'lighting respondents' (526 of the total 1230), 73% of them replied 'No', 'Don't know or no opinion', or 'no answer'. Given that the 'lighting respondents' mainly focused their comments on a narrow issue related to the current

exemption for theatre lighting under ecodesign, the replies of these respondents to the earlier questions cannot necessarily be considered representative. Therefore, the calculation was also done with "lighting respondents" removed. Then, 84% of the respondents to the OPC agree that the EU Energy Label helps when deciding which product to buy. Of the remainder, around 7% cited "don't know or no opinion" or did not reply and 9% responded negatively.

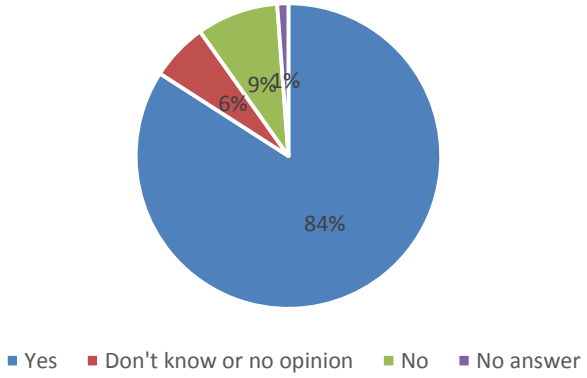

Figure 12: Consumer's view on the energy label – excluding lighting

When asked where they would look to find additional technical information about a product, respondents listed the following (more than one response permitted), ranked by the options provided: manufacturer's website (82%), the booklet of instructions (50%), [the Ecodesign] product information sheet (47%), internet user fora (39%), the retailer's website (18%), and consumer organisations (10%).

Some 63% of the participants were in favour of including Ecodesign requirements on reparability and durability, and 65% of respondents considered that this information should be on Energy Labels.

Regarding the reparability of products, participants valued mostly as "very important" to "important" (in the range 62%-68%)[72] each of the following: a warranty, the availability of spare parts, and a complete manual for repair and maintenance. The delivery time of spare parts was rated as 56% "very important" to "important".

Small and Medium Enterprises (SME) Consultation [SMEs < 250 employees]

One of the aims of the OPC was to gather specific information on SMEs' roles and importance on the market, and to acquire more knowledge on how the aspects related to the environmental impacts of these six product groups were considered by SMEs.

The quali-quantitative evaluation of the effect on SMEs of potential regulatory measures for the environmental impact of all six product categories gave the following results. Approximately 10.5% or replies were from SMEs. These SMEs were involved in the following activities (most popular cited first): (i) product installation, (ii) rent/ leasing of appliances, (iii) repair, (iv) retail of appliances or spare parts, (v) final product manufacture/ assembly, (vi) sale of second-hand appliances, (vii) "other" activities, and (viii) manufacture of specific components.

[72] Scale ranging from not important, somewhat important, important, very important, don't know or no opinion and no answer

In the OPC responses, SMEs reported that they were aware of the Ecodesign and EU Energy Label requirements applicable to the products they were involved in. Nevertheless, SMEs mostly declined to respond (90%) or replied in "don't know/ no opinion" (6%) when asked about the potential impact on their businesses per se, or potential impacts on SMEs compared to larger enterprises, of the introduction of resource efficiency requirements in the revised Ecodesign and Energy Labelling regulations. Of those SMEs who gave an opinion, some 3-4% considered that the impacts could be negative, and around 1% thought that the effects would be positive.

4.2. Responses relating specifically to refrigerating appliances

Between 37 % and 39 % of the participants answered the questions on refrigerating appliances and between 20 % and 29 % of the participants answered don't know or no opinion, depending on the question.

On the question whether the wine storage and low noise appliances should be covered by the definition of a household refrigerating appliance or should be in a separate class, the majority of the stakeholders were of the opinion that wine storage appliances and low noise refrigerating appliances should be covered by the definition of a household refrigerating appliance. This trend was seen in all stakeholder groups (i.e. MSs, NGOs, industry, NGOs, citizens and others). Of all stakeholders 24 % and 39 % respectively answered yes; 14% and 5% respectively answered no. These results are not in line with the results from the other stakeholder consultations. One stakeholder commented that it was unclear whether the question was whether these products should be in the scope or whether they should be in the scope with different requirements. If most stakeholders interpreted the question in the first sense, then the results would be in line with the results from the other stakeholder consultations.

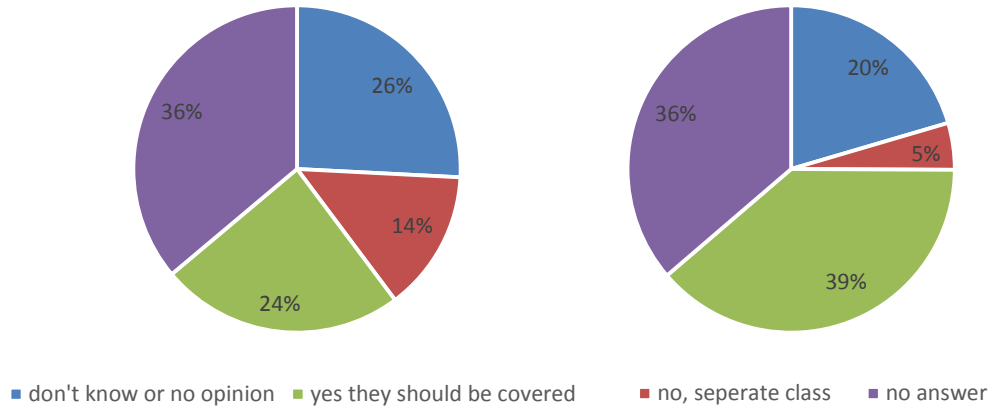

Figure 13: Stakeholder's view on wine storage appliances

With regards to whether different types of appliances should be treated differently in the energy efficiency calculations, in general the positive results were almost equal to the negative results. This is in line with the results from other stakeholder consultations.

- For automatic versus manual defrost, 19 % of all stakeholders said yes (i.e. 11 % yes, 5 % yes for ecodesign and 3 % for energy label) and 21 % said no. When looking into the results for the different stakeholder groups, NGOs clearly are against a different treatment (55 % contra - 9 % pro), while MSs are clearly in

favour (50 % pro - 25 % contra).

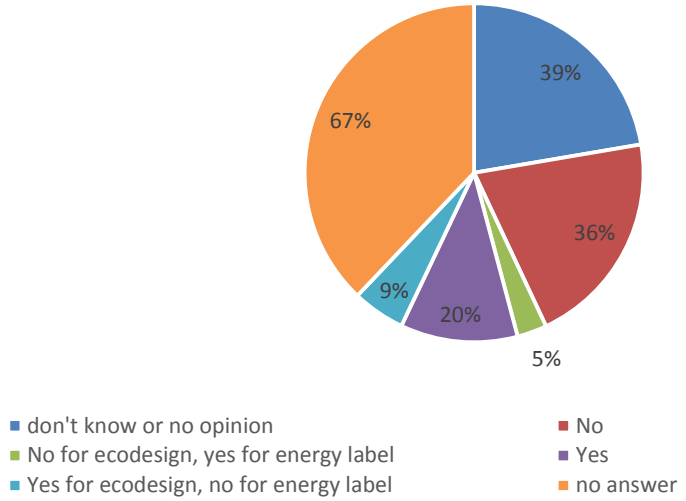

Figure 14: Stakeholders' opinion on treatment of auto versus manual defrost

- For the built-in versus standalone appliances, 13 % of all stakeholders said yes (i.e. 9 % yes, 2 % yes for ecodesign and 1 % yes for energy label) and 29 % of all stakeholders said no. In the different stakeholder groups, NGOs and citizens are clearly against a different treatment (respectively 60% and 33 % contra - 7 % and 16% pro), and MSs are in favour.

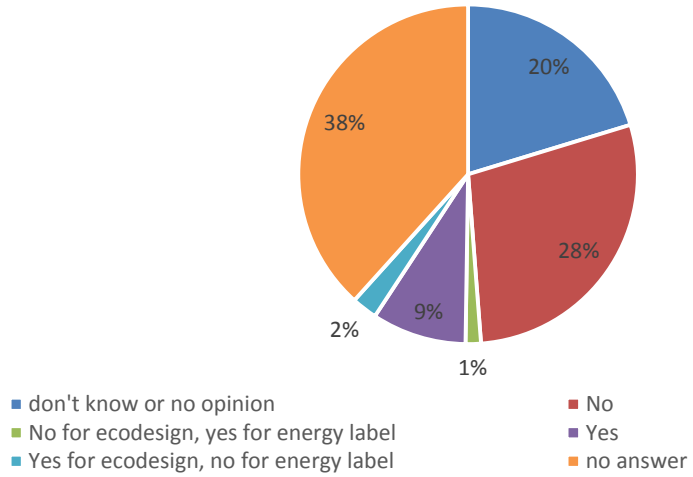

Figure 15: Stakeholders' opinion on treatment of built-in versus standalone

- For appliances with different compartments, 22 % of all stakeholders said yes (i.e. 15 % yes, 3 % yes for ecodesign and 4 % yes for energy label) and 20 % said no. The results for the different stakeholder groups show that NGOs are clear against a different treatment (49 % contra - 13 % pro), while MSs are clearly in favour (50% pro - 17% contra).

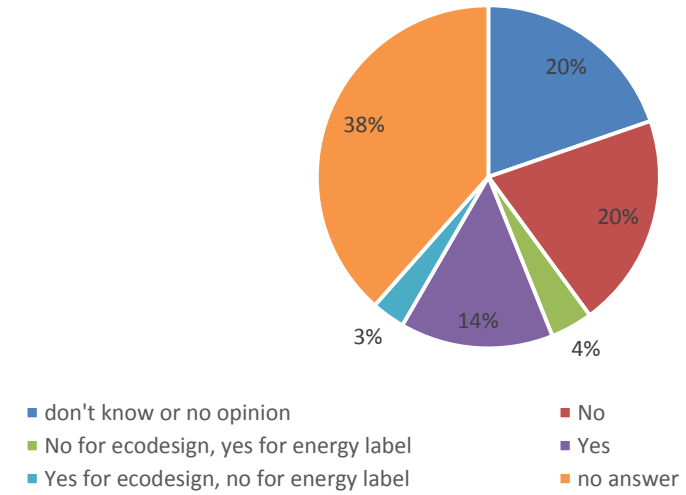

Figure 16: Stakeholders' opinion on treatment of appliances with different compartment types

- For appliances that help prevent food waste, 19 % of all stakeholders said yes (i.e. 13 % yes, 5% % yes for ecodesign and 1 % yes for energy label) and 16% said no. NGOs were clearly against (23% contra – 7 % pro). MSs and companies are in favour (respectively 42 % and 10% pro – 17 % and 6% contra).

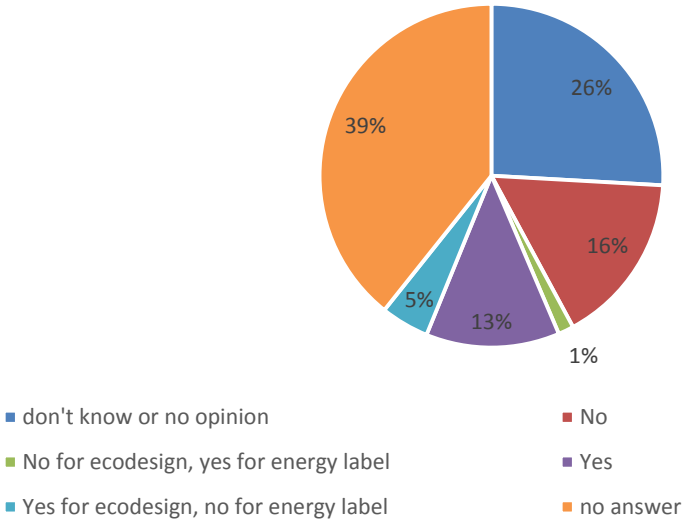

Figure 17: Stakeholders' opinion on treatment of appliances with optimised food storage

With regards to whether refrigerating appliances with glass doors should be in the scope of this regulations or the future regulation for commercial refrigerating appliances 22% was of the opinion that they should be in the scope here, and 15% was of the opinion that they should be in the scope of the commercial refrigerating appliances. This trend can be seen in all the stakeholder groups. This is in line with the results from other stakeholder consultations.

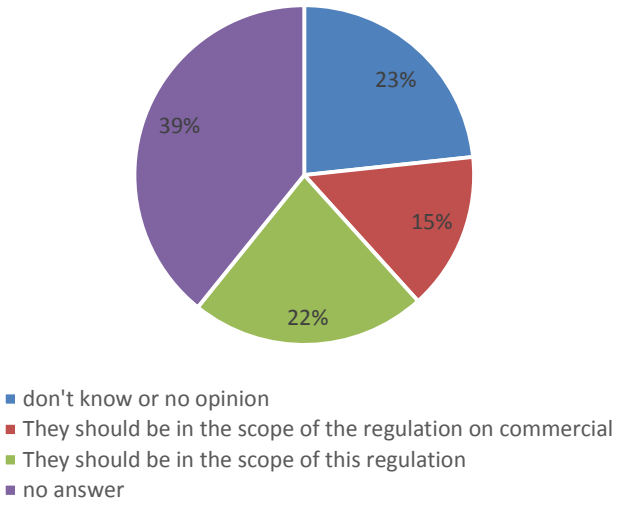

Figure 18: Stakeholders' opinion on glass door appliances

Finally, the further comments revealed that NGOs and citizens are most concerned about the circular economy aspects of the products such as the lifetime, the repair, the warranty and planned obsolescence. Companies are most concerned about the level of the energy efficiency requirements and the circular economy aspects; recycling companies ask for more circular economy requirements, while product manufacturers are more cautious and in some cases negative. One MS commented that the label should be easily understandable by consumers.

5. IA

An IA is required when the expected economic, environmental or social impacts of EU action are likely to be significant. The IA for the review of regulations (EC) No. 643/2009 and (EU) No. 1060/1020 was carried out between May 2017 and March 2018.

The data collected in the review studies, see Annex 1.4, served as a basis for the IA. Additional data and information was collected and discussed by the IA study team with industry and experts, and other stakeholders including MSs. During this process, several meetings were organised with industry and MSs experts. The additional data and information collection focused on:

- Additional market data on energy efficiency for the period 2015-2016;
- Fine-tuning of the metrics, especially for the combi-factor;
- Fine-tuning of definitions;
- Investigation of various options for wine storage appliances and minibars;
- Sensitivity analysis regarding electricity tariffs;
- Extended company information on SMEs, possible impacts.

In addition, inception impact assessments for the 'Regulatory measure on the review of ecodesign requirements for household cold appliances - (EC) No 643/2009' and for the 'Regulatory measure on the review of energy labelling for household cold appliances - (EU) No 1060/2010' were published on 26 January 2018 for feedback until 23 february 2018. In total 12 comments were received for the ecodesign measure and 9 for the energy labelling measure.

In general all stakeholdes are in favor of Ecodesign and Energy labelling requirements for refrigerating appliances. The submitted feedback commented amongst others on the strictness of Ecodesign requirements, the affordability of appliances, resource efficiency requirements and the use of the correction factors.

Annex 3: Who is affected and how?

This annex explains the practical implications of a potential ecodesign and energy labelling measures based on implementation of the preferred policy option, see Section 5.2.2.

1. PRACTICAL IMPLICATIONS OF THE INITIATIVE

The ecodesign regulation will apply to the manufacturers, importers and authorised representatives of refrigerating appliances in the scope of the regulations.

The energy labelling regulations will apply to the suppliers and the dealers of refrigerating appliances in the scope of the regulations.

They will need with comply the ecodesign requirements summarised in Table 27.

Table 27: Summary of the Ecodesign requirements

Who	What	When
Manufacturers, importers and authorised representatives	EEI limits according to the new metrics and new global standard	1 April 2021
Manufacturers, importers and authorised representatives	Minimum spare part availability of 7 years for thermostats, temperature sensors and printed circuit boards and of 10 years for door gaskets	1 April 2021
Suppliers	Provide Energy labels rescaled from A to G and based on the new metrics and new global standard	1 December 2020
Dealers	Display Energy labels rescaled from A to G and based on the new metrics and new global standard	1 April 2021

2. SUMMARY OF COSTS AND BENEFITS

For the preferred option, Table 28 and Table 29 present the costs and benefits which will have been identified and assessed during the impact assessment process.

Table 28: Overview of Benefits (total for all provisions) as compared to the baseline– Preferred Option

I. Overview of Benefits (total for all provisions) – Preferred Option		
Description	***Amount***	***Comments***
Direct benefits		
Energy efficiency savings	9.6 TWh by 2030	See Section 6.1.1
GHG-emissions savings	3.2 Mt CO_2eq/a by 2030	See Section 6.1.2
Circular economy improvements	< 1 Twh/a	No quantitative analysis was performed because the outcomes would be smaller than the error margin of the assessment. See Section 0
Additional business revenue	EUR 11 billion extra by 2030	See Section 6.2.1
Support of innovation, R&D and improved competition	No quantification	See Section 6.2.2
Decreased consumer expenditure	EUR 2.2 billion less by 2030	See Section 6.3
Increased Employment	11000 jobs extra by 2030	See Section 6.5.3

(1) Estimates are relative to the baseline for the preferred option as a whole (i.e. the impact of individual actions/obligations of the preferred option are aggregated together); (2) Please indicate which stakeholder group is the main recipient of the benefit in the comment section;(3) For reductions in regulatory costs, please describe details as to how the saving arises (e.g. reductions in compliance costs, administrative costs, regulatory charges, enforcement costs, etc.; see section 6 of the attached guidance).

Table 29: Overview of the additional costs as compared to the baseline – Preferred option

II. Overview of costs – Preferred option		
What	***Amount***	***Who***
For the first 6 months provide a second label and supply extra labels on request to dealers	EUR 3300000	Suppliers
Relabelling of the products	EUR 600000 on-off	Dealers
Database	EUR 90000 annual	Supplier
	EUR 90000 on-off	EU

(1) Estimates to be provided with respect to the baseline; (2) costs are provided for each identifiable action/obligation of the preferred option otherwise for all retained options when no preferred option is specified; (3) If relevant and available, please present information on costs according to the standard typology of costs (compliance costs, regulatory charges, hassle costs, administrative costs, enforcement costs, indirect costs; see section 6 of the attached guidance).

Annex 4: Analytical methods

1. GENERAL INTRODUCTION

Given the long track record of energy label and ecodesign regulation of household refrigeration appliances, the data availability is good. APPLiA collects data of all models on the EU-market and has done so for many years. These data are not sales-weighted. However, given the large number of models (>13500 models), it is fairly representative of energy efficiency and number of sales. Sales data from market research institutes (e.g. Growth from Knowledge (GfK)), periodically acquired by NGOs (e.g. TopTen) and other stakeholders confirmed this.

These sales data also give an overview of representative market prices, related to energy efficiency classes, in the larger MSs. It enables the assessment of the instantaneous price increases that would follow from the review of the measures (these price increases will diminish on the long run due to a 'learning curve' effect set at 1% price reduction per year).

The Review Study 2016 used APPLiA-data up to 2014; for the impact analysis the datasets for 2015 and 2016 were added. The reliability of most data could be checked by various sources and ultimately the data were confirmed by stakeholder consensus in various stakeholder meetings, bilateral and plenary. Employment impacts are derived from revenue per employee, again checked against reported revenue totals for the sector and anecdotal information from annual reports of individual manufacturers.

Employment impacts are derived from revenue per employee, again checked against reported revenue totals for the sector and information from annual reports of individual manufacturers.

In this Impact Assessment, in line with the Methodology for the Ecodesign of Energy-related Products[73] (MEErP), energy prices were assessed from Eurostat data. For future projections an escalation rate of 4% was used. All prices and costs are expressed in Euro 2010, calculated with historical inflation. For investment-type considerations, a discount rate of 4% is used, in line with the Commission's recommended values (as per the Better Regulation Toolbox).

In addition, there has been a sensitivity analysis that calculates energy costs and consumer expenditure at an escalation rate of 1.5 %. In short, this means that electricity tariffs in 2030 are not EUR 0.36/kWh, but EUR 0.24/kWh (all in Euro 2010).

For primary energy conversion rates for electricity generation and distribution a Primary Energy Factor (PEF) of 2.5 is used, implying by convention a 40% efficiency over the full projection period. For GHG emissions, the emission rate (in kg CO_2 eq./kWh) does

[73] Material-efficiency Ecodesign Report and Module to the Methodology for the Ecodesign of Energy-related Products (MEErP) PART 1: MATERIAL EFFICIENCY FOR ECODESIGN - Final report to the European Commission - DG Enterprise and Industry 5 December 2013.

vary over the projection period in line with overall EU projections as indicated in the MEErP.

The focus is on the period 2010-2030; projections till 2040 are relevant because at that time there will have been be a complete stock change.

2. MAIN CHARACTERISTICS OF THE MODEL

The impact assessment uses a stock model developed by VHK first in the context of the Methodology for the Ecodesign of Energy-using Products[74] (MEEuP) and then further developed in the MEErP and the Ecodesign Impact Accounting Study[75] (EIA Study) for the Commission. It has been used successfully, i.e. to the satisfaction of stakeholders and Commission, in over 20 impact assessment studies for Ecodesign and Energy Labelling studies.

The stock model has been specifically developed and paid for by the Commission (DG GROW and DG ENER) and is thus subject to the same intellectual property provisions as other contract work for the Commission.

Over the years, as it was part of various Commission contracts it has been scrutinised by many Commission officials of various DGs as well as experts from various stakeholder groups (industry, MSs and NGOs).

The input data for the stock model have been retrieved from preparatory studies and additional stakeholder consultation. For throughput data the model follows the MEErP and latest official (e.g. Eurostat) publications.

3. MODEL STRUCTURE

The general structure of the model follows the format and conventions as laid down in the EIA Study.

Figure 19 gives an illustration of the parameters used. The parameters with extension 'BAU' are used for the baseline scenario. The parameters with extension 'ECO' are used for one or more policy options (ECO1, ECO2, etc.).

The model is built in MS Excel, using a 1 year time step. Every parameter name corresponds to an Excel sheet. Auxiliary sheets are added for the calculations.

In the case of household refrigeration appliances, 4 scenarios are calculated (BAU, LLCC, Ambi, Lenient). The BAU scenario does not go back to the period before the first introduction of efficiency measures (1995), but picks up from the previous 2007 study and corrects for the changes in the AAPLiA database since then, up till 2016. From 2016 onwards the scenario follows the trends, taking into account a slightly diminished

[74] Methodology study Eco-design of Energy-Using products (MEEuP)– Final report to the European Commission DG Enterprise and Industry 28 November 2005.

[75] Ecodesign Impact Accounting – status May 2015, for EC, DG ENER. VHK, November 2015 (EIA Study)

effectiveness of the energy label and the lack of minimum requirements that will keep the "A+" energy class (the lowest of the 3 remaining classes) alive.

The other scenarios are calculated from the most recent 2016 APPLiA-database (> 13 000 models). The cut-off at a given minimum energy efficiency index is determined and then the average energy consumption of the cut-off models versus the remaining models is calculated to find the energy saving. This is the most conservative approach, i.e. it assumes no innovation but merely an increase of models with better existing technology. It applies only until 2023 (Tier II). After that, it is assumed that the energy label classes will develop as in the past.

As regards the number of models that will be forced from the market in 2021 (Tier I) and 2024 (Tier II), the scenarios take into account that in a business-as-usual and over a period of 6 years, e.g. in the period 2010-2016, at least 50% of old models – say 9% per year - are voluntarily removed from the catalogue and replaced by new models that have a better energy label classification. Likewise, over the period 2017-2023 it is assumed that 50% of models would be renewed voluntarily.

For instance, the LLCC option sets a Tier I-limit for 2021 at an index of 125% (new metric). The limit eliminates 40 % of 2016-models, but over the 2017-April 2021 period anyway 35% would have been eliminated, so the forced removal in April 2021 is in the order of 5-10%. Taking into account that the effectiveness of the energy label over the 2017-2021 period is less than before (conservative), the scenario takes an extra safety margin and says that 20% of models will be removed.

Likewise in 2024, the LLCC scenario sets a Tier I-limit for 2021 at an index of 10% (new metric). This limit removes 83% of 2016-models. Of this, already 40% were removed in 2020, 27% will be removed over the 2020-2023 period in a business-as-usual, so 16% remains to be forcefully removed in 2023. Taking into account that the new energy label classification (A-G) will not have an immediate effect, this figure is rounded up conservatively to 18%.

This representation is in itself already more 'dramatic' than what will happen in real-life. However, it can also be expected that manufacturers will anticipate the new limits. In addition, there is the effect that e.g. for the first year after the implementation of the limit there will still be non-compliant models in stock that can be sold. Overall, the actual transition will be smoother than what is projected. The tables hereafter gives the details of main inputs and outputs of the model.

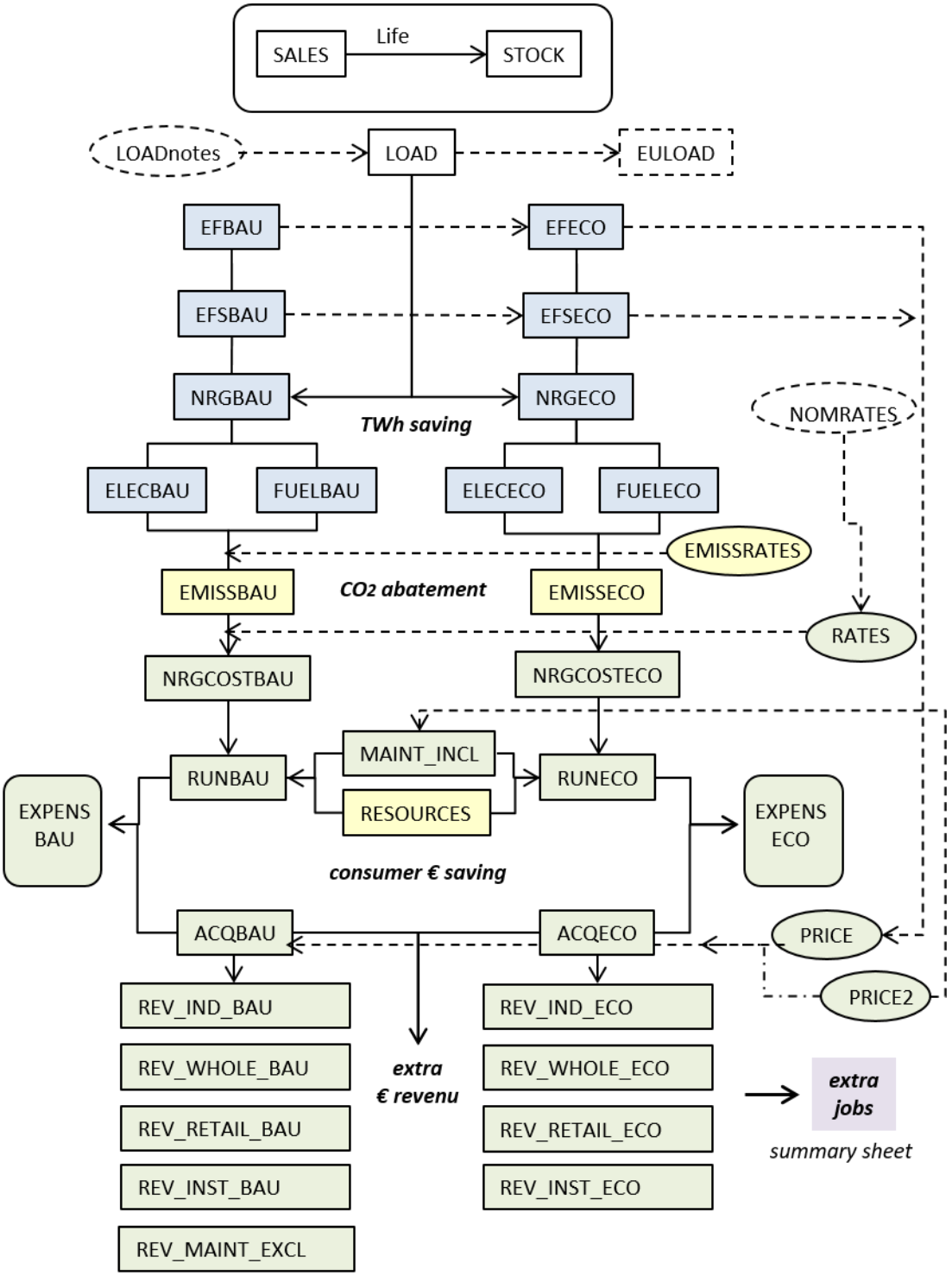

Figure 19: Structure of the core calculation

4. INPUTS

Table 30: Calculation main scenario inputs (sales weighted average)

base case 2015	energy				Money				unit sales %	Vnet, ltr per unit	Vnet sales %	EUR/kWh/a	EUR/kWh/a
		BC	LLCC	BAT		BC	LLCC	BAT				BC-->LLCC	LLCC-->BAT
COLD1 (rc=1)	**kWh/a**	119	79	55	**Price (EUR)**	495	589	922	18.6 %	251	16.4 %	2.35	13.88
	EEI	36	29	17	**LCC (EUR)**	884	847	1103					
	% gain	ref	34%	54%	**SPB (yr)**	ref	11.5	32.8					
COLD2 (rc=0.52)	**kWh/a**	177	131	52	**Price (EUR)**	1344	1427	2607	1.5%	207	1.1%	1.80	14.94
	EEI	58	43	17	**LCC (EUR)**	1925	1856	2777					
	% gain	ref	26%	71%	**SPB (yr)**	ref	9	50.4					
COLD7 (rc=1.31)	**kWh/a**	258	169	112	**Price (EUR)**	557	651	905	59.3 %	309	64.4 %	1.06	4.46
	EEI	36	24	16	**LCC (EUR)**	1403	1206	1272					
	% gain	ref	34%	62%	**SPB (yr)**	ref	5.1	11.6					
COLD8 (rc=2.15)	**kWh/a**	232	162	127	**Price (EUR)**	439	543	689	7.2%	226	5.7%	1.49	4.17
	EEI	37	26	20	**LCC (EUR)**	1200	1073	1106					
	% gain	ref	30%	45%	**SPB (yr)**	ref	7.4	11.9					
COLD9 (rc=2.15)	**kWh/a**	236	150	121	**Price (EUR)**	356	438	541	13.4 %	261	12.3 %	0.95	3.55
	EEI	38	24	18	**LCC (EUR)**	1130	930	938					
	% gain	ref	37%	52%	**SPB (yr)**	ref	4.8	8					
unit sales weighted average	**kWh/a**	226	149	103	**Price (EUR)**	522	615	870	100%	284	100%	1.20	5.56
	EEI	37	25	17	**LCC (EUR)**	1264	1103	1207					
	% gain	ref	34%	55%	**SPB (yr)**	ref	6	16					
sold volume (Vnet) weighted avg.	**kWh/a**	223	155	111	**Price (EUR)**	614	711	1062	100%	284	100%	1.42	8.08
	EEI	40	29	19	**LCC (EUR)**	1341	1214	1420					
	% gain	ref	31%	50%	**SPB (yr)**	ref	7	19					

BC=Base Case; LLCC=Least Life Cycle Costs point; BEP=Break-Even Point; BAT= Best Available Technology. EEI=Energy Efficiency Index (current regulation); LCC=Life Cycle Costs (euros). SPB=Simple Payback Period (years); na=not available

Changes since the Consultation Forum meeting:

- Inclusion of glass door wine storage & glass door mini bars[76];

[76] Annual sales of glass door appliances estimated at 0.3 m units/year at electricity use 300 kWh. Possible

- Extra resource efficiency measures for status display and lighting[77].

5. OUTPUTS

Table 31: Results scenario analysis

	per year								accumulative	
Sales (in '000 units)										
	1990	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2040**	**2021-'30**	**2021-'40**
all	17500	18800	19100	19400	19700	20000	20300	20900	na	na
Stock (in '000 units)										
all	268000	291400	297800	303200	308000	312800	317600	327200	na	na
Unit electricity consumption of sales (kWh/a)									accumulative	
	1990	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2040**	**2021-'30**	**2021-'40**
c	477	285	242	201	181	169	161	122	na	na
LLCC	477	285	242	201	181	113	114	86	na	na
Ambi	477	285	242	201	181	99	101	77	na	na
Lenient	477	285	242	201	181	146	138	104	na	na
EU electricity consumption (in TWh/a)*										
	1990	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2040**	**2021-'30**	**2021-'40**
BAU	138	122	104	86	73	65	59	51	645	1194
LLCC	138	122	104	86	73	61	50	36	598	1009
Ambi	138	122	104	86	73	59	47	32	584	958
Lenient	138	122	104	86	73	63	55	44	624	1108
EU GHG emissions (in Mt CO2 eq./a)*										
	1990	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2040**	**2021-'30**	**2021-'40**
BAU	69	51.4	42.5	34.1	27.9	23.3	20.1	15.3	231	406
LLCC	69	51.4	42.5	34.1	27.9	21.8	17.0	10.8	215	346
Ambi	69	51.4	42.5	34.1	27.9	21.3	16.1	9.6	210	329
Lenient	69	51.4	42.5	34.1	27.9	22.7	18.7	13.1	224	378
Consumer expenditure (in bn Euros 2010)										
	1990	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2040**	**2021-'30**	**2021-'40**
BAU	33.8	28.7	27.8	27.9	28.7	30.2	32.6	38.9	305	665
LLCC	33.8	28.7	27.8	27.9	28.7	30.2	29.8	33.3	297	612
Ambi	33.8	28.7	27.8	27.9	28.7	31.5	30.3	32.2	304	614
Lenient	33.8	28.7	27.8	27.9	28.7	29.7	31.0	35.6	298	630

saving 30% (→200 kWh/year). So annually 0.3m x 100 kWh= 0.3 TWh electricity saving added in this household refrigeration measure (i.e. not in possible commercial refrigeration measure). After 15years all the stock will presumably be changed and thus the accumulative saving in 2036 will be 4.5 TWh/yr (and will stay at that level).

[77] At 24 door-openings of 30s per day and 365 days per year the refrigerator light runs 73 hours. With a LED at 3 W this means an electricity consumption of 0.22 kWh/year per unit. At the current almost 20 million (> 90% replacement) sales this means an annual electricity saving of 5 GWh. At a complete stock change after 15 years (stock ca. 300 m units) this means an accumulative saving of 75 GWh (0.075 TWh). The inclusion of measures on electronic status displays (meaning LCD-LED or OLED screens able to show pixel-based dynamic content) will not save anything at the moment but it will presumably discourage manufacturers from introducing status display screens larger than 1 dm2 (diagonal 6-7").

Energy costs (in bn Euros 2010)

	1990	2005	2010	2015	2020	2025	2030	2040	2021-'30	2021-'40
BAU	24.5	18.7	17.7	17.7	18.3	19.6	21.8	27.9	199	450
LLCC	24.5	18.7	17.7	17.7	18.3	18.3	18.4	19.6	183	371
Ambi	24.5	18.7	17.7	17.7	18.0	17.6	16.8	17.0	175	338
Lenient	24.5	18.7	17.7	17.7	18.3	19.1	20.3	23.9	192	413

Acquisition costs (in bn Euros 2010, incl. VAT)

	1990	2005	2010	2015	2020	2025	2030	2040	2021-'30	2021-'40
BAU	9.3	9.9	10.1	10.3	10.4	10.6	10.7	11.1	106	215
LLCC	9.3	9.9	10.1	10.3	10.4	11.9	11.4	13.7	114	242
Ambi	9.3	9.9	10.1	10.3	11.4	13.4	13.3	15.0	129	272
Lenient	9.3	9.9	10.1	10.3	10.4	10.6	10.7	11.7	106	217

*= For LLCC/Ambi/Lenient scenarios: subtract extra saving for including glass door wine storage and glass door minibars in the scope. Annual saving over the 2020-2036 period is 0.3 TWh/yr electricity and 0.1 Mt Mt CO2/yr; savings on energy costs (EUR 0.06 billion) will be countered by the extra acquisition costs for well insulated glass doors.

6. BUSINESS IMPACT

Table 32: Business impacts

Industry revenu (in bn Euros 2010)

	1990	2005	2010	2015	2020	2025	2030	2040	2021-'30	2021-'40
BAU	3.73	4.01	4.08	4.14	4.20	4.27	4.33	4.46	43	87
LLCC	3.73	4.01	4.08	4.14	4.20	4.80	4.61	5.52	46	97
Ambi	3.73	4.01	4.08	4.14	4.20	5.48	5.19	5.93	50	107
Lenient	3.73	4.01	4.08	4.14	4.20	4.28	4.33	4.73	43	87

Wholesale revenu (in bn Euros 2010)

	1990	2005	2010	2015	2020	2025	2030	2040	2021-'30	2021-'40
BAU	0.28	0.30	0.30	0.31	0.31	0.32	0.32	0.33	3.2	6.5
LLCC	0.28	0.30	0.30	0.31	0.31	0.36	0.34	0.41	3.4	7.2
Ambi	0.28	0.30	0.30	0.31	0.31	0.41	0.39	0.44	3.8	7.9
Lenient	0.28	0.30	0.30	0.31	0.31	0.32	0.32	0.35	3.2	6.5

Retail revenu (in bn Euros 2010)

	1990	2005	2010	2015	2020	2025	2030	2040	2021-'30	2021-'40
BAU	3.70	3.98	4.04	4.11	4.17	4.23	4.30	4.42	42	86
LLCC	3.70	3.98	4.04	4.11	4.17	4.76	4.57	5.47	46	97
Ambi	3.70	3.98	4.04	4.11	4.57	5.34	5.32	6.00	52	109
Lenient	3.70	3.98	4.04	4.11	4.17	4.24	4.30	4.69	42	87

TOTAL business revenu (sum of above, in bn Euros 2010)

	1990	2005	2010	2015	2020	2025	2030	2040	2021-'30	2021-'40
BAU	7.72	8.29	8.42	8.55	8.68	8.82	8.95	9.21	88	179
LLCC	7.72	8.29	8.42	8.55	8.68	9.91	9.52	11.40	95	201
Ambi	7.72	8.29	8.42	8.55	9.09	11.23	10.89	12.37	106	224
Lenient	7.72	8.29	8.42	8.55	8.68	8.84	8.95	9.76	89	181

Industry jobs (in '000 jobs; 33% direct, 33% OEMs (o/w 50% EU), 33% business services; EUR50k/job)

	1990	2005	2010	2015	2020	2025	2030	2040	Increment vs BAU 2030	
BAU	75	80	82	83	84	85	87	89	ref	
LLCC	75	80	82	83	84	96	92	110	6	
Ambi	75	80	82	83	84	110	104	119	17	
Lenient	75	80	82	83	84	86	87	95	0	

Wholesale jobs (in '000 jobs; EUR250k/job)

	1990	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2040**	**Increment vs** BAU **2030**	
BAU	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.3	ref	
LLCC	1.1	1.2	1.2	1.2	1.3	1.4	1.4	1.6	0.1	
Ambi	1.1	1.2	1.2	1.2	1.3	1.6	1.5	1.8	0.3	
Lenient	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	0.0	

Retail jobs (in '000 jobs; EUR60k/job)

	1990	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2040**	**Increment vs** BAU **2030**	
BAU	74	80	81	82	83	85	86	88	ref	
LLCC	74	80	81	82	83	95	91	109	5	
Ambi	74	80	81	82	91	107	106	120	20	
Lenient	74	80	81	82	83	85	86	94	0	

All jobs (sum of above, in '000 jobs)

	1990	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2040**	**Increment vs** BAU **2030**	
BAU	150	161	164	166	169	171	174	179	ref	
LLCC	150	161	164	166	169	193	185	221	11	
Ambi	150	161	164	166	177	218	212	240	38	
Lenient	150	161	164	166	169	172	174	190	0	

na=not applicable

Table 33: Scenario results with electricity tariff escalation rate 1.5%(from 2015) instead of 4%

Consumer expenditure (in bn Euros 2010)

	per year					accumulative	
	2015	2020	2025	2030	2040	'21-30	'21-40
BAU	27.9	25.8	25.2	25.2	25.5	253	507
LLCC	27.9	25.8	25.6	23.6	23.9	250	486
Ambi	27.9	25.8	27.0	24.4	23.8	257	496
Lenient	27.9	25.8	24.9	24.1	24.1	248	486

Energy costs (in bn Euros 2010)

	2015	2020	2025	2030	2040	'21-30	'21-40
BAU	17.7	15.4	14.6	14.4	14.5	147	292
LLCC	17.7	15.4	13.7	12.2	10.2	136	244
Ambi	17.7	15.4	13.4	11.5	9.1	132	231
Lenient	17.7	15.4	14.3	13.4	12.4	142	270

Annex 5: Minutes of the consultation forum

1. WELCOME AND INTRODUCTION

The Chair welcomed the participants and explained the purpose of the meeting i.e. to discuss the results of the review study regarding Regulation (EU) No 643/2009 and Regulation (EU) No 1060/2010 and the proposed draft working documents.

2. ADOPTION OF THE AGENDA AND APPROVAL OF THE MINUTES OF PREVIOUS MEETINGS

The agenda was adopted without any changes.

The draft minutes of the Consultation Forums of 6 July 2017 on electronic displays that were circulated in advance of the meeting were approved.

3. STATE OF PLAY CONCERNING THE COMBINED ECODESIGN AND ENERGY LABELLING CONSULTATION FORUM

The chair explained that in accordance with the new energy labelling framework regulation, a consultation forum for energy labelling needs to be set up. The idea is to combine the consultations for ecodesign and energy labelling. This combined consultation forum will be set up in first quarter of 2019 at which time a call for interest will be launched. Existing members of the consultation forum need to reapply for membership.

4. PRESENTATION OF THE MAIN FINDINGS OF THE REVIEW STUDY

After a presentation by the Contractor (Van Holsteijn en Kemna) of the review study, the ensuing discussion raised the following key points:

Food waste study and multi-door factor – **AT** stated that the food waste issue can only be solved by looking at all factors (e.g. buying frequency of consumers, the amount of food to be stored and the time period to store it) and by involving all actors. This was backed up by **Independent retail Europe**, who also requested more information about how to optimise multi-door refrigerating appliances. **BEUC** was concerned that the correction factor might miss its intended effect without consumer awareness. **ECOS and CLASP** were concerned that the multi-door factor as it is defined would reward more products than only those that reduce food waste. Some suggestions were made to award the correction factor only when there is a separate door, to add clear information in the user manual to explain which food should be stored in which compartment, and to make the meat and fish compartment mandatory (i.e. the most important compartments) in order to receive a multi-door factor.

The Contractor stated that ecodesign and energy labelling cannot regulate all these factors. If in the future the standards will provide us with more tools to improve other factors than only temperature, more could be done. **The contractor** informed that the

study includes some information on the optimisation of multi-door refrigerating appliances. **The contractor** stated that the study on food waste was shared with other DGs with the aim to get more information on the consumer side. Moreover, the multi-door factor is a first step in the process to tackle food waste and could be improved, but to maintain certain flexibility, it is not a good idea to make fish and meat compartments mandatory.

The new test standard - IT stated that the conditions in the standard will lead to a worse functional performance (i.e. the storage of food) due to higher storage temperatures; this should be avoided to protect the consumer. **CLASP** stated that circumvention should be addressed better in the standard.

Combi factor - ECOS believes that the bonus is too high and that it might be misused by manufacturers.

The Contractor replied that the combi factor is the result of a compromise and needs to be sufficiently high not to ban type 1 refrigerating appliances from the market.

Glass door appliances - CLASP stated that it is unclear which test standard should be used when the glass door appliances would be included in the commercial refrigeration group. **Austria** asked about the current status of the commercial refrigeration preparations.

The contractor replied that still a lot of work needs to be done if they are to be included in the commercial refrigeration appliances, e.g. the test standard needs to be updated.

The Commission Services replied that the commercial refrigeration study will be revitalised, with the next step being the Inter-Service Consultation. It is the intention to include it as part of the package for the end of the year.

5. PRESENTATION OF THE WORKING DOCUMENTS

After a presentation by the Commission Services of the working documents the ensuing discussion raised the following key points:

5.1. Ecodesign

Article 1 - Scope

Scope definition - IT stated that the definition of the scope with the introduction of 5 categories creates confusion. Moreover, the definition of a household refrigerating appliance should be revised to make sure that technologies other than those with condensers are covered. **IT** also stated that the definition of the display function could be applicable to any type of product and that the boundary between commercial and household should be the fact that you can purchase the refrigerated items. This was supported by **SE**.

Chest freezers - IT stated that the definition for chest freezers is not included in the document. **AT** asked about the difference between professional chest freezers and

household chest freezers and said that they seem to be excluded from the professional refrigeration regulation.

The contractor confirmed that they are explicitly excluded from the professional refrigeration regulation.

Wine coolers and mini bars - ECOS is of the opinion that wine coolers and min-bars should be included in the scope of this regulation and stated that the glass door does not have a functionality. This was supported by **CLASP, DL, NL, SE, UK, FR, CECED. CECED** prefers to have a separate category for these products but was not sure about the EEI limit that should be applied. In addition **CLASP** requested to align the definitions with the definitions in the draft measure for commercial cold appliances.

The Commission Services stated that wine coolers will be taken up in the regulation and that definitions will be updated.

Mobile refrigerating appliances - CLASP asked why mobile refrigerating appliances are excluded. **DE** asked for clarification whether mobile refrigerating appliances that can be operated by electric mains are included and proposed to keep them in the scope.

The Commission Services replied that the definition of mobile refrigerating appliance was added with the aim to cover battery-operated appliances, and that the definitions could be improved.

Appliances < 10 litre - CLASP did not agree with the exemption for appliances below 10 litres.

Requirements for displays - UK requested to include the requirements for displays in this regulation or in the review of this regulation. **NL** asked the **UK** if they mean the requirements on resource efficiency or also regarding energy efficiency. **UK** replied that the energy efficiency of the entire appliance should be tested, including the display. **IT** stated that the regulation and the standard should require that the display is on during testing.

The Commission services replied that the intention was to only take up the resource efficiency requirements. If the request is to take up energy efficiency as well, further investigation is needed.

Article 2 - Definitions

Sequence of the definitions - IT considers that the definitions in Ecodesign and energy labelling should be in the same sequence.

The Commission Services stated that formally the definitions need to be ordered in the sequence in which they appear in the documents.

External door - CLASP stated that the definition of an external door is more complicated than proposed. **IT** agreed and stated that drawers and lids should be included in the definition of doors to avoid circumvention. **CECED** suggested replacing the

definition and including it in the coefficient for doors to avoid the complexity.

The Commission Services replied that concrete suggestions would be welcome.

Article 3 – Ecodesign requirements

See comments to Annex II.

Article 4 - Conformity assessment

Wine storage appliances -NL informed that wine storage appliances were missing in the text.

Article 5 – Verification procedure for market surveillance purposes & Article 6 – Indicative benchmarks

See comments to Annex IV and Annex V.

Article 7 - Repeal

No comments

Article 8 - Review

Suggestions for improvement - EEB, NL stated that 'no later than 5 years after entry into force' should move to the end of the sentence. **CECED** was concerned that the proposal introduces a gap between the new and old regulation. **CECED** requested adding a relative date for entry into force instead of a fixed date. **DE** opposed a relative date. **CLASP** asked to add a deadline for a vote of the MSs.

The Commission Services replied that there should not be a gap and that they are not in favour of adding a deadline for the vote because they do not have full control over the process after the consultation forum.

Article 9 - Entry into force

Fast track products – **DE** requested to include the 5 products in one publication so that they would come into force on the same date.

The Commission Services replied that it is the Commission's intention to implement the regulations at the same time; however, there might be different product specific reasons for having different dates.

Annex I - Definitions

3&4 star appliances - IT stated that the definition of 3 and 4 star compartments should be separated. **CECED** stated that there could be an 'EU exception' for the definition of a freezer in the EU standard that is being adapted from an international IEC standard.

Freezing capacity - IT recommended, with regards to the freezing capacity, going back to the minimum of 4.5 kg/100 l with a min of 2 kg. **CECED** stated that the new

condition does not make it easier to proof that you are a 4 star freezer, but agreed that this was not proven. **IT** stated that the new temperature conditions make the products appear more energy efficient, but the food preservation is worse. The measurement method should be adapted to avoid that food preservation is worse, without complicating the measurement. This can be done either by ensuring that the target temperature is the warmest temperature or by setting a maximum standard deviation. These things can be adapted through the regulation and/or through the standard.

Annex II - Ecodesign requirements

Ambition level - CECED gave a presentation explaining that the requirements are too ambitious in the time frame that is given. They proposed a 3 tier approach with a tier 0 in 2020 at the same level of efficiency of today, a 2nd tier in 2023 at the level of the proposed tier 1 and in 2028 a 3rd tier with LLCC requirements. **The contractor** replied with a presentation that showed that the tier 0 proposal would allow banned products to end up on the market again. **ECOS, CLASP, SE, NL** agreed that the CECED proposal was too conservative. **ECOS** understood that the timing wood be too ambitious and would be open to discuss possible timings; this was supported by **CLASP, SE, PL. IT** is concerned that the problem is more complicated than presented by VHK and requested an evaluation of EU data instead of non-EU data. **NL** stated that it is not in favour of setting tiers after the review date of the regulation and believes that the CECED presentation was a bit conservative. **CLASP** stated that it does not necessarily disagree with a 3rd tier after the review deadline. **BEUC/ANEC** requested more information with regards to low price refrigerating appliances for both the CECED and the European Commission's proposal.

The Commission Services also prefer not setting requirements after the review deadline and requested more information about the timing needed for testing.

Harmonised standard - IT asked whether manufacturers are required to use the harmonised standard and whether the MSAs are obliged to use the harmonised standard.

The Commission Services replied that the manufacturers are not obliged, but whether the MSAs are obliged will have to be checked.

Glass door appliances - BE asked whether glass door appliances can pass the current limits for wine coolers. **CECED** replied that they would not pass. **ECOS** replied that it would be preferential to have less tight requirements for glass doors. **NL** agreed, but was in favour of a correction factor that would only be applicable to wine storage appliances.

Product information – IT requested to fully align energy label and ecodesign product information requirements and requested not to repeat such requirements to be included in free access websites and the product information when this information already needs to be uploaded in the database. This was supported by **UK, NL and CLASP**. **EEB** agreed, but stated that the usefulness for consumers should be evaluated point by point.

Circumvention - CLASP stated that the circumvention clause needs to be adapted to

make sure that it does not appear that circumvention is allowed before 1/4/2020. They asked whether circumvention would be discussed on a horizontal level in a consultation forum. **AT** considered that the circumvention paragraph is not useful. **DE** thought that similar language should be used in ecodesign and energy label; **NL and EEB** supported this.

The Commission Services replied that this is also part of the energy labelling framework, and that it in response to MSs' requests to include this to be able to enforce circumvention. They welcome further written comments. As regards information requirements, the Commission Services replied that if the database is considered sufficient, it could be deleted in ecodesign.

Recyclability - **EURIC** presented its views on recyclability and explained the difficulties with recycling fridges and the increased cost of recycling VAP panels. **DE, DK and BE** asked EURIC to specify what type of requirements would be sufficient to solve the issue e.g. information, pictograms. **EURIC** stated that information does not help with the fact that the recycling will have to adapt. **CECED** stated that they are discussing voluntary labelling of VAP panels. **The Commission Services** gave an example of a pictogram on the panels as regards the composition of the foam, which has proven to be cost efficient. **IT** stated that the recyclers need to adapt the plants to be able to cope with this. **CECED** suggested sitting around the table with EURIC to further discuss the issue, and to avoid overregulation. **BEUC** asked EURIC whether the recycling process would be different if HFOs are used instead of hydrocarbons. EURIC is not aware of HFOs in foams in household refrigeration. **SE, REUSE, ECOS, BEUC, EEB and EURIC** commented on lack of other resource efficiency requirements and asked for the addition of some requirements that are useful for these products and suggested requirements on spare parts availability, easy repair, price of the spare parts, etc. **EEB** asked the contractor to share their calculations on resource efficiency.

The Commission Services replied that the measures that are proposed in the working documents are the ones that make sense for these products according to the review study. They stated that they are committed to look at resource efficiency and requested stakeholders to come forward with improvement proposals. However, ecodesign is not necessarily the right tool to address prices of spare parts. **The contractor** explained that there is still a large savings potential for fridges while this is not the case for products such as washing machines and dishwashers.

Fast freeze and winter switch - **CECED** requested an exception for the mandatory automatic fast freeze and winter switch for electromechanical appliances for a limited time e.g. until 2023.

Annex III - Measurements and calculations

Detail - **DE** commented that Annex III has too many details copied from the standard, and proposed to limit it to essential information. **BE, CECED** supported this. The Contractor replied that Annex III is a summary of the standard to ensure that the correct

method is followed. **IT** stated that the purpose of the annex is to avoid that the test method can be changed in such a way that the energy efficiency values are altered.

Other suggestions for improvement - **NL** stated that the definition for networked appliances should be aligned with the definitions in the network standby regulation and that the total volume should not be larger than the sum of the volume of the compartments. **DE** asked to align the temperature conditions for low noise appliances with the other appliances and to apply the L factor for fridge-freezers as well. **The Contractor** replied that the L factor makes sense for large freezers, not for small freezers.

Annex IV - Verification procedure

Parameters - **IT** stated that parameters are missing from Table 5. This was supported by **NL and SE**. **IT** requested to add all measured parameters. This was supported by **ECOS**. **NL** would not be in favour of adding all intermediate parameters. **SE** suggested adding the tolerance for the freezing capacity in the review clause.

Suggestions for improvement - **NL** stated that Annex IV should be aligned in format and wording with the verification and tolerances annexes of the other measures.

The Commission Services confirmed that that was their intention.

Clarification - **DE** requested more information about the notification procedure related to section (h) and the relation with the safeguard clause.

The Commission Services stated that they will follow this up bilaterally with DE.

3 tests - **BE** requested to remove the 3 tests from the verification procedure, although this was not supported by **IT and DK**. Alternatively, **BE** suggested to rephrase 2(e) to say that the product loses its presumption of conformity. **NL** replied that this is an internal MS procedure and that this kind of solutions might give problems for other MSs.

Annex V - Indicative benchmarks

Benchmarks - **CECED** stated that the converted values (based on the new standard) cannot be used to calculate the benchmarks and that the current values (based on the current harmonised standard) should be used. NL did not support this, but suggested to add a disclaimer.

Commission Services would welcome comments on the recitals.

5.2. Energy Labelling

General

Consumer survey - **UK** asked about the timing for the consumer study for labelling. **DE** asked what exactly would be evaluated. **BEUC** requested to share the results of the survey.

The Commission Services replied that the contract should start at the beginning of January. The results of that study will be shared with the consultation forum. They stated that they would share the terms of references with the consultation forum. The same type of study is being launched for the other product groups.

Article 1 - Subject matter and scope & Article 2 - Definitions

Stakeholders indicated that the same comments as for Ecodesign apply.

Article 3 - Obligations of the suppliers

Paper product information - NL stated that the paper version of the product information sheet should disappear, as the database should be sufficient. This is the case in Article 3, but it should be more explicit in the regulation, e.g. through a recital. This was supported by **CECED, Independent retail Europe**.

The Commission Services stated that this was the intention, but welcomes suggestions.

Suggestions for improvement - DE informed us about a wrong reference to the Annex in Article 3.

Article 4 - Obligation of dealers

Bear the label on the product - Independent Retail Europe suggested to alter the wording i.e. 'bear' is not specific enough and 'displayed on the outside or the top of the product' does not always makes sense. **NL** stated that the wording 'bears' leaves the necessary flexibility. **NL, DE and IT** stated that the label should be on the product and **IT** requested to clarify this in the regulation especially for the built-in appliances. **ECOS** suggested adding guidelines on the correct labelling of products. From comments made by **BE, DE, IT and UK** it became clear that MSs each have their own approach. DE suggested clarifying it in the ADCO. **UK** did not see the benefit of a European clarification and **BE** supported this.

Article 5 – Measurement methods

See Comments to Annex IX

Article 6 - Verification procedure for market surveillance

Suggestion for improvement - BE suggested to refer to 'the conformity of the product' instead of summing up the different parameters.

The Commission Services replied that this could be done.

Article 7 - Revision

Suggestions for improvement - NL asked about the reason for adding the second paragraph in Article 7, since it should be clear from the labelling framework regulation. **CLASP** suggested aligning with the review clause in ecodesign.

The Commission Services agreed that the second paragraph is not absolutely necessary and could be revised.

Circular economy - IT asked why requirements on circular economy were added to the article.

The Commission Services replied that there will be a horizontal discussion on circular economy in the CF of 19/12. A study on reparability/durability will investigate whether something could be added to the label on these issues.

Article 8 and 9 - Repeal and entry into force

Implementation date - CECED stated that the same comments as for ecodesign apply.

Annex I - Definitions

No comments.

Annex II -Energy efficiency classes

Grey efficiency classes - DE suggested not to start with a grey efficiency class G; **CLASP, SE, CECED** supported this. **CLASP** suggested removing the built-in factor to achieve this.

Colour of C class - CECED asked whether the C class would be green or yellow.

The Commission Services replied that it would be green.

Annex III - Energy label

QR code - CECED suggested not linking the QR code to the information of the supplier's website and the database, but rather to the database only; this was supported by **ECOS**. **IT** suggested reducing the size of the QR code.

The Commission Services replied that they would make the QR code as small as possible and that it would be linked to the database.

Label layout general - NL suggested using another colour than green for the border of the label in order to avoid confusion with an A labelled product. **DE and ANEC/BEUC** supported this. **IT** suggested not using the lightning bolt on the top. This was not supported by **BE**.

Icons - DE, ANEC/BEUC and BE suggested reducing some icons in size. **DE and ANEC/BEUC** suggested using an icon for the kW/annum and suggested removing the different compartments from the label. **IT** supported this, while **AT** did not. **DE and ANEC/BEUC** suggested using a scale, e.g. A to C, for the noise. **IT** suggested using the number of bottles instead of the volume for wine storage appliances, this was supported by **AT**. **CLASP** suggested that consumers might be interested in more information if they are more aware of the relevant issues; this was not supported by **DE. NL** supported this, and especially in relation to food waste and the multi-door appliance, which might

be incentivised just by adding something on the label. Independent Retail Europe and **CECED** supported a simple label.

The Commission Services suggested waiting for the outcome of the consumer study before making decisions.

A class - AT stated that the A-class should be populated soon after implementation. This was supported by **CECED**.

Smart appliances - EEB suggested including smart appliances on the label as per the labelling framework regulation. **NL and CECED** agreed. **NL** suggested including something in the impact assessment, in the documentation that goes to the parliament and potentially in the regulation so that we don't have to wait until the review.

The Commission Services replied that a preparatory study is ongoing for smart appliances. They will see how it can be reflected in the documentation.

Annex IV - Measurements and calculations

Stakeholders indicated that the same comments as in Ecodesign apply.

Correction factors - CLASP suggested removing some of the correction factors, mainly the built-in factor, for the energy labels.

Annex V - Product information sheet

Alignment - NL suggested removing wording that is not in line with the fact that entering information in the database is sufficient. This was supported by **IT**. In addition, **IT** suggested to fully align the ecodesign and energy labelling measures. Some examples were given.

Annex VI - Technical documentation

Declared values - NL suggested clarifying which values are required, declared or measured.

Annex VII - Information to be provided in the case of distance selling, except on the internet

Printed copy - IT suggested removing the 'printed copy' of the product information sheet to make sure that this is only per specific request.

Annex VII and Annex X - Arrow

Arrow - ECOS suggested only showing the label classes that are really available or grey out the other classes. **DE** supported this, while **NL** suggested that greying out the classes would not be convenient for distance selling by means of paper catalogues. **DE** stated that coloured classes would make the link with the energy label clearer for consumers. The **UK** supported this. **DE** asked if advertisements in black and white would need the coloured scaling. **CLASP** requested adding the little arrow to the consumer survey. **DK**

was concerned that the arrow as suggested by Germany would be too complicated for internet selling. **CECED** pointed out that the arrows are different in the different regulations and requested an alignment.

The Commission Services replied that another design for the arrow would be possible and requested the CF members to comment on the DE proposal for the arrow. They would check if the design of the arrow could be investigated in one of the consumer studies. The Commission Services confirmed that the current text would require the label to be in colour even if the promotion materials are in black and white.

Annex VIII - Information to be provided in the case of sale, hire or hire-purchase through the internet

No comments.

Annex IX - Verification procedure for market surveillance purposes

Stakeholders indicated that the same comments as for ecodesign apply.

Suggestions for improvement - NL suggested aligning with the texts of the other measures.

Annex X - Displaying the energy class and the range of the efficiency class in visual advertisement and promotional material

No comments.

5.3. Other comments

Timing - DK was not in favour of aligning ecodesign and energy labelling if this would mean that energy labelling would be delayed. **DE** suggested that if tier 1 would be delayed, we should not wait with the information requirements. **BE** asked how the date of application relates to the framework regulation, i.e. when does the 3-weeks relabelling period start?

The Commission Services confirmed that the 3 weeks start on the date of application.

ANEC/BEUC asked if there would be an opportunity to comment on the new label design that will be based on the consumer study.

The commission services confirmed that this would be possible and suggested doing a written consultation on this.

6. AOB

DE requested more information on the taskforce for ICT.

The Commission Services replied that they have established a task force and are drafting the request for service for a support study, hopefully to start in Q1 of 2018.

CECED asked whether the documents of the Inter Service Consultation will be made

public, noting that after the ISC, there will be a feedback period of 4 weeks when the document coming out of ISC will be made publically available.

The Commission Services could not guarantee this and explained the process.

Comments to the working documents are due by the 26th of January with some flexibility.

Attendance List

Commission Services	
DG ENER	C.3
DG GROW	C.1
DG ENV	B.1

MSs	
AT	Austrian Energy Agency
BE	FPS Economy, SME, Selfemployed and Energy
BG	Ministry of Economy
CH	Swiss Federal Office of Energy
CZ	State Energy Inspection Authority
	Ministry of Industry and Trade
DE	Federal Environment Agency
	Federal Institute for Materials
	Federal Ministry for Economic
	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
	Bavarian State Ministry for Environment and Consumer Protection
DK	Danish Energy Agency
EE	Estonian Ministry of Economic Affairs and Communications
FR	Ministère de l'énergie et du développement durable
IT	ENEA
LT	Perm rep LT
NL	Netherlands Enterprise Agency
PL	Ministry of Energy
SE	Swedish Energy Agency
UK	Department for Business, Energy & Industrial Strategy, Sustainable Energy using Products team, Home and Local Energy
	Department of Energy and Climate Change

Organisation
ANEC/ BEUC
ANEC/ BEUC
CECED **CLASP** **CLC/TC 59X**
ECOS **EEB**
EuRIC **EuroCommerce**
Independent Retail Europe
ORGALIME
RREUSE
TOPTEN
VHK

Annex 6: Employment and Market in the household refrigerating appliances sector

1. EMPLOYMENT

The employment in household refrigerating appliances sector is shown in Figure 20.

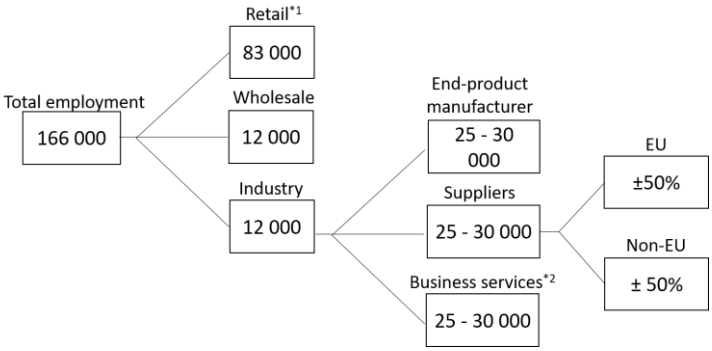

Figure 20: Distribution of number of jobs in the household and refrigerating appliances sector in the EU (EU 2015 – Review study 2016). *1Includes maintenance; *2accountants, advertising agencies, caterers, IT specialists.

2. SIZE OF THE MARKET

The EU 2015 market for household refrigeration appliances in scope, according to the Review study 2016, is shown in Figure 21.

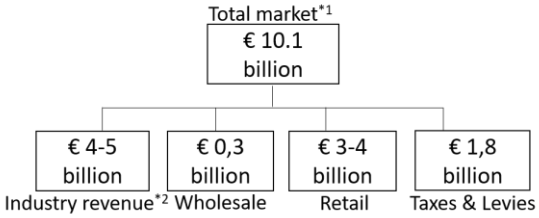

Figure 21: The market of household refrigerating appliances (EU 2015 – Review study 2016). *1In consumer prices; *2manufacturer selling prices.

EU production, imports and exports EUR 1 billion in manufacturer selling prices, according to Eurostat in 2015 are shown in Figure 22.

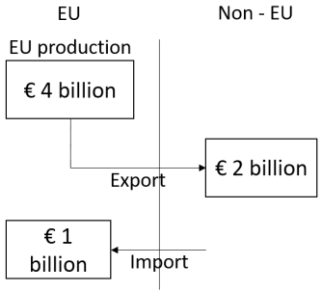

Figure 22: EU production, import and export (Eurostat).

Main importers are China (44% of value) and Turkey (36%). Exports are fragmented; Russia (16% of value) is one of the larger destination countries. Production value strongly declined after the 2007 financial crisis, but now stabilised. For the future, an

annual growth rate of 2%, in value and unit sales, is deemed realistic.

According to the Review study 2016, around 19.4 million units were sold in 2015. The installed stock was 303 million units in 2015 in the EU (1.4 per household, 1.3 per dwelling[78]).

Wine storage appliances represented less than 1% of sales (0.2 million units) and installed stock (3 million units) in 2015. Around 70-80% of wine storage appliances have glass doors; the others have solid doors. At an average (high) price of over EUR 1300/unit, the annual sales value is estimated at EUR 0.26 billion.

Sales of absorption appliances, including hotel minibars, amount to 0.2-0.3 million units annually. It is estimated that around 3 million minibars were installed in 2015 (mainly) in hotels. At an average sales price of EUR 133 the sales value of absorption appliances is estimated at EUR 40 million in end user prices (excluding VAT).

3. COMPETITIVENESS AND TRADE

Globally the household refrigeration appliance industry is highly competitive. Asian manufacturers rapidly expand their global market share. For these manufacturers, product-price, rather than quality, is one of the main selling points.

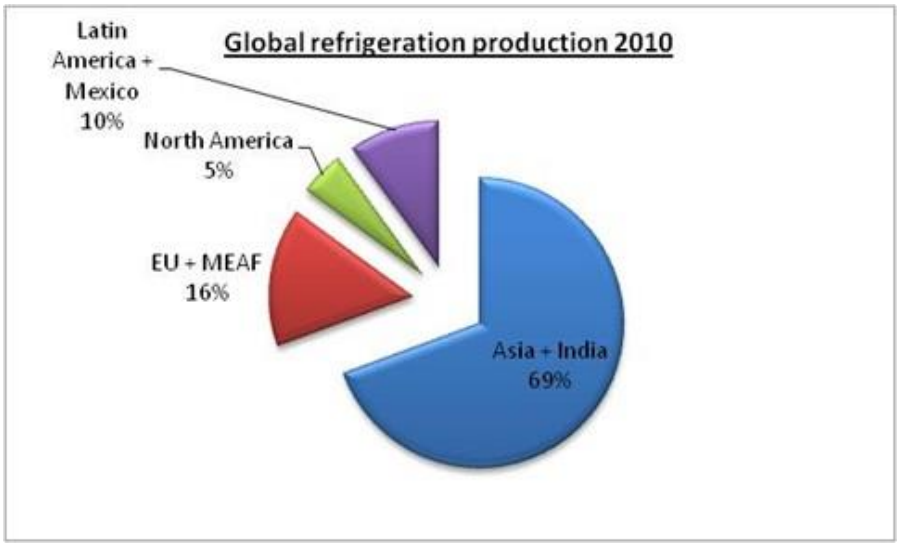

Figure 23: ***Global refrigeration production in 2010 (source: ENERG-ICE project[79])***

As a comparison, in the US, the energy label and minimum energy efficiency performance standards exist but it is a less important commercial driver. There, the employment in the 28 household refrigerator and home freezer manufacturing establishments dropped from 22775 jobs in 2002 to 13971 in 2007 and 8603 people in 2012. The value of shipments in 2012 was $3.6 billion, down 36.8% from $5.8 billion in

[78] In 2015 there were 210 million households (primary dwellings). Occupied secondary dwellings add 12%. Vacant dwellings (8%) are not considered to have a refrigeration appliance.

[79] https://www.dow.com/en-us/energice . The project was co-funded by the EU's LIFE programme. Note that Dow does not mention the source of the graph. Only the US trend could be verified through Census data. The EU market share seems pessimistic, given the Eurostat Prodcom data.

2007.[80] [81]

In the EU; where the energy label ins an important driver, unit production decreased by 12% and the value of production dropped by 15% over the 2006-2013 period (Review Study 2016),. This was mainly due to a 10% shrinkage of the apparent domestic consumption[82] (EUR 5.57 billion 2006, EUR 5.02 billion in 2013) in the wake of the 2007-2008 crisis. Imports increased from a 28% market share in 2006 to a 38% share in 2013. Exports also increased with 18% to a level of EUR 1.06bn in 2013. Based on the average turnover per employee (around €150k/job, strictly in the end-product industry[83]) it is estimated that almost 5000 jobs were lost in the period 2006 (33k jobs) and 2013 (28k jobs), mainly due to the financial crisis. In other words, the EU industry is doing considerably better than the US industry in this sector.

The latest Eurostat data[84] suggests that over the period including 2016, in aggregate the value of apparent EU consumption increased by almost 10% to EUR 5.5 billion and is now at pre-financial crisis level. Imports increased by almost 23% (EUR 2.4 billion in 2016). EU exports decreased to a value of EUR 0.9 billion in 2016, down 16% from 2013. EU production value dropped by 2.4% versus 2013 and is now at a level of close to EUR 4.1 billion.

[80] https://www.census.gov/newsroom/press-releases/2014/cb14-133.html . Data relate to the household refrigerator and home freezer manufacturing industry (NAICS 335222)

[81] US government, Household Refrigerator and Home Freezer Manufacturing, Economic Census 2012.

[82] Apparent consumption= production + imports − exports.

[83] This is without supplier jobs and external business services to make it comparable to the US figures. In the employment figures for the scenario analysis jobs at suppliers and business services were included.

[84] Eurostat, Europroms, extract 30.11.2017 for PRC numbers 275111 10/33/35/50/70.

Annex 7: The Ecodesign and Energy Labelling Framework

The Ecodesign Framework Directive and Energy Labelling Framework Regulation are framework rules, establishing conditions for laying down product-specific requirements in regulations adopted by the Commission. The Commission's role in the implementation of delegated and implementing acts is to ensure a maximum of transparency and stakeholder participation in presenting a proposal, based on generally accepted data and information, to the European Parliament and Council for scrutiny. Figure 24 gives an overview of the legislative process.

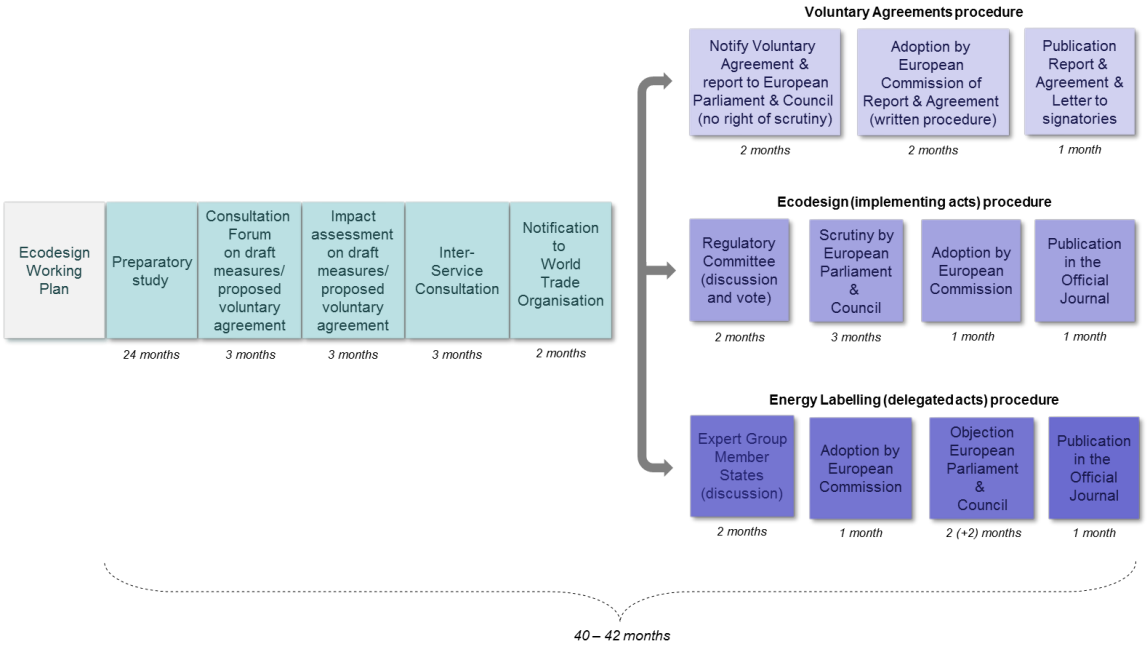

Figure 24: Overview of the legislative process

Energy labelling delegated acts are usually adopted in parallel with ecodesign implementing measures laying down minimum energy efficiency requirements for the same product group. This is done to ensure a coherent impact of the two measures: energy labelling should reward the best performing products through mandatory rating, while ecodesign should ban the worst performers.

The process starts with establishing the priorities for Union action in this area. Priority product groups are selected based on their potential for cost-effective reduction of greenhouse gas emissions and following a fully transparent process culminating in working plans that outline the priorities for the development of implementing measures.

A first list of priority product groups was provided in Article 16 of the Ecodesign Framework Directive in force at that time[85]. Subsequently, the (first) Ecodesign Working Plan 2009-2011[86], the (second) Ecodesign Working Plan 2012-2014[87] and the Ecodesign

[85] Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products and amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament and of the Council**.** OJ L 191, 22.7.2005

[86] Communication from the Commission to the Council and the European Parliament - Establishment of the working plan for 2009-2011 under the Ecodesign Directive. COM/2008/0660 final. 21 October 2008. (Ecodesign Working Plan 2009-2011)

[87] Commission Staff Working Document Establishment of the Working plan 2012-2014 under the

Working Plan 2016-2019 were adopted by the Commission after consultation of the Ecodesign Consultation Forum (composed of MS and stakeholder experts).

The products listed in the three plans (1st working plan: 1-10; 2nd working plan: 11-18; 3rd working plan: 19-25) can be found in Table 34.

Table 34: Overview of products listed in the 3 Working plans

1. *Air-conditioning and ventilation systems (commercial and industrial)*	14. *Enterprises' servers, data storage and ancillary equipment*
2. *Electric and fossil-fuelled heating equipment*	15. *Smart appliances/meters*
3. *Food preparing equipment (including coffee machines)*	16. *Lighting systems*
4. *Industrial and laboratory furnaces and ovens*	17. *Wine storage appliances (c.f. Ecodesign regulation 643/2009)*
5. *Machine tools*	18. *Water-related products*
6. *Network, data processing and data storing equipment*	19. *Building automation control systems*
7. *Refrigerating and freezing (professional)*	20. *Electric kettles*
8. *Sound and imaging equipment (incl. game consoles)*	21. *Hand dryers*
9. *Transformers*	22. *Lifts*
10. *Water-using equipment*	23. *Solar panels and inverters*
11. *Window products*	24. *Refrigerated containers*
12. *Steam boilers (< 50MW)*	25. *High- pressure cleaners*
13. *Power cables*	

There were also a number of conditional products listed in the 2nd Working Plan that the Commission committed to study closer before deciding to launch full preparatory work (such as thermal insulation, power generating equipment). In the 3rd Working Plan, the Commission committed to assess certain ICT products in a separate track to determine the best policy approach for improving their energy efficiency and wider circular economy aspects and a potential inclusion in the Ecodesign working plan.

Once the product group has been selected, a preparatory study is undertaken by an independent consultant, also involving extensive technical discussions with interested stakeholders. The preparatory study follows the MEERP. Subsequently, the Commission's first drafts of ecodesign and energy labelling measures are submitted for discussion to the Consultation Forum, consisting of MSs' and other stakeholders' representatives.

After the Consultation Forum, the Commission drafts an impact assessment, which after approval of the IAB is taken forward to the inter-service consultation together with draft implementing measures. In this and subsequent steps, the Parliament's functional mailboxes for delegated/implementing acts are copied on each message from the Commission services. After the inter-service consultation, stakeholders are alerted when the draft measures are published in the WTO notification database.

After the WTO notification phase is completed, the two procedures follow different paths. The draft energy labelling delegated act is discussed in a MS Expert Group where opinion(s) are expressed and consensus is sought but no vote is taken. The draft ecodesign measure is submitted for vote to the Regulatory Committee of MS experts.

Ecodesign Directive - SWD(2012)434/F1 (Ecodesign Working Plan 2012-2014)

The European Parliament and Council have the right of scrutiny for which a period of up to four months, if requested, is foreseen. Within this time the co-legislators can block the adoption process by the Commission. Parliament committees sometimes discuss draft objections to measures (light bulbs and fridges in 2009) or vote to reject a measure (vacuum cleaners in 2013[88]). On one occasion an objection was even adopted in plenary, blocking the measure for televisions in 2009[89].

Today, 30 Ecodesign Regulations, 17 Energy Labelling Regulations, 3 voluntary agreements and 2 tyre labelling regulations have been implemented. An overview of these measures can be found in Table 35.

Table 35: Overview of applicable measures

Framework legislation	
2017/1369	*Energy labelling Framework Regulation*
2009/125/EC	*Ecodesign Framework Directive*
1222/2009/EC	*European Parliament and Council Regulation on the labelling of tyres with respect to fuel efficiency and other essential parameters*
30 Ecodesign implementing regulations	
1275/2008	*Standby and off mode electric power consumption*
107/2009	*Simple set-top boxes*
244/2009	*Non-directional household lamps (amended by 859/2009/EC)*
245/2009	*Fluorescent lamps without integrated ballast, for high intensity discharge lamps and for ballasts and luminaires (amended by 347/2010/EU)*
278/2009	*External power supplies*
640/2009	*Electric motors (amended by regulation 4/2014/EU)*
641/2009	*Circulators (amended by regulation 622/2012/EU)*
642/2009	*Televisions*
643/2009	*Household refrigerating appliances*
1015/2010	*Household washing machines*
1016/2010	*Household dishwashers*
327/2011	*Fans*
206/2012	*Air conditioning and comfort fans*
547/2012	*Water pumps*
932/2012	*Household tumble driers*
1194/2012	*Directional lamps, light emitting diode (LED) lamps and related equipment*
617/2013	*Computers and servers*
666/2013	*Vacuum cleaners*
801/2013	*Networked standby electric power consumption*

[88] This objection was defeated in ENVI committee by 43 votes against and 4 in favour.

[89] The motivation of the objection was that the EP wanted to delay the discussion of the draft labelling measure so that it would have to become a delegated act under the recast post-Lisbon Energy Labelling Directive in 2010. The measure was indeed subsequently adopted as a delegated act.

813/2013	*Space heaters*
814/2013	*Water heaters*
66/2014	*Domestic cooking appliances (ovens, hobs and range hoods)*
548/2014	*Power transformers*
1253/2014	*Ventilation units*
2015/1095	*Professional refigeration*
2015/1188	*Solid fuel local space heaters*
2015/1189	*Local space heaters*
2015/1189	*Solid fuel boilers*
2016/2281	*Air heating products, cooling products, high temperature process chillers and fan coil units*
2016/2282	*Use of tolerances in verification procedures*
17 Energy labelling supplementing regulations	
1059/2010	*Household dishwashers*
1060/2010	*Household refrigerating appliances*
1061/2010	*Household washing machines*
1062/2010	*Televisions*
626/2011	*Air conditioners*
392/2012	*Household tumble driers*
874/2012	*Electrical lamps and luminaires*
665/2013	*Vacuum cleaners*
811/2013	*Space heaters*
812/2013	*Water heaters*
65/2014	*Domestic cooking appliances (ovens and range hoods)*
518/2014	*Internet energy labelling*
1254/2014	*Domestic ventilation units*
2015/1094	*Professional refrigeration*
2015/1186	*Local space heaters*
2015/1187	*Solid fuel boilers*
2017/254	*Use of tolerances in verification procedures*
3 Voluntary Agreements (Report to the EP & Council)	
COM (2012) 684	*Complex set top boxes*
COM (2013) 23	*Imaging equipment*
COM(2015)178	*Game consoles*
2 tyre labelling amending regulations	
228/2011	*Wet grip testing method for C1 tyres*
1235/2011	*Wet grip grading of C2, C3 tyres, measurement of tyres rolling resistance and verification procedure*
Previous legal acts still in force	
92/42/EEC	*Hot-water boilers efficiency Council Directive (Ecodesign)*

96/60/EC	*Household combined washer-driers (Energy labelling)*
2002/40/EC	*Household electric ovens Commission Directive (Energy labelling) – will be repealed on 1/1/2015*

MSAs, designated by the MSs, will verify the conformity of the products with the requirements laid down in the implementing measures and delegated acts. These can be done either on the product itself or by verifying the technical documentation. The rules on Union market surveillance and control of products entering the Union market are given in Regulation (EC) No 765/2008[90]*. Given the principle of free movement of goods, it is imperative that MSs' market surveillance authorities cooperate with each other effectively.*

[90] Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products and repealing Regulation (EEC) No 339/93. OJ L 218, 13.8.2008, p. 30

Annex 8: Existing Policies, Legislation and Standards affecting household refrigerating appliances

A number of directives and regulations affect household refrigerating appliances.

1. EU ECODESIGN AND ENERGY LABELLING REGULATIONS

The current Ecodesign Regulation sets some generic requirements and minimum energy efficiency requirements for household refrigerating appliances. The scope is household refrigerating appliances with a volume lower than or equal to 1500 l. This also includes household refrigerating appliances sold for non-household use or for the refrigeration of items other than foodstuffs and electric mains-operated household refrigerating appliances that can be battery-operated. It excludes refrigerating appliances powered by energy sources other than electricity, battery-operated appliances, custom made appliances, appliances for the tertiary sector and appliances where the primary function is not the storage of foodstuffs.

The **current Energy Labelling Regulation** sets energy labelling requirements for household refrigerating appliances. The scope is the same as the scope of the current Ecodesign Regulation.

Ecodesign and energy labelling regulations on components *- In addition to ecodesign and energy labelling regulations on the final products, some ecodesign requirements might be applicable on the product's components. Components that are regulated under ecodesign and/or energy labelling are the following:*

- *External power supplies (Ecodesign Regulation (EC) No 278/2009[91])*
- *Electric motors (Ecodesign Regulation (EC) No 640/2009[92]);*
- *Circulators (Ecodesign Regulation (EC) No 641/2009[93]);*
- *Fans (Ecodesign Regulation (EU) No 327/2011[94]);*
- *Water pumps (Ecodesign Regulation (EU) No 547/2012[95]);*
- *Lamps (Ecodesign Regulation (EC) No 244/2009[96] and (EC) No 245/2009[97] and*

[91]

[92] Commission Regulation (EC) No 640/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for electric motors. OJ L 191, 23.7.2009, p. 26.

[93] Commission Regulation (EC) No 641/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for glandless standalone circulators and glandless circulators integrated in products. OJ L 191, 23.7.2009, p. 35.

[94] Commission Regulation (EU) No 327/2011 of 30 March 2011 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW. OJ L 90, 6.4.2011, p. 8.

[95] Commission Regulation (EU) No 547/2012 of 25 June 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water pumps. OJ L 165, 26.6.2012, p. 28

[96] Commission Regulation (EC) No 244/2009 of 18 March 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for non-directional household lamps. OJ L 76, 24.3.2009, p. 3.

Energy Labelling Regulation (EU) 874/2012[98]).

The components of household refrigerating appliances are not in the scope of these regulations.

Horizontal ecodesign regulations *- In addition to those requirements, some horizontal aspects of energy using products are regulated. Horizontal measures are:*

- *Electric power consumption standby and off mode (Ecodesign Regulation (EC) No 1275/2008[99]);*
- *Networked standby (Ecodesign Regulation (EU) No 801/2013[100]).*

Household refrigerating appliances are not in the scope of these regulations.

2. OTHER EU POLICIES

*The **Low Voltage Directive**[101] regulates health and safety aspects including e.g. mechanical, chemical, noise related or ergonomic aspects. Apart from this, the directive seeks to ensure that the covered equipment benefits fully from the Single Market. The LVD covers electrical equipment operating with a voltage between 50 and 1000 V for alternating current and between 75 and 1500 V for direct current. Falling under this category,* household refrigerating appliances *are covered by the scope of the LVD, but there is no overlapping in terms of the type of requirements.*

*The **WEEE Directive** set requirements on e.g. recovery and recycling of Waste of Electrical and Electronic Equipment to reduce the negative environmental effects resulting from the generation and management of WEEE and from resource use. The WEEE Directive applies directly to* household refrigerating appliances. *Ecodesign implementing measures can complement the implementation of the WEEE Directive by including e.g. measures for material efficiency, thus contributing to waste reduction, instructions for correct assembly and disassembly, thus contributing to waste prevention and others.*

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[97] Commission Regulation (EC) No 245/2009 of 18 March 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps, and repealing Directive 2000/55/EC of the European Parliament and of the Council. OJ L 76, 24.3.2009, p. 17.

[98] Commission Delegated Regulation (EU) No 874/2012 of 12 July 2012 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of electrical lamps and luminaires. OJ L 258, 26.9.2012, p. 1

[99] Commission Regulation (EC) No 1275/2008 of 17 December 2008 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment. OJ L 339, 18.12.2008, p. 45.

[100] Commission Regulation (EU) No 801/2013 of 22 August 2013 amending Regulation (EC) No 1275/2008 with regard to ecodesign requirements for standby, off mode electric power consumption of electrical and electronic household and office equipment, and amending Regulation (EC) No 642/2009 with regard to ecodesign requirements for televisions. OJ L 225, 23.8.2013, p. 1.

[101] Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits. OJ L 96, 29.3.2014, p. 357. (LVD)

*The **RoHS Directive**[102] restricts the use of six specific hazardous materials and four different phthalates found in electrical and electronic equipment (EEE).* Household refrigerating appliances products *are directly covered by the RoHS Directive. There is no overlapping requirement with a proposed ecodesign regulation.*

*The **REACH Directive**[103] restricts the use of Substances of Very High Concern (SVHC) to improve protection of human health and the environment. The REACH Directive applies directly to* household refrigerating appliances. *There is no overlapping requirement with a proposed ecodesign regulation.*

*The **EMC Directive**[104] sets requirements for the Electro-Magnetic Compatibility performance of electrical equipment to ensure that electrical devices will function without causing or being affected by interference to or from other devices. The EMC Directive applies directly to* household refrigerating appliances. *There is no overlapping requirement with a proposed ecodesign regulation.*

*The **ETS** sets a cap on the total amount of certain greenhouse gasses that can be emitted by installations. This cap reduces over time, so that the total emissions fall. Within this cap companies receive or buy emission allowances which they can trade with one another as needed. They can also buy a limited amount of international credits. The ETS does not directly apply to* household refrigerating appliances*, however, it does apply to electricity production. Hence, if the electricity consumption of household refrigerating appliances reduces, the electricity companies will have to trade less or the price of carbon will reduce under the cap system. Consequently, the price of electricity will drop.*

3. POLICIES AT EU MS LEVEL

There are no measures and policies at MS level for household refrigerating appliances.

4. NON-EU POLICIES

The Standards & Labelling database www.clasponline.org distinguishes 280 different energy efficiency measures such as minimum efficiency requirements, comparative energy labels and endorsement labels. Countries with active energy efficiency policy tend to address household refrigeration appliances.

Many countries have either introduced energy labels based on or inspired by the EU

[102] Directive 2011/65/EU 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. OJ L 174, 1.7.2011, p. 88. (RoHS Directive)

[103] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC. OJ L 396, 30.12.2006, p. 1–849 (REACH Regulation)

[104] Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility. OJ L 96, 29.3.2014, p. 79 (EMC Directive)

energy label[105], the United States of America (USA) programs or a combination of both.

The International Energy Agency (IEA) Energy Efficient End-use Equipment (4E) Benchmarking programme has made a comparison of the efforts in several countries, based on a normalised kWh/a Annual Unit Energy Consumption, see Figure 25.

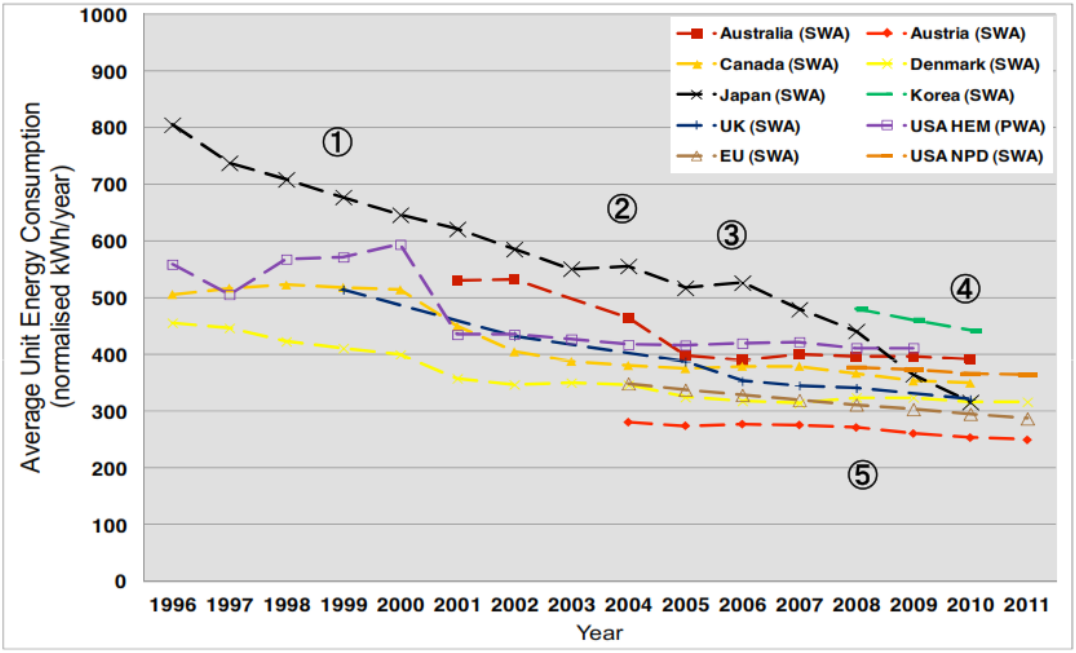

Figure 25: Average Unit Energy Consumption in selected countries and regions (Source: IEA 4E M&B, version 2014)

In 2011, many different standards where applicable each having differences in test conditions. Today, a new global standard has been published, i.e. IEC 62552: 2015 which attempts to align the test conditions.

China, Japan, Australia and the USA have informed that they will or have introduce(d) new limits based on the new IEC standard.

Figure 25 shows that the EU was still at the forefront in 2011, however, seeing this upcoming reviews in China, Japan, Australia and the USA will change this picture.

To safeguard competition in the EU, it is important that the EU keeps on distinguishing based on innovation and quality. Up to date requirements will enable this. In addition, the use of the standard, adapted to the EU situations, in ecodesign and energy labelling is essential for global competitiveness.

[105] European Commission Conference on Product Policy –Ecodesign & Energy Labelling, 20-21 Feb. 2014, misc. lectures.

Annex 9: Evaluation of the Ecodesign and Energy Labelling Regulations for household refrigerating appliances

In the context of the Better Regulation policy,[106] *the Commission is committed to evaluate all EU activities intended which have an impact on society or the economy in a proportionate way.*

A joint evaluation of the Ecodesign and Energy Labelling Directives[107] *was carried out by the Commission in 2015. Main findings and conclusions were presented in a Report to the European Parliament and the Council*[108]*. Among others it was pointed out that the ecodesign and energy labelling measures in place are effective and bring tangible and substantial energy and cost savings. The implementation of the two Directives is estimated to save 175 Mtoe primary energy per year by 2020, which corresponds to 19% savings with respect to business-as-usual energy use for those products. These policies will deliver almost half of the 20% energy efficiency target by 2020. Dependency on imports of energy would be reduced by 23% and 37% for natural gas and coal, respectively. In total, the ecodesign and energy labelling measures in place to date are estimated to save end-users of products 100 billion euro per year in 2020 through lower utility bills (translated into roughly 500 euros yearly savings in each household).*

This annex presents the relevant findings of the evaluation of the Ecodesign and Energy labelling Framework legislation complemented by findings from the Review study 2016. The Annex focusses on relevance, effectiveness and efficiency.

1. RELEVANCE

The evaluation of the framework Regulations has shown that the objectives (increasing energy efficiency and the level of protection of the environment; providing consumers with information that allows them to choose more efficient products; and ensuring the free movement of energy-related products in the European Union) remain very much relevant.

2. EFFECTIVENESS

This section focuses on two key objectives of the current Regulations, i.e. ensuring a transition towards more energy-efficient household refrigeration appliances, and achieving significant energy savings. Other impacts are quantified but are not analysed in depth.

[106] https://ec.europa.eu/info/law/law-making-process/better-regulation-why-and-how_en

[107] COM(2012) 765 final, REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL, Review of Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products (recast)

[108] COM(2015) 345 final, Report from the Commission to the European Parliament and the Council Review of Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication of labelling and standard product information of the consumption of energy and other resources by energy-related products

Energy savings

Figure 26 gives the real energy use up to 2016 and the projected energy use projected in the Impact Assessment 2009[109], with (ECO 2009) and without (BAU 2009) the current regulations.

It shows that the reality has exceeded the expectations. An energy use of 88 TWh/a was expected in 2016, but in reality the energy use is 83 TWh/a (APPLiA database 2016). The financial crisis caused sales and stock to be lower than expected, but the appliances' efficiency in 2016 was not lower than what was expected.

The technical innovations came from a series of innovations at component and system level as described in Annex 10.

In absolute numbers, the electricity consumption went from 108 TWh/a in 2009 to 83 TWh/a in 2016, i.e. a saving of 25 TWh/a (23%) over 7 years. This also means a carbon emission reduction of 9.4 Mt CO2 eq./a.

These savings were realised while the stock of installed appliances increased with 7.4 million units over the 2009-2016 period, i.e. from 296.6 to 303.2 million units, and while the average volume of new units increased by 4%.

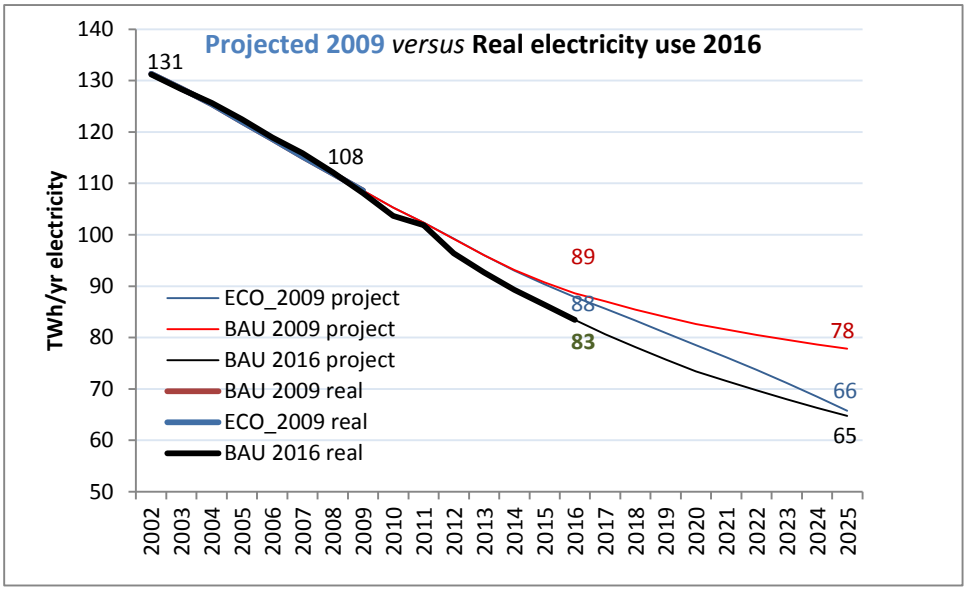

Figure 26: ***Electricity consumption of household refrigeration appliances 2002-2025. According to BAU and ECO scenarios assessed in 2009 versus real 2016 and BAU 2025 scenario (Impact assessment report household refrigerating applainces. VHK 2018[110]).***

Manufacturers and industry associations recognise that the Ecodesign Directive – together with the Energy labelling Directive has had a role in promoting the development and adoption of more energy efficiency appliances[111].

In other words, the current regulations have been effective in terms of energy savings.

[109] EC, impact assessment, SEC(2009)1020 published 22.7.2009. Based on data of preparatory study 2007. (Impact Assessment 2009)

[110] Impact assessment Ecodesign for household refrigerating appliances. VHK (this Impact Assessment)

[111] SWD(2014) 23 final PART 2/2, Commission Staff Working Document Part 2: Results of the case studies Accompanying the document the Communication from the Commission to the European Parliament, the Council and the European Economic and Social Committee A vision for the internal market for products Brussels, 22.1.2014.

Enforcement

The Appliance Testing for Energy Label Evaluation (ATLETE)[112] project included refrigerators and freezers in the period 2009 – 2011. The main goal of this project was to increase the European-wide implementation and control of ecodesign and energy labelling measures for appliances. Around 80 refrigerators and freezers models have been tested to check their compliance with EU Ecodesign regulation and Energy Labelling declarations. 79% of the tested models have proven compliance with their energy labelling class, however as much as 57% of the models did not comply with at least one of the tested parameters (including also for instance the declared volume, the storage temperature, etc). The project methodology, list of tests and laboratories, the results of all tested appliances and lessons learned and recommendations for policy-makers are available on the project website.

Today again, domestic refrigerating appliances are part of the EEPLIANT2[113] project that started in September 2017 with the objective to increase the rate of compliance. Seventeen Market Surveillance Authorities (MSAs) and a national agency from fifteen Member States work jointly to coordinate their monitoring, verification, and enforcement actions. In this regard, the project is expected to have a transnational impact across the EU Single Market.

Finally, compliance with regards to the application of the energy labels on products at the point of sales was not 100%. In addition, product documentation was not always complete.

3. EFFICIENCY

This section describes how efficient the current Regulation has been in delivering the above mentioned benefits.

Table 36 gives an overview of the different average prices per appliances in a scenario where no measures where proposed in 2009 (BAU 2009) and in a scenario where the current regulations were proposed and implemented (current scenario), calculated according to the Impact Assessment 2009, this Impact Assessment and in Reality. In the Impact Assessment 2009, the average price per appliance was expressed in fixed 2005 Euros. In this Impact Assessment, average price per appliance is expressed in fixed 2010 Euros. Given the inflation rate over the 2005-2010 period the price in fixed 2010 Euros is be 10% higher than the price in fixed 2005 Euros.

Table 36: Average prices per appliance according to the Impact Assessment 2009 and the this Impact Assessment

Year	**2009**	**2016 - BAU**	**2016 - Current**
Impact assessment 2009 (fixed 2005 prices) (EUR)	444	447	469
Current Impact Assessment (fixed 2010) (EUR)		491	516
Reality (EUR)			536

[112] project website: http://www.atlete.eu/index.php
[113] Project website: http://www.eepliant.eu/index.php/new-about-eepliant/about-eepliant-2

The real price is 4 % higher than the calculated price in this Impact Assessment. This is partly due to a larger inner volume of the average appliance (+9 %)[114] and a higher Value Added Tax (VAT) rate (20 % (average EU 2016) instead of 19 % (EU 2009)).

Currently, when purchasing a household refrigerating appliance, the consumer pays **EUR 45** extra compared to BAU. This amount is distributed among the different actors as follows:

- VAT (20 %) = EUR 7.5;
- Retail = EUR 17;
- Wholesale = EUR 3.5;
- Industry = EUR 17%.

At almost 20 million units sales per year this means an extra revenue of EUR **150 million for the tax office**, **EUR 340 million for retail**, **EUR 70 million for wholesale** and another **EUR 340 million for industry**.

In Table 37, the life cycle cost of the average household refrigerating appliance in a BAU and a current scenario are calculated. The energy escalation rate and the discount rate compensate each other as they are both equal to 4 %.

Table 37: Life cycle cost calculation in a BAU and Current scenario in fixed 2010 Euros.

	2016 - BAU	**2016 - Current**
Average price per appliance (EUR)	491	536
Average electricity consumption (kWh/a)	231	197
Electricity tariff (EUR/kWh)	0.20	0.20
Energy cost over the product life (16 year) (EUR)	739	630
Total life cycle cost (EUR)	1230	1166

In total consumers will pay EUR 63 less. The payback period is roughly be 8-9 years (halfway product life) for the current scenario versus BAU 2009.

At 20 million unit sales per year this means a savings of around **EUR 1.26 billon for consumers**.

No adverse effects on affordability have been mentioned by stakeholders.

The estimated cost for **compliance activities** for the whole of the domestic refrigerators and freezers sector is around EUR 160 million/year. Around 60 % of this **(EUR 86 million)** is considered as directly resulting from the internal market legislation while the remaining 40% are costs that would most probably occur even in the absence of legislation. Total substantive compliance costs – product designs related activities, testing and testing equipment – are estimated between 80-90 % of the total compliance costs. The administrative costs (information collection, preparation of technical files, DoC) represent 10-20 % and for the current regulations are calculated at **EUR 0.5 million annually**, divided over the various stakeholders (see BAU in Section 6.4).

The total turnover of the sector was estimated at EUR 4.8 billion and thus EUR 86

[114] Annual volume increase 1.2% per year during 7 years

million is 0.2 % of the turnover. Assuming conservatively that Ecodesign and Energy Labelling accounted for half of the compliance costs, the specific compliance costs for these measures amounted to around **EUR 43 million or 0.1 % of turnover**. Eventually this translates into 0.1 % of the consumer price or around **EUR 0.50 per appliance**.

3. Relevance

This section describes the relevance of the current regulations.

The Review study 2016 and this Impact Assessment show that the regulations support a transition towards more energy-efficient household refrigeration appliances effectively. Moreover, they deliver substantial savings.

However, higher savings could be achieved by revising the requirements (see Section 0). This forms the basis of the proposal for an updated regulation. Moreover, the current regulations only regulates the energy efficiency of the appliances. The Review study 2016 revealed that household refrigerating appliances can contributing substantially to the Commission's Circular Economy Initiative.

Annex 10: Problem drivers

In this Annex more details are given on the problem drivers.

1. SPECIFIC PROBLEM DRIVERS RELATED TO PROBLEM 1 – OUTDATED ENERGY EFFICIENCY REQUIREMENTS

1.1. Technological progress

Technology for household refrigerating appliances keeps on evolving. Today, the energy efficiency limits and energy classes in the current Ecodesign and Energy Labelling Regulation are no longer challenging and should be updated.

Some of the technological improvements are listed here:

- The efficiency of refrigeration compressors and their motors has increased significantly;
- The electronics controls have become ubiquitous and smarter;
- The vacuum insulation panels' (VIPs) effective life has improved and they are now more commonly used (mostly in upmarket appliances);
- Knowledge on low- GWP refrigerants has grown and they are now used also in larger appliances;
- Heat transfer capacity of evaporators and condensers is enlarged through better materials and system design.

The situation of the products versus the current energy label and versus the BAT will described at the time of the entry into force and today.

At the time of entry into force - At the time of entry into force, no models qualified for the A+++ energy efficiency class (EEI < 22). The share of models qualifying for the A++ energy efficiency class (22 ≤ EEI < 33) was less than 10%. The current Ecodesign and Energy Labelling Regulation mentions indicative EEI benchmarks for BAT in the range of 28 to 29.7.

Today - The current Regulations ban appliances with an EEI higher than 42 from being placed on the market. In practice, this means that there are only three energy efficiency classes at the moment (A+/A++/A+++). Today, the share of appliances qualifying for the A+++ label is more than 11%; the share of models with the A++ label is more than 40 % (APPLiA database 2016). The EEI of best available models, without climate correction factor, are in the range of 18 to 22.The Review study 2016 mentions that the benchmark for setting minimum requirements, i.e. the LLCC, is at an EEI-level of 24 to 29, depending on the category. Industry indicated a slightly higher LLCC at an overall EEI-level of 30 and possibly lower depending on category and metrics.

1.2. Outdated calculation

The energy efficiency metrics in current Regulations do not or no longer give consumers the correct information regarding the real-life behaviour of modern appliances and should be revisited.

A number of correction factors were introduced in the current metrics to compensate for certain aspects:

- The climate-class (1.1 for sub-tropical ST and 1.2 for tropical T);
- The defrosting strategy (no frost 1.2);
- Built-in versus stand-alone appliances (built-in 1.2);
- The presence of a chill compartment (50 kWh at EEI=100).

The use of these correction factors, potentially leads to an exaggerated EEI. In addition, some of these factors are used as (legal) loopholes, e.g. leading to Sweden reportedly having more 'tropical' refrigerators than countries like Spain. They are clouding the real electricity consumption and efficiency for the end-consumer. Some other factors are technically justified but overestimated for modern appliances in real life. Consequently, for many years, NGOs and MSs have asked for the elimination or at least drastic reduction of these factors.

Furthermore, some energy impacts have become more significant due to the decreasing energy consumption of appliances. Hence, they can no longer be considered covered by the current test- and calculation method. In the current test method, refrigerators and freezers are tested empty and with closed doors. Recent tests by consumer organisations have revealed that the compensation for real-life door openings and the introduction of 'warm' load used today (test done at an increased ambient temperature of 24°C) is no longer adequate. Especially for the introduction of warm load the actual energy consumption is at least 10% higher.

1.3. New global standard

A new global International Electrotechnical Commission (IEC) standard for household refrigerating appliances, IEC 62552:2015, was published in 2015. It will be used in Minimum Energy efficiency Performance Standards (MEPS) (like the minimum efficiency requirements in Ecodesign) and energy labelling programs in Australia, in Japan, in China and - in due time – in North America. The use of the standard, adapted to the EU situation, in ecodesign and energy labelling is essential to enhance global competitiveness, to improve market surveillance and to lower the burden for industry.

This standard aims to be:

- Universally applicable - using local variables in a globally harmonised context;
- More efficient - faster and lower costs;
- More accurate - more sophisticated defrost testing;
- More reliable - closing loopholes, precise indications of relevant testing of refrigerating appliance testing.

Most important changes in comparison to the existing standard are shown in Table 38.

Table 38: Differences between the harmonised and the new global standard.

	Harmonised standard*	**New global standard (IEC 62552:2015)**	**Improvement**

Energy testing	25 °C	16°C and 32°C. 24 °C is taken as a reference	Better impression of real-life performance, avoids design-optimisation to a single ambient temperature
Fresh food compartment temperature	+5 °C	+4 °C	Better for food preservation.
Freezer temperature (−18°C for 3- and 4-star compartments)	Measurement of temperature inside test-packages	Measurement of the air temperature	Faster
Target temperature chill compartments	0 °C	2 °C	More favourable treatment of chillers
Testing period	Fixed 24-hour period (or more)	Until steady state conditions are achieved	Faster
Energy consumption for defrosting	Integrated in the 24 h test	Measured separately, and added ex-post to steady state energy consumption if appropriate	More accurate monitoring. Testing now accommodates several types of defrosting control mechanisms.
Circumvention	No provisions	Test institutes are obliged to investigate anomalies due to circumvention and report this to Market Surveillance Authorities (MSAs)	Avoiding circumvention - many test laboratories are privatised and work for MSAs as well as for industry.

*Harmonised for the current Ecodesign and Energy Labelling Regulation[115].

Due to the decrease of the food compartment temperature, the energy consumption for fresh food compartments will increase (+11.9%). Due to changes in measurement of the freezer temperature, the energy consumption for 3- and 4-star compartments decreases (-6%); for an upright freezers between -1.8% (with auto-defrost) and -4.7% (without auto-defrost); for chest freezers -6%. In combination, the energy consumption will increase with 12.7% for a typical refrigerator-freezer with a single thermostat design (Type I) and between 1.6% (without auto-defrost) and 3.6% (auto-defrost) for a typical refrigerator-freezer with two thermostats (Type II).

N and M factors are more favourable for chill than for fresh food compartments, to avoid loopholes due to the change in chill temperature, chill compartment's performance requirements will need to be stringent.

1.4. Volume effect

The electricity consumption of EU household refrigerating appliances is negatively

[115] Commission communication in the framework of the implementation of the 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 and of Commission Delegated Regulation (EU) No 1060/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household refrigerating appliances. OJ C 22, 24.1.2014, p. 32 (harmonised standards)

impacted by an increasing net volume of the household refrigerating appliances. In 2015, the total refrigerated (5 °C) net volume, including the volume of the fresh food compartment of combis, was 65.8 million m³. The total freezer net volume (−18 °C), including the freezer compartment of combis, was 18.6 million m³. The average net volume per EU appliance was 278 litres/unit. In total, the net volume of household refrigerating appliances in the EU was 84.4 million m³. The increase in volume is at a rate of 1.8 %/yr and due to the growth in the number of households/dwellings, the increased market penetration (more refrigerating appliances per household), the 1.2 % annual growth in volume of the average appliance.

2. PROBLEM DRIVERS RELATED TO PROBLEM 2 – POOR CIRCULAR ECONOMY PERFORMANCE

Household refrigerating appliances should contribute to the reduction of food waste. They should facilitate the implementation of the WEEE Directive by adapted design which enables recovery of components. Finally an early end-of-life or reduction of efficiency during life should be avoided.

Below the circular economy aspects of household refrigerating appliances are described.

2.1. Emissions from refrigerants and foaming agents

No requirements should be set on refrigerants.

Refrigerants and foaming agents used in household refrigerating appliances today, are in 99% of all models low-GWP substances. Typically, isobutane is used as refrigerant and cyclopentane is used as foaming agent. In addition, the F-gas Regulation[116], includes in Annex III a prohibition for the placing on the market of domestic refrigerators and freezers that contain HFCs with GWP of 150 or more.

2.2. Improved reparability

Life-time extension – lifetime extension including from re-use, is not useful seeing the large energy saving potential. Such requirements would stagnate the entry of new, more efficient models on the market.

Avoiding early end of life - The availability of spare parts that most frequently fail, i.e. thermostats/thermistors and electronics should be ensured at least until the at least until the appliance reaches a lifetime equal to the simple payback period (6-7 year). According to Review study 2016, the failure rate of household refrigerating appliances can be around 13% in the first 5 years.

Maintaining efficiencies throughout the appliance's life - The availability of spare parts that lead to a reduction in efficiency throughout the refrigerating appliance's life should be ensured. According to the Review study 2016, the replacements of door gaskets are problematic and can contribute to a decrease in energy efficiency (around

[116] 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. OJ L 150, 20.5.2014, p. 195

10% due to aging of all components) throughout the appliance's life.

2.3. Enhanced recyclability

Products should be designed to facilitate recycling.

Recycling of refrigerators is regulated through the WEEE Directive. Annex VII of the WEEE Directive includes a list of materials which need to be collected separately during the recycling process.

2.4. Avoiding food waste

Design for optimal food storage should be promoted.

The most important contribution to reducing material resources comes from its primary function: the preservation of perishable foodstuffs.

The Complementary study, concluded that the material resources deployed and waste in the food chain are a manifold of those used in energy-related products. Roughly two-thirds of this food passes the household refrigerating appliances and 11% of food is thrown away, mainly because it is (believed to be) perished. This is partly due to suboptimal storage conditions. The fresh food compartment temperature (4 °C) is right for (most) dairy products. The shelf-life of meat and fish as well as leafy vegetables could be doubled or tripled in the chill compartment (2 °C). Many fruits and vegetables would preserve longer in a cellar compartment (12 °C).

More details about the food flow, see also Figure 27, will be described in the following.

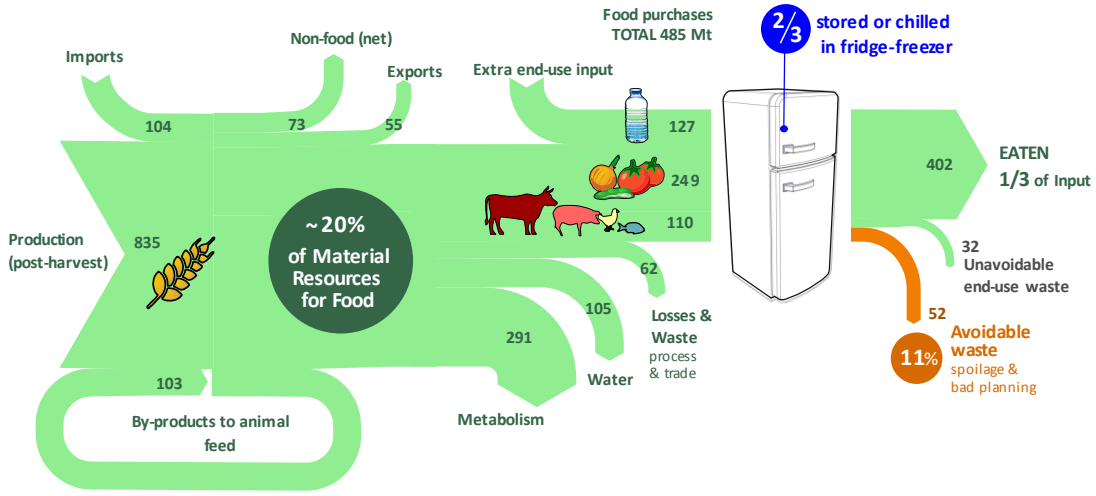

Figure 27: Simplified EU food flow diagram (flows in Mt) (Complementary study 2017[117])

EU-citizens purchase in total 485 Mt of food and beverages (excluding tap water) for their own consumption every year (reference 2011-2012). This amounts to 970 kg/yr per capita (18.6 kg/week) or 2276 kg/yr per household (43.8 kg/week). Roughly 30% of this

[117] Preparatory review study on Commission Regulation (EC) No. 643/2009 and Commission Delegated Regulation (EU) No. 1060/2010 - Complementary research on optimal food storafe conditions in refrigerating appliances. VHK in coll. with Oakdene Hollins for the European Commission. February 2017. (Complementary study 2017)

food is bought for them by food service facilities (restaurants, canteens, etc.) and 70% is bought by the households themselves for consumption at home. This is 679 kg per capita and 1593 kg/household/year (30.6 kg/hh/week).

One third of this food is stored at room temperature, one third is permanently stored in fridge or freezer compartment and one third --mainly beverages-- is stored in the refrigerator after opening (e.g. UHT milk) and/or before being served chilled. On average it is estimated that two-thirds of the time this last group is kept at room temperature and for one-third of the time between purchase and consumption it is kept in the refrigerator.

Overall, at any one time it is estimated that 43% of purchases is in the refrigerator or freezer. This is approx. 13 kg/week. This is confirmed by Geppert in consumer studies in four EU-countries (UK, Germany, France, Spain) that found median values --with a large spread-- of 4.2 shopping trips per week and a median of 3.2kg/trip that ended up in the refrigerator or freezer. Geppert also found that at the most 23-28% of net volume of the refrigeration appliance was filled, even where respondents qualified their fridge or freezer as 'full'.

In total, almost 18% of food and beverage purchased by end-users is wasted (167 kg/cap/yr, 392 kg/hh/yr). Of this, three-quarters is wasted at home (294 kg/hh/yr) and one quarter is wasted by food services. Of the 294 kg/hh/yr wasted at home, 112 kg/hh/yr is unavoidable (peels, bones, etc.) and 182 kg/hh/yr is due to food spoilage and bad planning, i.e. in principle avoidable. This comes down to 3.5 kg/hh/week, of which two-thirds, i.e. 2.3 kg/hh/week passes through a fridge or freezer over its shelf life at home. If we look at the fridge and freezer at any point in time then we could say that 43% of 3.5 kg/hh/week, or 1.5 kg/hh/week, is thrown away. This could relate to bad planning, i.e. leftovers from overcooking that are also not consumed at a later stage, or spoilage, i.e. past the 'use by' date or unattractive/unhealthy to eat. Both categories, bad planning and spoilage, contribute about equally to the unavoidable waste.

1. UNCLEAR SCOPE

Ambiguities in the scope of the current Ecodesign and Energy Labelling Regulation offers potential loopholes which should be closed.

The scope is electric mains-operated household refrigerating appliances with a storage volume of lower than or equal to 1500 l. In addition, these regulations also include in the scope household refrigerating appliances sold for non-household use or for the refrigeration of items other than foodstuffs and electric mains-operated household refrigerating appliances that can be battery-operated.

This scope introduces some uncertainties that will be explained below.

3.1. Household versus non-household

Some refrigerating appliances, used in non-household environments are identical to household refrigerating appliances. By simply declaring them as a non-household refrigerating appliance they are out of the scope of the current Ecodesign and Energy

Labelling Regulation, this should be avoided.

An example is the professional chest freezers which is identical to household chest freezers; by declaring these professional chest freezers as professional, they are excluded from the scope of the regulation; seeing that professional chest freezers are specifically excluded from the Ecodesign Regulation for Professional Refrigeration[118] they are not in the scope of any ecodesign or energy labelling regulation.

3.2. Overlap between the different ecodesign and energy labelling regulations.

Since the entry into force of the current Ecodesign and Energy Labelling Regulation some ecodesign regulations and energy labelling regulations have been published or are in preparation which have refrigerating appliances in their scope. Possible overlap between all these regulations should be avoided and gaps should be closed.

An overview of existing and planned Ecodesign refrigerating regulations is given in Annex 8.

3.1. Scope definition based on functionality versus technology

Some refrigerating appliances use other technologies than the compressor technology. Examples are absorption, thermos-electric and possibly in the future magnetic cooling and thermo-acoustics. Some of which have lower efficiencies, but have functional characteristics which justify their continued placing on the market. The current Ecodesign and Energy Labelling Regulations differentiates on the basis of technology. The scope needs to be defined and requirements need to be adapted to allow their placing on the market based on these functionalities.

As an example, mini bars are typically equipped with absorption refrigeration generators, they are low noise refrigerating appliances specifically designed to be installed in hotel rooms where guests sleep in the room where the appliance is installed. These appliances should be defined according to their functionality, not their technology as is the case today.

A second example is a mobile refrigeration appliance. These appliances are designed for use in means of transport (cars, mobile homes, boats, etc.), they should also be resistant to mechanical vibration and shocks as well as operation in a tilted position. These appliances should be exempted based on their functionality not on their energy source (battery-power of the transport vehicle (12 V) or a gas/kerosene tank) as is the case today.

[118] Commission Regulation (EU) 2015/1095 of 5 May 2015 implementing Directive 2009/125/EC of the European Parliament and of the Council with regards to ecodesign requirements for professional refrigerated storage cabinets, blast cabinets, condensing units and process chillers. OJ L 177, 8.7.2015, p. 19 (Ecodesign Regulation for Professional Refrigeration)

Annex 11: LLCC scenario

In this Annex more details are given about the LLCC scenario.

1. CHANGES TO THE SCOPE

The scope is defined first by the large functional and technology-neutral categories and expanding on what is in the scope and what is not.

Products in the scope are **refrigeration appliances** with a volume between 10 and 1500 l.

And excluding:

- Products in the scope of Ecodesign Regulation for Professional Refrigeration;
- Refrigerating appliances with a direct sales function[119];
- Mobile refrigerating appliances.

Subcategories are made for low noise refrigerating appliances, wine storage appliances and appliances with transparent doors. The low-noise appliances are mainly appliances that use absorption technology. They include most mini-bars in hotel (bed) rooms. Low noise is defined as equal to or lower than 20 dB(A). Wine storage appliances are identified by their precision temperature control and the presence of anti-vibration measures. Transparent doors are mainly found in mini-bars and wine storage appliances.

2. CHANGES TO THE METRICS

2.1. Proposed changes

The changes to the metrics involve changes to the reference lines and correction factors as follows.

Reference lines (Modelling parameters) - The new standard works with different temperature regimes, as such, calculation method to determine the EEI (reference lines) is adjusted. The reference lines (N and M factors) were determined through a technical approach. In the current Ecodesign and Energy Labelling Regulations they were determined through a regression analysis of a commercial database. In addition, the concept of appliance categories is abandoned and instead all combinations of compartment types are possible. A combination parameter (C) differentiates between the different types of appliances. This gives more flexibility in design.

Correction factors - The correction factors for the climate-class is eliminated; the one for built-in versus standalone (B) and the defrost strategy (A) are reduced by more than half. For dedicated freezers, i.e. only consisting 3- or 4-star freezer compartment, a negative correction (L) is introduced to take into account the effect of introducing warm loads.

[119] Draft working document Ecodesign and Energy Labelling for Commercial Refrigeration

2.2. Full calculation method

2.2.1. For refrigerating appliances

Energy Efficiency Index EEI

The Energy Efficiency Index EEI, expressed in % and rounded to the first decimal place, compares the Annual Energy consumption AE (in kWh/a) with the reference Standard Annual Energy consumption SAE (in kWh/a) and is calculated as:

$$\text{EEI} = AE / SAE.$$

Annual Energy consumption (*AE*)

AE, expressed in kWh/a and rounded to two decimal places, is calculated as follows:

$AE = 365 \cdot E_{daily} + E_{aux}$;

with the daily energy consumption E_{daily} in kWh/24h and rounded to three decimal places calculated from the daily energy consumption at an ambient temperature of 16°C (E_{16}) and at an ambient temperature of 32°C (E_{32}) as follows:

$E_{daily} = 0.5 \cdot (E_{16} + E_{32})$;

with

$E_{16} = 0.001 \cdot 24 \cdot (P_{ss16} + \Delta E_{d\text{-}f16} / t_{d\text{-}f16})$, and;

$E_{32} = 0.001 \cdot 24 \cdot (P_{ss32} + \Delta E_{d\text{-}f32} / t_{d\text{-}f32})$.

Standard Annual Energy consumption SAE

The Standard Annual Energy consumption *SAE*, in kWh/a and rounded to two decimal places, is calculated as follows:

$$SAE = C \cdot D \cdot L \cdot \sum_{c=1}^{n} A_c \cdot B_c \cdot \frac{V_c}{V} \cdot (N_c + V \cdot r_c \cdot M_c);$$

where c is the compartment index suffix and n is the total number of compartment types; V_c (in dm³ or litres, with one decimal) is the volume of the compartment; V (in dm³ or litres, rounded to the nearest integer) is the total volume with $V \leq \sum_{c=1}^{n} V_c$; r_c, Nc, Mc and C are modelling parameters specific to each compartment with values as set out in Table 39; and Ac, Bc, D and L are the compensation factors with values as set out in Table 40.

Note that for the variable temperature compartments the compartment type with the lowest target temperature is chosen for which it is declared suitable.

Table 39: The values of the modelling parameters per compartment type in the calculation of EEI

Compartment type	r_c [a]	N_c	M_c	C
Pantry	0.35	75	0,12	between 1,15 and 1,56 for refrigerator-freezers[b], 1,15 for other combis, 1,00 for dedicated appliances
Wine storage	0.6			
Cellar	0.6			
Fresh food	1.00			
Chill	1.1	138	0,12	
0-star & ice-making	1.2	138	0,15	
1-star	1.5			
2-star	1.8			
3-star	2.1			
Freezer (4-star)	2.1			

[a] $r_c=(T_a-T_c)/20;$ with T_a=24°C and T_c.
[b] C for refrigerator-freezers is determined as follows:
where *frzf* is the freezer volume $V_{freezer}$ as a fraction of total volume with $frzf=V_{freezer}/V$:
if $frzf \leq 0{,}3$ then $C=1{,}3+0{,}87 \cdot frzf$;
else if $0{,}3<frzf<0{,}7$ then $C=1{,}87-1{,}0275 \cdot frzf$;
else C=1,15.

Table 40: The values of the correction factors per compartment type in the calculation of EEI

Compartment type	A_c		B_c		D				L_c	
	Manual defrost	Auto-defrost	Freestanding	Built-in	≤ 2[a]	3[a]	4[a]	> 4[a]		
Pantry	1,00		1	1,04	1,00	1,02	1,035	1,05	1,00	
Wine storage										
Cellar										
Fresh food										
Chill				1,06						
0-star & ice-making	1,00	1,10		1,10					1,00[b]	0,90[c]
1-star										
2-star										
3-star										
Freezer (4-star)										

[a] number of doors or compartments, whichever is lowest;
[b] for 3- and 4-star compartments integrated in combi appliances with other compartments than 3-and 4-star compartments;
[c] for dedicated 3- or 4-star refrigerating appliances or combi appliances with only 3- and 4-star compartments.

2.2.2. Calculation methods for low-noise refrigerating appliances

Energy Efficiency Index EEI

The Energy Efficiency Index *EEI*, expressed in %, and rounded to decimal place, is calculated as:

EEI=AE/AEC.

Basis for the assessment of the energy consumption of low noise refrigerating appliances is the steady state power consumption at a single ambient temperature of 25 °C P_{ss25} (in W), measured in accordance with Section A.5.

The daily energy consumption $E_{daily25}$ at 25°C ambient temperature, in kWh/24h and rounded to three decimal places, is given by:

$E_{daily25} = 0{,}001 \cdot 24 \cdot P_{ss25}$.

Annual Energy consumption (AE)

The annual energy consumption *AE*, expressed in kWh/a and rounded to 2 decimal places, is given by:

$AE = 365 \cdot E_{daily25}$.

Standard Annual Energy consumption SAE:

The Standard Annual Energy consumption *SAE*, expressed in kWh/a and rounded to 2 decimal places, is calculated as follows:

$$SAE = C \cdot D \cdot L \cdot \sum_{c=1}^{n} A_c \cdot B_c \cdot \frac{V_c}{V} \cdot (N_c + V \cdot r_c \cdot M_c);$$

where c is the compartment index suffix and n is the total number of compartment types; V_c (in dm³ or litres, with one decimal) is the volume of the compartment; V (in dm³ or litres, rounded to the nearest integer) is the total volume and $V \leq \sum_{c=1}^{n} V_c$.; r_c, Nc, Mc and C are modelling parameters specific to each compartment and described in; and Ac, Bc, D and L are the compensation factors.

In most cases, low noise refrigerating appliances are manual defrost ($A_c = 1$), stand-alone ($B_c = 1$), dedicated ($C = 1$), single door ($D = 1$) appliances with cellar ($r_c = 0{,}6$), fresh food ($r_c = 1$) or pantry ($r_c = 0{,}35$) compartment type as defined in Tables 39 and 40. The latter implies $N_c = 75$ and $M_c = 0{,}12$ and $L = 1$. The Standard Annual Energy consumption *SAE* (in kWh/a) can thus be simplified as follows:

- for cellar types: $SAE = 75 + V \cdot 0{,}6 \cdot 0{,}12 = 75 + 0{,}072V$;
- for fresh food types: $SAE = 75 + V \cdot 1 \cdot 0{,}12 = 75 + 0{,}12V$;
- for pantry types: $SAE = 75 + V \cdot 0{,}35 \cdot 0{,}12 = 75 + 0{,}042V$.

2.2.3. Conversion

It is impossible to make a simple calculation to convert the current metrics to the newly proposed metrics. But, as a significant part of the previous analysis --e.g. on the LLCC and others-- starts from the current EEI it is important for policy makers to get an understanding of the implications in terms of the newly proposed EEI.

For that purpose a stochastic conversion was made on the basis of the models in the most recent APPLiA database 2016. Table 41shows how the rounded current EEI values (first column) in that database translate into the average, minimum, maximum and standard deviation values according to the new index. This is done for the three main categories in the database: refrigerators (Cat. 1), refrigerator-freezer combis (Cat. 7) and the upright freezers (Cat. 8).

Table 41: Conversion Table

Category--->		***1. Fridge***				***7. Combi***				***8. Upright freezer***				***Model count*** *(total 12493)*		
EEI ***now***		Avg	*Min*	*Max*	*Stdev*	Avg	*Min*	*Max*	*Stdev*	Avg	Min	Max	Stdev	1	7	8
42	***A+***	**140**	*130*	*150*	*1.8%*	**143**	*123*	*177*	*7.2%*	**130**	92	147	7.5%	642	3243	589
41		**141**	*133*	*143*		**135**	*133*	*159*		**117**	100	125		20	116	10
40		**132**	*132*	*132*		**134**	*120*	*143*		**123**	111	123		2	144	1
39		*128*				**129**	*117*	*144*		*119*				0	52	0
38		*125*				**130**	*119*	*133*		**116**	82	107		0	51	2
37		*121*				**134**	*131*	*138*		*113*				0	38	0
36		*117*				**129**	*128*	*130*		*111*				0	16	0
35		*113*				**120**	*111*	*128*		*109*				0	34	0
34		**110**	*110*	*110*		**120**	*120*	*120*		*108*				1	14	0
33	***A++***	**109**	*105*	*115*	*1.6%*	**113**	*89*	*139*	*7.0%*	**107**	75	118	7.0%	848	4564	311
32		**108**	*106*	*109*		**113**	*95*	*138*		**100**	86	105		9	58	6
31		*104*				**111**	*92*	*114*		**82**	74	82		0	17	1
30		*100*				**95**	*92*	*113*		*98*				0	35	0
29		**95**	*95*	*95*		**107**	*107*	*107*		*94*				1	1	0
28		*92*				*104*				*91*				0	0	0
27		*89*				*100*				*88*				0	0	0
26		*85*				*96*				*84*				0	0	0
25		*81*				*92*				*81*				0	0	0
24		*79*				*88*				*79*				0	0	0
23		*75*				**76**	*74*	*76*		*77*				0	5	0
22	***A+++***	**72**	*72*	*77*	*1.5%*	**74**	*65*	*92*	*7.8%*	**73**	56	78	5.9%	106	1454	54
21		*69*				**71**	*69*	*75*		**66**				0	18	0
20		*65*				**65**	*61*	*71*		**58**	52	58		0	8	1
19		*61*				**64**	*60*	*68*		*54*				0	2	0
18		**57**	*57*	*57*		**56**	*55*	*58*		*51*				1	18	0
17		*54*				*52*				*48*				0	0	0
weighted average														***total***		
New EEI		**119**	*113*	*126*	*1.6%*	**118**	*98*	*144*	*7.2%*	**107**	84.3	133	7.3%	1630	9888	975
EEI now (2016)		**35.9**				**34.5**				**37.8**						

Average values in small italic font are interpolations estimated from available values.

3. FOOD WASTE

To prevent food waste, the following changes have been proposed to the metrics.

- The concept of appliance categories has been abandoned, this was already

described in this Section. Consequently, the flexibility in combining different compartment types has increased. This will aid designers in producing better solutions for food preservation, tuned to the nature of the foodstuffs;

- The target temperature of chill compartments[120] (See Annex 11) have been lowered. Consequently, the metrics for these compartments are more favourable. This will facilitate the use of these type of compartments is facilitated;

A multi-door correction for appliances with three or more doors has been introduced, see Table 42.

Table 42: Multi door correction factor

Number of doors	Multi door factor
< 3	1
3	1.02
4	1.035
> 4	1.05

This will aid product designs that improve shelf-life of perishable foods with a factor two to three[121]. However, it does not compensate for the full 20% extra energy consumption from these appliances.

[120] A chiller is a compartment with a temperature of 0-2°C, which can increase shelf-life of meat and fish by a factor two to three.

[121] Compartments with a separate door give better temperature and humidity control than sub-compartments (i.e. compartments that share a common door). But they give more energy losses at the level of gaskets and thus a lower energy efficiency rating for the energy label. At the very least this penalty should be avoided to allow better food preservation.

Annex 12: Analysis of the impact details

In this Annex additional information is given on the impact of the different options.

1. NUMBER OF UNITS REMOVED FROM THE MARKET

1.1. Option 1 – Baseline

Figure 28 shows the number of models per energy efficiency class (current Energy Labelling Regulation) in a BAU scenario was extrapolated to 2030.

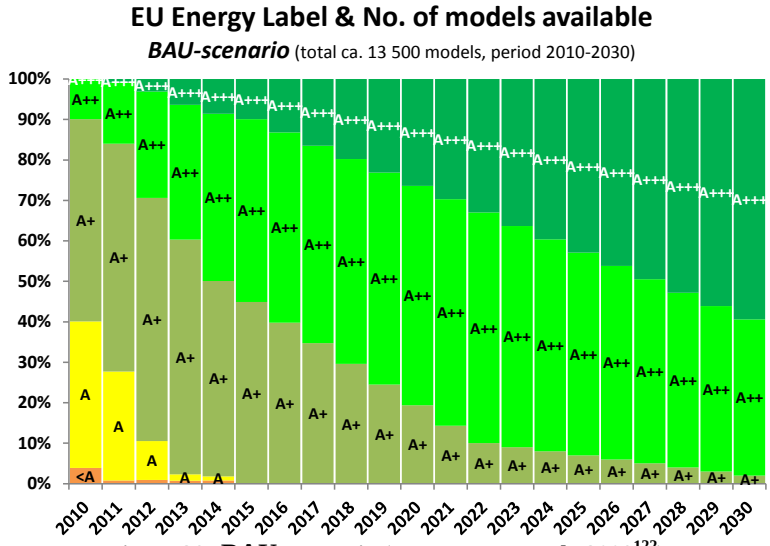

Figure 28: BAU scenario (Preparatory study 2008[122])

Table 43 gives the distribution of models in each energy efficiency class according to the current EEI and current Energy Labelling Regulation.

Table 43: Energy label class distribution and EEI of household refrigerating appliances EU 2010-2030 in a BAU (APPLLiA database 2016)

EEI		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
22	A+++	0%	1%	3%	6%	9%	10%	13%	17%	20%	23%	26%	30%	33%	36%	40%	43%	46%	50%	53%	56%	59%
33	A++	10%	15%	26%	33%	41%	45%	47%	49%	51%	52%	54%	56%	57%	55%	52%	50%	48%	46%	43%	41%	39%
44	A+	50%	56%	60%	58%	48%	45%	40%	35%	30%	25%	19%	14%	10%	9%	8%	7%	6%	5%	4%	3%	2%
55	A	36%	27%	10%	2%	1%																
75	<A	4%	1%	1%	1%	1%																
wt avg EEI		**48.1**	**45.3**	**41.8**	**39.3**	**37.9**	**36.9**	**35.9**	**35.0**	**34.1**	**33.2**	**32.2**	**31.3**	**30.5**	**30.0**	**29.5**	**29.1**	**28.6**	**28.1**	**27.6**	**27.2**	**26.7**

In between 2010-2016, a period of 6 years, the industry removed around 50 % of models from their catalogues (8.3 %/year) and substituted them by models with higher energy efficiencies.

Applying this BAU behaviour to the period 2016-April 2021, a period of 4.25 years, 35 % of models on the market in 2016 would be substituted in April 2021. This happens at a new EEI = 135 (current EEI = 40-41) (APPLiA database 2016). Applying this to the

[122] Preparatory studies for Eco-design requirements of EuPs, Lot 13: Domestic refrigerators & freezers. Milena Presutto, ENEA (Preparatory study 2008)

period April 2021 - April 2024, just before Tier 2, 65 % of 2016 models will have been removed. This happens at a new EEI=110 (current EEI=31) (APPLiA database 2016).

1.2. Option 3 - LLCC scenario

Tier 1 of the LLCC scenario proposes a maximum new EEI = 125 (current EEI = 38). This eliminates around 40 % of the 2016 models. In 2021, compared to the baseline scenario, around 5 % will be cut off.

Tier 2 of the LLCC scenario proposes a maximum new EEI =100 (current EEI = 30). This eliminates around 83 % of the 2016 models. In 2024, comparted to the baseline scenario, around 18% will be cut off. This percentage is relatively high because this limit cuts into the mass of models that are declared just below the A++ class limit.

In a different approach, the number of models per energy efficiency class (current Energy Labelling Regulation) was extrapolated to 2030, see Figure 29. It shows that the cut-off in 2020 would be 10% in the LLCC scenario in 2021 and 10% in 2024.

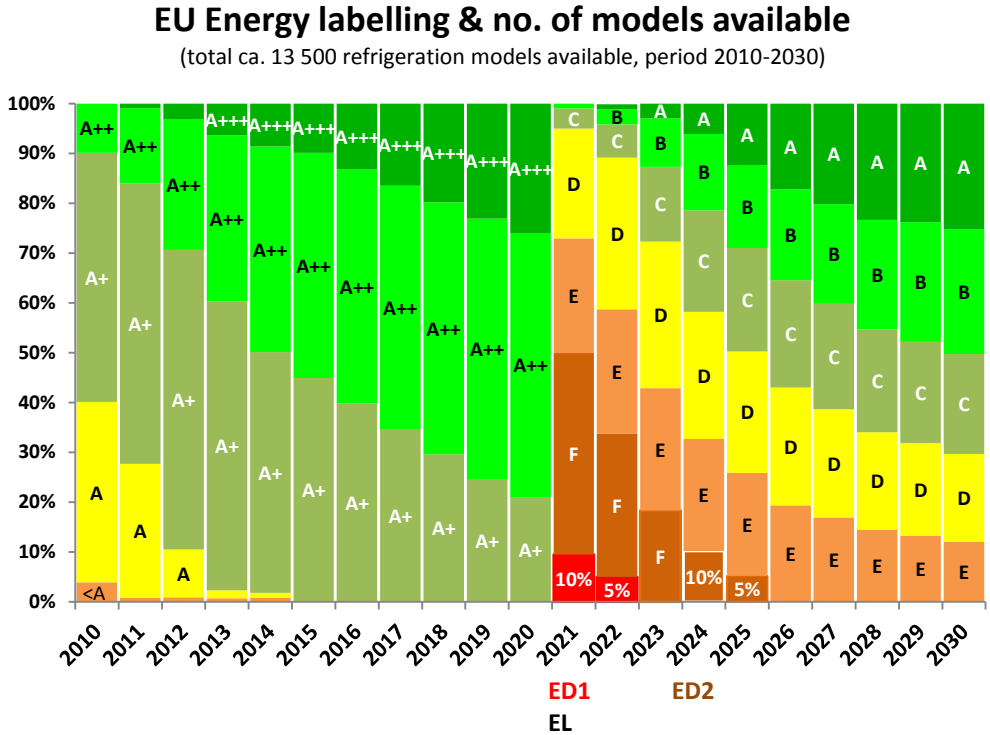

Figure 29: Energy label class distribution of standard household refrigerating appliance models available in the EU over the period 2010-2030 (actual 2010-2016 and projections 2017-2030) with proposed LLCC-measures (APPLLiA database 2016)

Table 44 gives the distribution of models in each energy efficiency class according to the current EEI and current Energy Labelling Regulation (top) and according to the LLCC proposal in Section 5.2.2.

Table 44: Energy label class distribution and EEI of household refrigerating appliances EU 2010-2030 (APPLLiA database 2016)

	EEI	class	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			actual (CECED database)							projection													
Current EEI	22	A+++	0%	1%	3%	6%	9%	10%	13%	17%	20%	23%	26%										
	33	A++	10%	15%	26%	33%	41%	45%	47%	49%	51%	52%	53%										
	44	A+	50%	56%	60%	58%	48%	45%	40%	35%	30%	25%	21%										
	55	A	36%	27%	10%	2%	1%																
	75	<A	4%	1%	1%	1%	1%																
			new 'virtual'											new applied									
New EEI	41	A												1%	2%	6%	12%	17%	20%	23%	24%	25%	
	51	B											0%	1%	3%	10%	15%	17%	18%	20%	22%	24%	25%
	62	C								0%	1%	1%	2%	4%	7%	15%	20%	21%	22%	21%	21%	20%	20%
	78	D								13%	16%	19%	22%	23%	27%	30%	32%	26%	24%	24%	22%	20%	19%	18%
	98	E								5%	5%	6%	10%	15%	18%	25%	23%	22%	21%	19%	17%	14%	13%	12%
	118	F								42%	44%	45%	42%	40%	40%	29%	18%	10%	5%					
	130	G								40%	35%	30%	25%	20%	10%	5%								
		wt.'d avg.																					
Current EEI			**48.1**	**45.3**	**41.8**	**39.3**	**37.9**	**36.9**	**35.9**	**35.0**	**34.1**	**33.2**	*24.4*	*26.8*	*26.5*	*18.8*	*19.5*	*19.7*	*20.1*	*19.5*	*18.9*	*18.6*	*18.3*
New EEI									117	116	113	110	81	89	88	63	65	66	67	65	63	62	61

1.3. Option 4 - Ambitious scenario

Tier 1 of the ambitious scenario proposes a maximum new EEI = 100 (current EEI = 30). This eliminates around 83 % of the 2016 models. In 2021, compared to the baseline scenario, around 48 % will be cut off.

Tier 2 of the ambitious scenario proposes a maximum new EEI =75 (current EEI = 75). This eliminates around 85 % of the 2016 models. In 2024, comparted to the baseline scenario, around 20% will be cut off.

1.4. Option 5 - Lenient scenario

Tier 1 of the lenient scenario proposes a maximum new EEI = 135. This eliminates around 35 % of the 2016 models. This is exactly what can be expected in a baseline scenario.

Tier 2 of the lenient scenario proposes a maximum new EEI = 120. This eliminates around 35 % of the 2016 models. This is less than what is expected in the baseline scenario. In other words, the ecodesign measures has no impact and all the energy saving has to come from an improved energy label.

2. ELECTRICITY SAVINGS – ENERGY CONSUMPTION PER UNIT

In addition to the total electricity savings, the energy consumption per unit was determined.

Figure 30 shows the projected average energy consumption per unit placed on the market over the period 2005-2030.

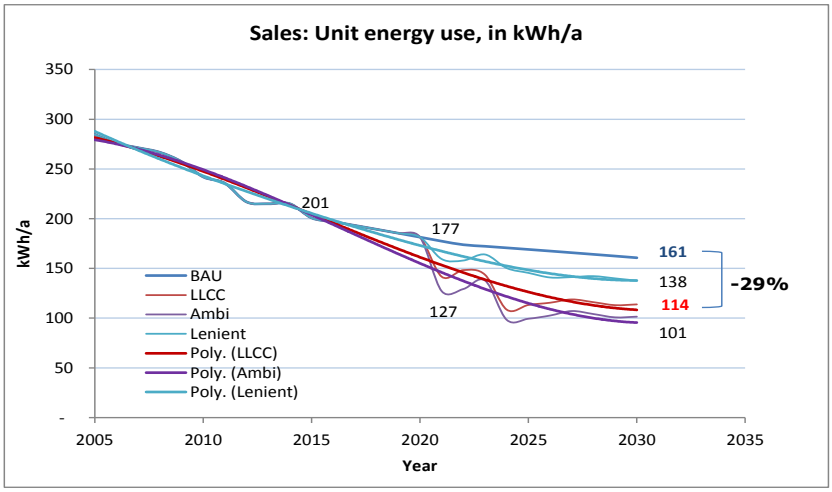

Figure 30: Average energy consumption of units sold over the period 2005-2030, in kWh/a electricity. Values corresponding to Table 3 (thin lines); values taking into account the anticipation before the measure and the sales of stock after the measure (thick lines). (Impact assessment study 2018)

An anticipation before the measure and the stock sold after the measure into account can be expected (see the tick lines in Figure 30) this will make the transition smoother.

The savings expected by 2030 for the different scenarios are given in Table 45. The savings of the baseline relative to 2015 are 40 TWh (20 %).

Table 45: Overview of the energy consumption and savings for each scenario in comparison to the baseline (Impact Assessment Study 2018)

	Energy consumption (kWh/a)	Savings compared Baseline (kWh/a)	Savings compared Baseline (%)
baseline	161		
LLCC	114	47	29
ambitious	101	60	37
lenient	138	23	14

3. CONSUMER EXPENDITURE

The consumer expenditure consists of the acquisition cost and the energy cost. Details of the acquisition cost and energy cost are given in the following paragraphs.

In addition, a sensitivity analysis is presented.

3.1. Acquisition cost and energy cost

The acquisition costs with various scenarios are given in Figure 31.

Option 3 - LLCC - the acquisition cost increases with the introduction of the ecodesign measures. In addition, it increases again when (somewhere around 2024) the low-cost improvement options are exhausted and manufacturers have to use more advanced and costly design options. **Option 4 - Ambitious** - manufacturers have to already use the more advanced and costly options in 2021 when confronted with the ambitious requirements. After that, improvement options are more limited and further price increase will be slower than e.g. with the LLCC-scenarios. It is clear that the Ambitious scenario is very challenging for the average consumer, not only in terms of overall economics (SPP >10 years) but also in terms of affordability (procuring the money to finance the

purchase). **Option 5 – Lenient** - there is hardly any impact on the product price, i.e. the small increase in production costs will be compensated by the learning effect.

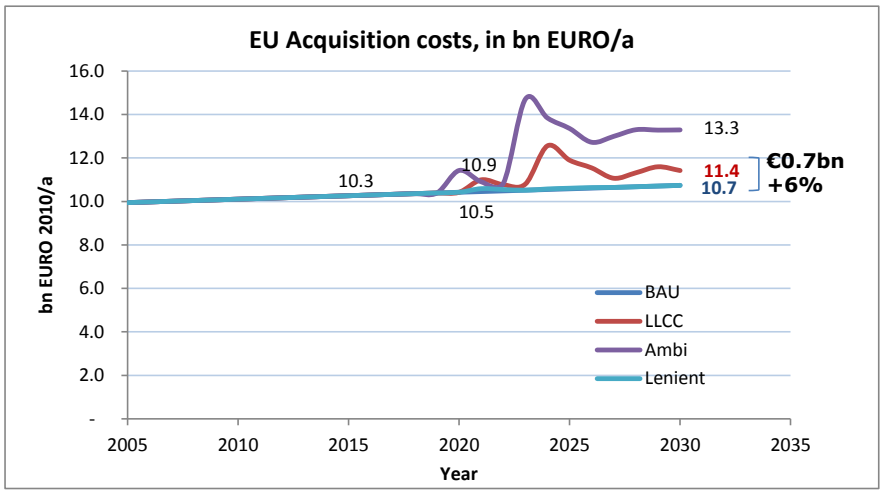

Figure 31: Projected consumer acquisition costs over the period 2005-2030, in billion Euros (NPV 2010) (Impact Assessment Study 2018).

Figure 32 shows the energy costs for various scenarios (in 2010 Euros).

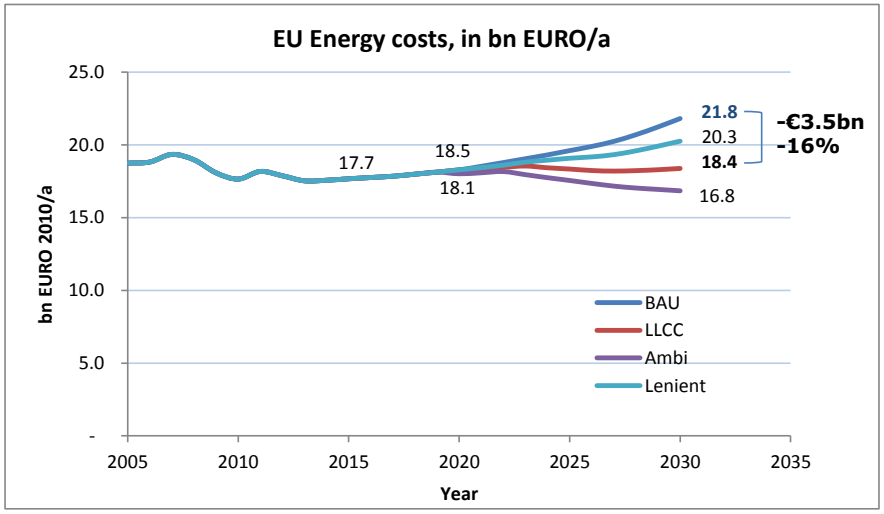

Figure 32: ***Projected consumer energy costs over the period 2005-2030, in billion Euros [2010] (Impact Assessment Study 2018)***

Due to the increasing electricity prices, energy costs go up (baseline, lenient scenarios) or stay more or less equal (LLCC scenarios) with respect to 2015. The exception is the ambitious scenario, which – at the expense of heavy investments in acquisition costs as mentioned - manages to save some EUR 0.9 billion (5%) in 2030 with respect of the 2015 average.

Table 46 gives the savings in energy cost in comparison to the baseline.

Table 46: Overview of the energy cost savings by 2030 for each scenario in comparison to the baseline

	Energy Cost in 2030 (billion Euro 2010/a)	Savings in 2030 (billion Euro 2010/a)	Savings in 2030 (%)
baseline	21.8		
LLCC	18.4	3.4	16
ambitious	16.8	5.0	21
lenient	20.3	1.5	7

3.2. Sensitivity analysis

The consumer expenditure in Section 6.3 has been calculated according to the MEErP with an escalation rate, i.e. a price increase above inflation, of 4%. This means for instance for 2030 a household electricity tariff of EUR 0.36/kWh (in Euro 2010). Considering the stagnation in electricity tariffs in recent years this may be too high. Recent PRIMES scenarios use a considerably lower tariff, which –on average—comes down to an escalation rate of 1.5 %. This means a tariff of EUR 0.24/kWh (in Euro 2010).

The sensitivity analysis presented in Table 47 gives the consumer expenditure and energy costs at this lower tariff, in order to validate whether this would make the scenarios uneconomical for consumers. The costs are given per year (2015-2040) and accumulative over the periods 2021-2030 and 2021-2040.

Table 47: Scenario results with electricity tariff escalation rate 1.5 % (from 2015) instead of 4 % (Impact Assessment Study 2018)

Consumer expenditure (in bn Euros 2010)

	per year					accumulative	
	2015	**2020**	**2025**	**2030**	**2040**	**'21-30**	**'21-40**
BAU	27.9	25.8	25.2	25.2	25.5	253	507
LLCC	27.9	25.8	25.6	23.6	23.9	250	486
Ambi	27.9	25.8	27.0	24.4	23.8	257	496
Lenient	27.9	25.8	24.9	24.1	24.1	248	486

Energy costs (in bn Euros 2010)

	2015	**2020**	**2025**	**2030**	**2040**	**'21-30**	**'21-40**
BAU	17.7	15.4	14.6	14.4	14.5	147	292
LLCC	17.7	15.4	13.7	12.2	10.2	136	244
Ambi	17.7	15.4	13.4	11.5	9.1	132	231
Lenient	17.7	15.4	14.3	13.4	12.4	142	270

The most important outcome is, although monetary savings are of course lower than at an escalation rate of 4%, that all the three policy scenarios still represent an annual saving in 2030 versus the BAU -scenario in terms of consumer expenditure. When looking at the accumulative expenditure over 2021-2030, the ambitious scenario has a consumer expenditure higher than BAU; the LLCC and Lenient scenario are still lower. In the long run, i.e. over the period 2021-2040, all policy scenarios have again a lower accumulative consumer expenditure than the BAU.

4. ADMINISTRATIVE BURDEN

In this section more information about the administrative burden according to the Impact Assessment for the Energy Labelling Framework Regulation is given and applied to the

refrigerating appliances in the scope.

Administrative costs are defined as the costs incurred by enterprises, the voluntary sector, public authorities and citizens in meeting legal obligations to provide information on their action or production, either to public authorities or to private parties[123]. The Commission's in-house Administrative Burden Calculator was used to calculate administrative cost for businesses and public authorities.

The different actions are explained in detail below.

4.1. Label transition for the A-G label

Suppliers have to supply two labels instead of one for a period of 6 months at a cost of EUR 0.3 to print a label[124]. Around10 million household refrigeration appliances sold in 6 months time. This means a cost of approximately EUR 3.3 million for suppliers. Furthermore, suppliers may have to supply some replacements labels on request of dealers depending on the delivery channel for replacement labels.

Dealers have to re-label around 2.5 % of products on stock/display or on the internet. An average time of five minutes per product is assumed at a tariff of EUR 14.30/h, resulting in EUR 1.20 per label and –for 0.5 million household refrigerating units—a total of EUR 0.6 million.

4.2. Mandatory product registration database

The key burdens due to this option are similar to those for the product registration database for radio equipment[125]:

Training of staff to become acquainted with the system: this is a one-time investment and not considered significant.

Upload manufacturer information and obtain manufacturer code, depending on the design for the operation of the database. This is again considered not significant.

Upload product specific information: this implies selecting appropriate information, formatting, and actually uploading the information. This is considered to be significant.

For household refrigeration equipment an estimated average of 1500 models[126] per year will need to be registered in the database[127]. Two hours of collection and registration time

[123] Commission impact assessment Guidelines

[124] Estimated at 0.50 Australian dollar (exchange rate at the time approximately 0.6 €/Australian dollar) by George Wilkenfeld and Associates Pty Ltd, Regulatory Impact Statement, Energy Labelling and Minimum Energy Performance Standards for Household Electrical Appliances in Australia, February 1999, p. 40

[125] SWD(2012) 329 final, p.31

[126] Equivalent models (i.e. models that are exactly the same with regard to energy efficiency, but sold under different model codes or even brand names) can be registered through a single registration and therefore count here as one model.

[127] For electronic products 2500-3000 per product group based on Energy Star registrations, for many domestic appliances such as washing machines, dishwashers, tumble driers vacuum cleaners it is likely to be much lower, possibly as low as 500. Industry databases for other domestic appliances such refrigeration and cooking points to about 2000-3000. For heating/cooling equipment it is estimated to be lower, in the range of 250-1000 depending on the specific product group. For commercial and industrial products it would be in the range of 2000-3000 for motors and fans, but as low as 50 for power transformers (VHK)

per model family is assumed[128]. This corresponds with the estimated administrative costs borne by suppliers for Australia's product registration database, i.e. EUR 60/model [129]. For the 1500 models this results in EUR 90000 per year.

The burden for MSs' market surveillance authorities to obtain documents is significantly reduced by this measure. It is, however, assumed that they spend the freed-up time on other market surveillance activities instead thereby contributing to higher compliance rates.

The costs for the Commission to set up the database are likely to be similar to the product registration base for radio equipment, adjusted for the number of models to be registered and kept in the database. The cost for the product registration base for radio equipment was estimated at EUR 300000 investment and EUR 30000 annual maintenance costs for registration of 5000 models per year[130]. Based on the above estimate of 1500 models per year, share of household refrigeration appliances in the total Commission investment is EUR 90000 and the maintenance costs are estimated at EUR 9000 per year.

4.3. Expand the database study, Commission costs

The budget for the current three-year study covering six products was EUR 500.000[131]. The cost for the Commission to cover about 30 products would thus be approximately EUR 1 million per year. For household refrigeration appliances (1 of 30 product groups) it would amount to EUR 33000/year.

4.4. Change 'least life cycle cost' requirement

This measure does not require administrative effort additional to business-as-usual. However, there are likely to be compliance costs for business in order to meet the more stringent requirements. Such compliance costs are likely to be negligible for product groups that have energy labels, where almost all businesses would, because of the energy label, in any case already go beyond the minimum ecodesign requirements. For product groups only covered by ecodesign requirements (and no energy labels) the compliance cost in terms of redesign may be significant for some businesses. A recent case study for laptops estimated that the total design costs for compliance with the seven applicable EU internal market directives and regulations, including ecodesign, is EUR 8 million per year[132]. Assuming that: 1) one quarter of that cost is due to ecodesign[133]; 2) changing the least life-cycle cost requirement to break-even point may increase the design cost by half; and 3) laptops constitute about one third of the ecodesign regulation for computers, the

[128] At an employee tariff of € 32.10 per hour representative for professionals

[129] 100 Australian dollar per model (exchange rate at the time approximately 0.6 €/Australian dollar). In addition, Australia charges a registration fee of 150 Australian dollar per model (George Wilkenfeld and Associates Pty Ltd, Regulatory Impact Statement Energy Labelling and Minimum Energy Performance Standards for Household Electrical Appliances in Australia: Supplementary Cost-Benefit Analysis on Transition to a Revised Energy Label, November 1999, p. 18)

[130] SWD(2012) 329 final, Annex X

[131] http://ec.europa.eu/energy/intelligent/files/tender/doc/2013/tender_specifications_eaci_iee_2013_002.pdf

[132] SWD(2014) 23 final part 2, p. 52 and 54

[133] Although there were seven applicable EU internal market directives that caused the total cost, not all of those impacted design significantly and thus the weight of ecodesign among the seven is estimated to be higher than one seventh: at one fourth.

total additional compliance cost above business-as-usual for the 15 regulations for product groups which have no energy label could be EUR 45 million per year[134].

4.5. Support joint surveillance actions Horizon2020

Joint surveillance actions fit the requirements and description of 2014 Horizon2020 call on the energy efficiency market uptake segment of "Ensuring effective implementation of EU product efficiency legislation" for which the indicative cost was 1.5-2 million euro for the EU budget[135]. Such a call would be opened every year with the aim to support several joint actions per year. The share of household refrigerating appliances (1 of 30 product groups) is estimated at EUR 60'000/year.

4.6. External laboratory testing

Manufacturers of household refrigeration appliances use self-declaration to declare relevant values for Ecodesign and Energy Label measures. All large manufacturers will have facilities for in-house testing. These facilities are used for declaration of Ecodesign and Energy Label values but also for broader Research and Development (R&D). Smaller manufacturers of e.g. wine storage appliances and minibars may not have these facilities and would resort to testing at a thrid party test laboratory. The extra costs, estimated at on average. The APPLiA database lists no more than 250 different wine storage models. Assuming that half of those are produced by SME manufacturers and that each model is redesigned every 10 years, this means that 12-13 models would require such testing. At on average EUR 3000 per model for the the third party fee and logistics costs this amounts to EUR 36000 annually. Likewise, for minibars at the most 10 models per year will be tested by third party laboratories, resulting in EUR 30000/year in annual costs for SMEs. In total, the external costs would amount to EUR 66000. Note that all these costs, including for wine storage appliances and minibars, are part of the business-as-usual, i.e. they are needed already today for the current energy label.

4.7. Market surveillance costs

No precise figures on total MS expenditure on market surveillance are available, since only about half of the MSs share information of available budgets. In 2011 the budget was estimated at EUR 7-10 million[136]. Based on (incomplete) data collected from MSs it is currently likely to be around EUR 10 million. Household refrigeration appliances are one of thirty products for surveillance. Assuming the effort to be equally distributed per product group this amounts to EUR 330000 of market surveillance costs for surveillance of household refrigeration appliances.

Introducing reviewed legislation

[134] € 8 million divided by 4 (estimated share of impact of ecodesign in EU internal market directives applicable to laptops) multiplied by 0.5 (50% extra design costs on top of business-as-usual due to the change of least life cycle cost requirement to break-even point requirement) multiplied by 45 (to account for all 15 product groups, because laptops only constitute 1/3 of a product group).

[135] http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/2362-ee-15-2014.html

[136] P. Waide *et al.*, Enforcement of energy efficiency regulations for energy consuming equipment: findings from a new European study, Proceedings of the 6th International Conference EEDAL'11 Energy Efficiency in Domestic Appliances and Lighting

Ecodesign and Energy Label regulations for household refrigeration appliances already exist, so the infractructure of notified bodies and market surveillance authorities is already in place in MS. Furthermore, the legal format is a 'regulation' and thus no transposition in national law is required. As a placeholder, an amount of EUR 100000 it is assumed that in total for all 28 MS is required for training and answering questions on the changes in the regulations.

5. SOCIAL IMPACT

5.1. Affordability

A sensitivity analysis was done on the LCC calculation comparing the LCC in EU, Germany and Romania.

The electricity prices were set at:

- EUR 0.297 /kWh in Germany,
- EUR 0.126 /kWh in Romania, and
- EUR 0.205 /kWh in the EU.

The appliances selected for this analysis are the unit sales weighted average and sold volume weighted, with energy consumption and price of the appliances as included in Annex 4, Table 30. It was assumed that the unit's purchase price is be the same in all cases.

For the unit sales weighted average and the sold volume weighted average the results are shown in Table 48.

Table 48: payback time in the EU, Germany and Rumania

	Payback time (year)	
	unit sales weighted	sold volume weighted
EU	5,9	7,0
Germany	4,1	4,8
Rumania	9,6	11,3

In Romania, the payback times are higher more than double the payback time in Germany but still lower than the full lifetime (i.e. 16 year).

5.2. Employment

The boundaries for the calculation of the impact on employments are:

- Only direct jobs in the production and distribution chain are considered, i.e. including OEM suppliers and business services but excluding the indirect employment effect of employees in the production and distribution chain buying/renting houses, doing their shopping, paying taxes, etc.;

- It is assumed that the increase in revenue leads to an increase in the number of jobs, but in this case, where employment is declining (see par. 6.5.2), it can also be understood as retaining jobs that would otherwise be lost;
- The total number of direct jobs is considered. However, it needs to be taken into account that typically half of the OEM jobs (16% of industry jobs) is created/retained outside the EU through imports of components.

Annex 13: Glossary

Term or acronym	*Meaning or definition*
ANEC	European Association for the Co-ordination of Consumer Representation in Standardisation (NGO)
APPLiA	Home Appliances Europe, formerly CECED
ATLETE	Appliance Testing for Energy Label Evaluation
BAT	Best Available Technology
BAU	Business-as-usual (describing a scenario without any further intervention)
BEUC	European Consumer Organisation (NGO)
CECED	European Committee of Domestic Equipment Manufacturers (industry association representing manufacturers of home appliances in the EU)
CLASP	Collaborative Labeling and Appliance Standards Program
DG	Directorate General
DMC	Domestic Material Consumption
4E	Energy Efficient End-use Equipment
ECOS	European Environmental Citizens Organisation for Standardisation (NGO)
EEB	European Environment Bureau (NGO)
EEE	Electrical and Electronic Equipment
EEI	Energy Efficiency Index
ENV	Environment, Public health and safety
EEPLIANT	Energy Efficiency ComPLIANT Products
ETS	Emissions Trading Scheme
EU	European Union
EURIC	European Recycling Industries' Confederation
GfK	Growth from Knowledge
GHG	Greenhouse gas
GWP	Global Warming Potential
HFO	Hydrofluoro-olefin
hh	Household
IEA	International Energy agency
IEC	International Electrotechnical Commission; global standardisation

	organisation
kg	kilogram
kWh	kilo Watt hour, 10^3 Watt per hour (unit of energy)
LCC	Life cycle cost over the whole lifetime of a product, including purchase cost and energy costs
LLCC	Least life cycle cost; used to determine the energy efficiency requirements that minimise costs of a product for its whole lifetime.
MEErP	Methodology for the Ecodesign of Energy-related Products[137]
MEEuP	Methodology for the Ecdesign of Energy-using Products
MEPS	Minimum Energy efficiency Performance Standards
Mt CO_2 eq.	Mega tonne CO_2 equivalent, 10^9 kg of gas equivalent to potency of CO_2 (uni of GHG emissions)
Mtoe	Million Tonnes of Oil Equivalent
MS	Member State
MSA	Market Surveillance Authority (in charge of enforcing ecodesign regulatio in a MS)
NGO	Non-Governmental Organisation e.g. ANEC, BEUC, ECOS, EEB, RREUSE
ODP	Ozone depleting
OEM	Original Equipment Manufacturer
OPC	Open Public Consultation
PEF	Primary Energy Factor
R&D	Research and Development
REFIT	Regulatory Fitness and Performance
SME	Small and Medium-sized Enterprises
SVHC	Substances of Very High Concern
TopTen	International program to create a dynamic benchmark for the most energ efficient products
TWh	Tera Watt hour, 10^{12} Watt per hour (unit of energy)
Type I	single thermostat design
Type II	two thermostats

137 Material-efficiency Ecodesign Report and Module to the Methodology for the Ecodesign of Energy-related Products (MEErP) PART 1: MATERIAL EFFICIENCY FOR ECODESIGN - Final report to the European Commission - DG Enterprise and Industry 5 December 2013.

VAT	Value Added Tax
VIP	Vacuum insulation panels
WEEE	Waste Electrical and Electronic Equipment
wt%	Weight percentage or percentage by weight
Yr or a	Abbreviation used as denominator for units expressed per year (e.g. TWh/yr or TWh/a)

Annex 14: List of Figures

Annex 15: List of Tables