



Preparatory/review study - Annex H

Commission Regulation (EC) No. 643/2009
with regard to **ecodesign requirements for
household refrigeration appliances**
and
Commission Delegated Regulation (EU) No.
1060/2010 with regard to **energy labelling of
household refrigeration appliances**

FINAL REPORT – ANNEX H

Prepared by

VHK and ARMINES

in collaboration with Viegand & Maagøe and Wuppertal Institute
contract co-ordination VITO

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This annex contains full text of stakeholder comments

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Raising standards for consumers



The Consumer Voice in Europe

Preparatory study on the revision of the Ecodesign and Energy Labelling requirements on household refrigeration

ANEC/BEUC comments on the draft report on tasks 1-6 of 14 November 2015

Contact: Angeliki Malizou – sustainability@beuc.eu & anec@anec.eu

Prolonged lifetime and durability minimum requirements

1. Prolonged lifetime

By extrapolating current trends and taking into account possibly stricter Ecodesign requirements phasing out A+ models it is expected that by the time the revised regulations enter into force the products put on the market would belong to energy efficiency classes A++ and A+++ . According to Gensch and Blepp (2015)¹ further efficiency gains of 40-50% with respect to A+++ are necessary in order to achieve environmental payback times² of 10 years and less. This means that it only makes sense to replace an A+++ model if the new model has half the electricity consumption of the A+++ one. The analysis in Task 6 of the preparatory study shows that the savings of the current BAT compared to A+++ efficiency levels are between 10 and 25%. Only in case of fridge-freezers (COLD 7) further efficiency gains of 45% are foreseen (see tables 64 to 69). The study team also concludes that “there are no BNAT (Best Not yet Available Technology) options that we feel will come to market within a time-period that is relevant for reshaping the Ecodesign and Energy Labelling measures”. This means that, especially in case of A+++ appliances a longer life time makes sense.

In addition, taking into account the average electricity consumption of fridge-freezers since 1980 and its extrapolation until 2020, Bakker et al. (2014)³ come to the conclusion “that product life extension is the preferred strategy [...]: refrigerators bought in 2011 should be used for 20 years”.

¹ Gensch, C. and Blepp, M.: Betrachtungen zu Produktlebensdauer und Ersatzstrategien von Miele-Haushaltsgeräten. Im Auftrag der Miele & Cie. KG. 2015. https://www.miele.com/media/miele_com/media/files/infomaterial/Studie_Oeko-Institut_Lebensdauer_2015.pdf

² i.e. the time it takes until the additional efforts to produce a new product equals the cumulated efficiency gains through lower consumption during the use phase.

³ Bakker, C; Wang, F.; Huismana, J.; den Hollander, M.: Products that go round: exploring product life extension through design, Journal of Cleaner Production, Volume 69, 15 April 2014, p. 10-16.

Also, if there is a shift in the electricity mix to more renewable energy sources, the Global Warming Potential (GWP) during use phase is lower, resulting in smaller savings potential through more efficient appliances and thus advantages for appliances with longer durability.

This forward-looking information indicate that extending the lifetime of refrigerating appliances that will be placed on the market in the future can be beneficial both for consumers as well as for the environment. We invite the study team to consider this information in the analysis.

2. Minimum durability requirements

An important aspect, which is not yet sufficiently covered by the preparatory study, is related to durability minimum requirements that would ensure a minimum product lifetime. It would be important to analyse the impacts of a lifetime which is much lower than the average. GfK data (see Prakash et al. 2015⁴) show that the average age of refrigerators that were replaced due to a defect decreased from 15.1 years in 2004 to 14.0 years in 2012/2013 and in the case of freezers the average product age decreased from 16.1 years in 2004 to 13.0 years in 2012/13. Especially the share of appliances that were replaced due to a defect within the first 5 years has increased substantially. One reason for this early replacement could be attributed to the price decrease for new products and the price increase for repair over the past years. Both these trends can constitute repair relative expensive compared to the purchase of a new appliance. As a result, even though a repair would still be possible it is no longer economically viable. Therefore, requirements that ensure a certain minimum lifetime are very important to prevent early failures and subsequently premature replacements.

This aspect is for example covered in the study by Ricardo AEA on *“The Durability of Products -- Standard assessment for the circular economy under the Eco-Innovation Action Plan”*. This study considers a minimum lifetime of 7 years as appropriate for refrigerating appliances. The study looks into existing standards as a starting point for the development of a standard for measuring the durability of these components that are more likely to fail. It also identifies aspects that might serve as generic minimum design and construction requirements aiming to ensure a certain quality level and thus a minimum lifetime.

We invite the study team to provide a detailed analysis of durability aspects and technical solutions in the final report.

ENDS

⁴ Prakash, S.; Dehoust, G.; Gsell, M.; Schleicher T. & Stamminger, R. (2015). Einfluss der Nutzungsdauer von Produkten auf ihre Umweltwirkung: Schaffung einer Informationsgrundlage und Entwicklung von Strategien gegen „Obsoleszenz“: Available at http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_10_2015_einfluss_der_nutzungsdauer_von_produkten_auf_ihre_umwelt_obsoleszenz_17.3.2015.pdf



BAM and UBA comments on the draft report (tasks 1-6) "Ecodesign & Labelling Review Household Refrigeration"

We appreciate the review of requirements regarding Ecodesign and Energy Label of household refrigeration appliances. We would like to comment on the following topics:

Scope and definitions

We agree that the term "non-household" remains in the scope. Certainly, it would be nicer not to have it in a regulation covering household refrigeration, but probably it is necessary to avoid loopholes. The expression "household or similar" does not seem to be more suitable. A technical definition would be desirable but is probably difficult to find.

Apart from that, we support what Hans-Paul Siderius commented after the first stakeholder meeting in July 2015: the definitions should be such that every refrigeration appliance in the scope of the regulations concerning household, commercial and professional refrigeration is unambiguously covered by one (and only one) regulation.

Durability

We appreciate that during the stakeholder meeting in December 2015, it was announced that in task 7 an option is planned which considers durability in more detail. From our point of view, there are still open questions:

Is it really clear that lifetime extension is not worthwhile, even with newer and more energy efficient appliances? The recommendations with regard to life time extension are still based on backwards looking research (replacement of A or A+ appliances) and are not future oriented (replacement of A++ or A+++ appliances).

Rationale:

It can be assumed that by the time of entry into force of a revised regulation, the main energy efficiency classes put on the market are A++ and A+++. According to

Gensch and Blepp (2015)¹ it needs further efficiency gains of 40-50% (with respect to A+++) in order to achieve environmental payback times of 10 years and less. This means, if someone has an A+++ model it only makes sense to replace it, if the new model has half the electricity consumption than the A+++ one. The analysis in Task 6 of the preparatory study shows that the savings of current BAT in comparison with A+++ efficiency are between 10 and 25%, only in case of fridge-freezers (COLD 7) further efficiency gains of 45% are seen (see tables 64 to 69). The study team also concludes that "there are no BNAT (Best Not yet Available Technology) options that we feel will come to market within a time-period that is relevant for reshaping the Ecodesign and Energy Labelling measures". This means that, especially in case of A+++ appliances, a longer life time makes sense.

Also Bakker et al. (2014)², taking into account the average electricity consumption of fridge-freezers since 1980 and its extrapolation until 2020, come to the conclusion "that product life extension is the preferred strategy [...]: refrigerators bought in 2011 should be used for 20 years". This means, already for an average fridge-freezer bought in 2011 they recommend a life time of 20 years as being the most environmental friendly.

If other impact categories than only total energy consumption or the GWP are regarded – especially impact categories with higher impact in the manufacturing phase (e.g. metallic resources or acidification) the results would be much more in favour of longer durability.

Would it not be possible to include durability requirements in the regulations, perhaps also only for certain components which are prone to fail early? The study should at least elaborate on durability aspects and show the possibilities and pros and cons of minimum durability requirements. The decision if such requirements are set is a political one which is taken afterwards, this is not the task of the preparatory study. The RCARDO-AEA study (2015), which has been already cited in the preparatory study, provides already a sound analysis of test methods of components of refrigerating appliances.

Rationale:

The time span of the 'first useful service life' has decreased over the past years in Germany: GfK data (see Prakash et al. 2015)³ show that the average age of refrigerators, that were replaced due to a defect decreased from 15.1 years in 2004 to 14.0 years in 2012/2013. In case of freezers it decreased from 16.1 yrs (2004) to 13.0 yrs (2012/13). Especially the share of appliances that were replaced due to a defect within the first 5 years has increased substantially (ibid.). One reason for the latter aspect is supposed to be the price decrease for new products while at the same time the repair costs increased over the past years. Both developments make the repair relative expensive compared to the purchase of a new appliance. Even though

¹ Gensch, C. & Blepp, M.: Betrachtungen zu Produktlebensdauer und Ersatzstrategien von Miele-Haushaltsgeräten. Im Auftrag der Miele & Cie. KG. 2015.

² Bakker, C; Wang, F.; Huismana, J.; den Hollander, M.: Products that go round: exploring product life extension through design, Journal of Cleaner Production, Volume 69, 15 April 2014, p. 10-16

³ Prakash, S.; Dehoust, G.; Gsell, M.; Schleicher T. & Stamminger, R. (2015). Einfluss der Nutzungsdauer von Produkten auf ihre Umweltwirkung: Schaffung einer Informationsgrundlage und Entwicklung von Strategien gegen „Obsoleszenz“.

a repair would still be possible it is economically not viable anymore. In such a situation minimum requirements that ensure a certain minimum lifetime are very important to prevent early appliance failure and subsequent replacement.

Compensation factors

We agree that there is a need for compensation factors for auto-defrost, built-in and combi. The built-in compensation should be such that it only compensates for the different measurement method for built-in appliances.

Rationale:

Auto-defrost: Refrigerating appliances are less efficient if the evaporator is covered with ice. No-frost appliances need more energy under standard conditions compared to static appliances as they have regular defrosting cycles to melt the ice on the evaporator and drain the water. The energy consumption of static appliances might thus be lower under standard conditions compared to an equivalent no-frost appliance. Under real life conditions however it can be assumed to be higher, 1) due to ice covering the evaporator and 2) as also during manual defrosting additional energy is needed (e.g. for cooling down the freezer / the freezing compartment after manual defrosting). For static appliances these two aspects are not covered under standard conditions.

Built-in: The main argument in favour of a compensation factor for built-in appliances is, that they do not necessarily have a higher energy consumption as such but that (at least part of) the higher consumption value comes from the way they are tested. Both industry and the study team argue that the energy consumption of stand-alone appliances would increase when tested under built-in conditions. Stand-alone appliances might even need more energy than an equivalent built-in appliance that has a worse test result on the label, as it is not well prepared for that situation. Consumers could therefore be misled by the good label performance of a stand-alone appliance and decide for such an appliance even though they finally use it under built-in conditions.

Combi: such a factor seems reasonable as combi appliances (e.g. fridge-freezers) have an advantage compared to single appliances, e.g. through shared walls that result in lower "ambient temperatures" and thus less heat loss. Therefore it is good to introduce such a factor that makes the requirement stricter for combi appliances.

We also think that a multi-door compensation could be reasonable because it could lead to more appliances with compartments having different temperatures and thus possibly to energy savings. However, it strongly depends on the consumer's behaviour if multi-compartment appliances really result in less food waste and less shopping trips. A compensation factor should only be granted if there are, compared to appliances with 1 or 2 doors, savings under real life conditions which are not accounted for under standard conditions. Such savings could also result from the fact, that only the necessary compartment is opened and thus less air exchange takes place. This is, however not yet discussed in detail in the report and should be elaborated in a bit more detail.

An additional compensation factor for chill compartments is not necessary from our point of view.

Regarding the glass doors of wine coolers, we do not think that it is necessary to have a compensation factor, but to formulate the ecodesign requirements such that wine coolers do not have any problems to stay on the market. The label however should show that wine coolers with glass door consume more energy than a fridge with comparable size and temperature.

Suggestion regarding the scenarios in Task 7

We propose to use one of the scenarios to assess the impact of life time requirements, e.g. requirement on one or two components like the thermostat or the compressor based on the analysis of the Ricardo-AEA study.

Contact

Federal Institute for Materials Research
and Testing

Andrea Harrer
Section S.4
Ecodesign and Energy Labelling

+49-30-8104-3689
andrea.harrer@bam.de

Federal Environment Agency

Ines Oehme
Section III 1.3
Ecodesign, Environmental Labelling
Environmental Friendly Procurement

+49-340-2103-2585
ines.oehme@uba.de

Re/genT Note¹:15420 / CE14 / V3		Technical Note
Project	Eco-design & Labelling Review Household Refrigeration, preparatory/review study	
Subject	CECED Comments to Interim report (14.11.2015) of Eco-design & Labelling Review Household Refrigeration	
Author	Martien Janssen of Re/genT BV Lage Dijk 22 5705 BZ Helmond The Netherlands martien.janssen@re-gent.nl	
To	CECED WG Cold	

1. Introduction

1.1. Document revision history

Release date	Author	Version	Remark / document change
28-11-2015	MJ	D1	First trial
1-12-2016	MJ	D2	Version for discussion at WG cold meeting Milan, 3/12/2015
14-01-2016	MJ	V1	Review for WG Cold meeting 19-1-2016
21-01-2016	MJ	V2	Update after WG Cold meeting 19-1-2016 <ul style="list-style-type: none"> • Info on load processing efficiency test added.
25-01-2016	MJ	V3	Added: <ul style="list-style-type: none"> • Issue of rounding • Build-in compensation for fresh food

1.2. General

The EU commission, DG Energy has ordered a review study of current eco-design requirements (regulation 643/2009) and labelling (delegated regulation 1060/2010) for cold appliances. A study team lead by VHK, the Netherlands, has presented a second interim report (dated 14-11-2015) which has been discussed in a second stakeholder meeting, held in Brussels, 14-12-2015 and is further referred to as “the report”.

This notes collects observations from CECED, based on analysis performed, two WG cold meetings and several phone conf. calls.

The comments in this note make reference to the appropriate chapter in the interim report. Comments of editorial nature or minor technical considerations are collected in the appendix.

A few important items are not discussed in this note:

¹ The last digits refer to the version number of this note

- a) The technical analysis of chapter 9 has been discussed and studied in great detail. Comments and proposals are included in Re/genT Note :15423 / CE15 / V5.
- b) The life cycle analysis of chapter 12 has been studied and commented upon in Re/genT note: Re/genT Note :15424 / CE16 / V1. This has been presented before the stakeholder meeting and its contents have been presented by the study team during this meeting. This document has not been further updated and comments are believed to be taken into account by the study team.

2. Executive summary

In general the concept of using no categories but base the analysis on compartments is welcomed. The use of compensations on energy in steady of correction factors which was proposed by CECED has been included in the study which is appreciated.

3. Chapter 3: Scope

For wine storage appliances, the new category proposed by CECED has been considered but deemed unnecessary. The reasons mentioned:

1. The products are on its basis similar to e.g. cellar appliances
2. If eco-design requirements would be set, these can easily be set at a different level than for regular appliances (e.g. different level for refrigerators (R) with only wine storage compartments.

The latter is indeed one of the manufacturers concern. The second is that if wine storage appliances are mixed with other products this limits the distribution of the energy efficiency classes for the other products² (today all wine storage appliances are above A+).

As a generic remark CECED supports strongly the statement that the definitions should be such that every refrigeration appliance in the scope of the regulations concerning household, commercial and professional refrigeration is unambiguously covered by one (and only one) regulation.

4. Chapter 4: Standards

A reference is included for power consumption in standby and off mode. It should be indicated that this is not relevant for cold appliances.

It is mentioned that the load processing tests has little added value. This is confirmed by CECED. The technical background (on page 31) is not completely correct as it mentions that the energy consumed is more driven by the energy released from the food and not by appliance characteristics. Actually the energy consumed is directly proportional to both the efficiency of the refrigeration system and the heat released from the food. CECED argument for not using load processing testing is based on another fact, namely that it adds little discrimination between products if the test would be included in the energy consumption declared, this at the expense of a significant increase in test time, test costs and uncertainty of the final result. In appendix 2 a slide has been added which explains that for appliances at the same energy consumption level during the regular tests, potential differences in

² In a rescaled system, efficiency class G could possibly be around the current eco-design limit of A+, which would bring all current wine storage appliances into G.

refrigeration system efficiency contribute little to a final energy consumption declaration if the load processing efficiency test would be included. The incremental energy of load processing can much easier be compensated for by an increased ambient temperature during the test compared to actual home temperatures³.

5. Chapter 5: Legislation

A rounding issue is present when checking efficiency classes. The legislation requires that the annual energy is rounded to two digits before calculating the energy efficiency index. The annual energy on the label is to be rounded up to the nearest integer. In a verification of the label only the rounded up value is generally available. If this is used to calculate the energy efficiency index often a value just above the efficiency class threshold is found, while the original data used by the manufacturer would result in an efficiency index just below the threshold.

If the annual energy consumption on the label would be rounded to the nearest integer (instead of only upward rounding), this problem would be avoided. However, this would generate another problem, namely that the declared value would be below the actual value used by the manufacturer, based on test results. At a consumption level of 100 kWh/y this effect becomes 0.5 % which is significant in the verification process. This could be resolved by allowing an extra 0.5 kWh/y in the tolerance of the verification process (or by adding a digit in the declared annual energy but this is less desirable).

6. Chapter 9: Technical Analysis and Metrics

The report proposes to use the specific annual electricity consumption q in [kWh/(dm³a)] rather than the annual energy consumption (AE) today. In principle these are equivalent formulations, where q expresses better that the consumption of larger appliances is significantly smaller than for small appliances per litre volume.

Further the report proposes to base new reference line on a technical analysis rather than a statistical one as this is biased by existing regulations. The technical analysis contains a major point: it is assumed that larger appliances have thicker insulation. Therefore, reference lines drawn as function of volume do not compare technically equivalent products (assuming the same insulation thickness) but already include an improvement option for the larger appliances.

The report also based new reference lines on the new global standard, which is supported. The impact of the global standard to the appliance energy use has been reported earlier in Re/genT report: 15127 / CE40 / V2 “the impact of the new global standard”.

The CECED study included in the Note 15423 / CE15 / V5 follows the same approach and analyses the method in detail.

Further chapter 9 discusses compensations.

³ Which has been the generic approach by using 25 C as ambient temperature at the current test standard. In the new global test standard this level can be chosen and has been proposed in the report as 24 °C which corresponds to an actual test at 25 °C.

1. Auto-defrost: For No-Frost a 20 % correction for frozen food compartments on the energy is proposed, based on the statistical analysis. This is confirmed.
2. Built-in compensation: A compensation of 4 % for fresh food and 10 % for frozen food is proposed in chapter 9, based mainly on the difference in test conditions for built-in products. This is confirmed. (Note that CECED proposed earlier new categories rather than compensation factors, however as the proposed compensations are only slightly lower than current corrections this is acceptable). Note that in the executive summary a compensation of 5 % is reported for the fresh food.
3. Chill: The study does not propose any compensation. It is stated that the equivalent volume calculation (r_c) should give enough compensation. Its value is given as 1.25 however, with the new global standard this will reduce to $(24-2)/20 = 1.1$ as the target temperature has increased to +2 C. CECED has presented during the stakeholder meeting that definitely a compensation is needed for such compartment as it results in environmental savings not expressed in the energy tests of refrigerators. This is further worked out in a Re/genT note: 16104 / CE17 / V2.
4. Multi-compartment: For reasons of additional consumer benefits in food preservations (and storing foods at higher temperature than today). The proposed compensations are 2, 3.5 and 5 % for 3, 4 and > 4 doors respectively. This is slightly lower than CECED proposal of 3, 5 and 6%.
5. Wine storage: The study mentions that there are no apparent reasons for a different reference line. This ignores the fact that wine storage appliances (especially those with a glass door) have a much higher consumption than the A+ level today. This limits the possible distribution of energy efficiency classes (or it results in a large part of the wine storage appliances in G). As the study proposes a compartment concept rather than categories, it is indeed difficult to treat wine storage appliances differently. If eco-design limits would be set for these products, compensation is definitely required for glass doors of a value of at least the 20 % presented in the study.

Appendix 1: smaller issues

Here a list of smaller issues found are included, varying from technical observations to typo's.

Chapter	Page	Comment
Ex. summary	11	The calculation of consumer expenditure per product does not seem to be OK. The energy bill of 17.1 billion Euro is divided by the annual production, while it should be the fleet (303 million) resulting in 56.4 EUR/unit rather than 878 EUR/unit
3.1	17	The text “technically the AC/DC converter will usually come into play if an electric mains-(AC) operated appliance can also be battery operated” should be rephrased as: “technically the AC/DC converter will usually come into play if a battery operated appliance needs to be electric mains-(AC) operated”
4.1	26	The measurement method for wine storage appliances is mentioned to be included in the communication, Part 2. This reference is unclear (if it is referring to the transitional method communicated by the commission, it should also refer to the new harmonized standard EN62552:2013 where wine storage

		appliances are included).
4.2.2	29	<ul style="list-style-type: none"> • Add to storage tests that these are carried out with test packages. • For freezing and cooling capacity tests the word M-packages after ballast load should be eliminated (the ballast load contains normal packages and M-packages) • It is mentioned that the temperature rise test is not included in the current regulation. However, it is included as part of the information requirements.
4.2.3	30	It is mentioned that currently “a few simple 24 h tests are no longer sufficient”. This is an underestimation of current praxis. Only for refrigerators without frozen food compartments, this may be the case, but for any other product, utmost care must be taken to stability (requiring at least two 24 h tests for comparison) or for proper registration of defrosts (which can prolong the test time to 72 hours or more, plus stabilization time needed before this test time).
4.3	32	The following text “Similarly, to reach an average .., within a restricted time period, costs less energy than reaching..”, suggest that this is about a dynamic process. However, this is not the case, suggested replacement: “Similarly, to maintain an average .., within a restricted time period , costs less energy than maintaining...”
4.3	35	0-0.5 % less energy for freezers (category 8-9) is not according the CECED report where it is listed as 2 % (see Re/genT report Report_15127_CE40_V2)
9.1.2	83	V_{eq} is presented as a non-dimensional number, which is confusing. Propose to replace it with r_{eq} as it weighs the r_c factor for different compartments.
9.3.3	93	“Only Embraco gives performance data over a large set to ...” There are more manufacturers giving the data over a range (e.g. Secop).
9.3.4	99	It is mentioned that using “waste heat” to defrost the evaporator may not show up in the new IEC standard. Actually, it does show up, e.g. if the evaporator is defrosted with refrigerator air only (needs closing of freezer section which is not common), then the new standard will show an incremental energy consumption for a defrost of practically zero.

Appendix 2: load processing efficiency

Introduction

- The normal energy consumption of a cold appliance is influenced by:
 - The quality of the insulation (the actual heat load)
 - The efficiency of the refrigeration system
- New global test standard (IEC62552-3) introduces a load processing efficiency test (not obligatory):
 - Measures separately refrigeration system efficiency by introducing warm loads to fresh food and/or freezer compartments
 - Using a standard load quantity the incremental energy used per year by the fridge for cooling down or freezing the load is calculated
- High efficient products generally have both high insulation quality and high refrigeration system efficiency
- Calculation example to understand the possible impact.



Calculation

Insulation: Good Bad
 Refrigeration System: Bad Good

- Example with combi having the same consumption in the normal energy consumption test
- Worst case example assumed here: 20 % difference in load processing efficiency



Example calculation	X	Y
Energy consumption [kWh/y], interpolated between 16 and 32 C test	250	250
Load Processing Efficiency	1	1.2
ΔE processing [kWh/y]	36	30
Total consumption [kWh/y]	286	280



Conclusion

- The addition of load processing increments the total energy consumption, but this can also be achieved using a higher interpolation temperature (generally: if load processing is included the interpolation temperature should be reduced).
- Introducing load processing has only a very small impact on the difference between products.
- Load processing tests introduces:
 - Significant additional test costs.
 - The new global standard improves the reproducibility of the test (less influence operator). This is compromised by this new test.
 - Additional uncertainty in the final results (in particular due to time needed for placement of warm load).
- Recommendation: do **not** include load processing in the annual consumption



Re/genT Note¹:15423 / CE15 / V6		Technical Note
Project	Ecodesign & Labelling Review Household Refrigeration, preparatory/review study	
Subject	CECED Comments to Interim report (14.11.2015); Topic: technical model chapter 9	
Author	Martien Janssen of Re/genT BV Lage Dijk 22 5705 BZ Helmond The Netherlands martien.janssen@re-gent.nl	
To	CECED WG Cold and VHK	

1. Introduction

1.1. Document revision history

Release date	Author	Version	Remark / document change
5/12/2015	MJ	D1	First draft for internal discussion with ad-hoc group
7/12/2015	MJ	V1	Update after comments from ad-hoc group
8/12/2015	MJ	V2	Update on appendix 1 for the combi heat load calculations with respect to the distribution of wall thicknesses between fridge and freezer part.
12/1/2016	MJ	V3	Revision based on adjusted volume approach and combi-factor, input for WG Cold Phone conf. on 13/1/2016
14/1/2016	MJ	V4	Small adjustments; document for a meeting with VHK scheduled on 19/1/2016
21/1/2016	MJ	V5	Update after meeting of 19-1-2016, inclusion of impact of global standard.
22/1/2016	MJ	V6	Small addition to table of impact of new global standard.

1.2. General

The EU commission, DG Energy has ordered a review study of current eco-design requirements (regulation 643/2009) and labelling (delegated regulation 1060/2010) for cold appliances. A study team lead by VHK, the Netherlands, has presented a second interim report (dated 14-11-2015, further simply referred to as “the report”) which has been discussed in a second stakeholder meeting (Brussels, 14-12-2015).

This notes collects observations from CECED, based on an analysis performed on the technical model used in chapter 9 of the report, discussions in a WG Cold meeting, Milan, 3-12-2015, the above mentioned stakeholder meeting, collaboration work with CECED members and an exchange meeting with VHK on 19/1/2016.

¹ The last digits refer to the version number of this note

This note replaces earlier versions, in particular the note presented before the stakeholder meeting, which used a different (incorrect) model for reference lines.

The method of choosing a technical model in combination with statistical methods rather than just statistical data for setting new reference lines is welcomed by CECED. There is indeed significant bias in current product data as appliances have been optimised towards existing reference lines and energy classes.

From an analysis of the technical model, following observations are made, which are further discussed in this note:

- a) The basis of the technical model is correct, though it is recognised that due to its simplifications, it may not always respond properly to input changes.
- b) A few errors were found in the volume and area calculation for which corrections are listed in this note.
- c) Specifically for the combi products, the technical model does not address properly the heat exchanger temperatures.
- d) The proposed reference line in the report does fit with the technical model results for category 1 (fridge) and category 8 (freezer) but not for the combi. A different method of setting a reference line is proposed in this report.

2. Issues with the technical model

2.1. Appliance volume and area

The original formula's are:

$$V_{\text{ref}} = (w-2t) \cdot (d-2t) \cdot (h-a-2t) - b^2 \cdot w$$

$$A_{\text{ref}} = 2 \cdot (w-t) \cdot (d-t) + 2 \cdot [(h-t-a) \cdot (d-t) - (b+0.5t)^2] + 2 \cdot (w-t) \cdot (h-t-a)$$

Which needs correction to:

$$V_{\text{ref}} = (w-2t) \cdot (d-2t) \cdot (h-a-2t) - b^2 \cdot (w-2t)$$

$$A_{\text{ref}} = 2 \cdot (w-t) \cdot (d-t) + 2 \cdot [(h-t-a) \cdot (d-t) - b^2] + 2 \cdot (w-t) \cdot (h-t-a)$$

Both are relatively small corrections.

A larger error is found for the combi appliance where the surface area calculated is too large (it seems that two times the separator wall area seems to be included, while the separator should be entirely excluded)². This results in too high heat losses of the combi.

Further the method for using an average temperature for a combi based on volume ratio's is not so accurate. There are two issues here:

- a) The heat load is proportional to the surface area ratio rather than volume ratio.
- b) In praxis fresh food compartments are less insulated than frozen food compartments³.

² In principle the surface area for the combi should be the same as for the single door appliance with the same height, width, depth and wall thickness.

³ For a combi, it is possible to optimise the foam given a certain foam quantity. This results in thicker insulation at the coldest compartments.

The model is therefore extended by calculating the fresh food and frozen food compartment surface areas separately; details are given in appendix 1. An issue is how to set the wall thickness for a combi appliance. This is discussed in the next chapter.

2.2. Wall thickness

The wall thicknesses in the model have been taken from the data base analysis presented in chapter 10 where wall thicknesses have been reconstructed from appliance properties present in the CECED data base⁴. In the technical model not the average values have been used but roughly the higher end values found (from 10 to 20 mm more wall thickness depending on the product). This is not wrong, but means that the model represents already well insulated products.

There are a number of issues to consider:

- a) Especially for larger appliances, often elements are included which reduce the net storage volume (e.g. door features, ice makers, etc.) which may get translated into wall thickness by the method used.
- b) Appliance production is mostly based on platforms where products with different volumes only have different heights (so shelves, baskets, etc. can be shared) and maintain the same thickness.
- c) For built-in the option to increase wall thickness with volume increase is much more limited.
- d) The fact that larger appliances are on average more insulated is indeed partly due to the fact that more space is available (as listed in the report) but partly also due to current regulations, so in fact some of the bias present in the market is then copied back into the model.

The fact that the input of the model uses an increasing wall thickness at increasing volumes rather than a constant wall thickness, means that products at different sizes are not compared any more at equivalent technology levels, i.e. one of the obvious energy saving options (increase in foam) has then already been used for the larger sized appliances. To use a wall thickness as a function of volume is on itself not wrong; it just needs recognition of the above considerations and that it is actually a policy parameter rather than a technical parameter.

In some of the calculations, the wall thickness of the largest appliances was set too high. This can also be shown by calculating the optimal wall thickness which is the point where any further increase in wall thickness reduces the volume more than the reduction in heat loss. The parameter to minimize is then the specific heat loss⁵ in W/dm^3 . In general, the wall thickness should be kept smaller than this minimum value as increasing it to the exact minimum is inefficient in terms of material use.

A further constraint for wall thicknesses is the foaming process where any thickness larger than 100 mm is difficult to handle (process itself and duration).

⁴ Note that the CECED database does not contain wall thickness as a parameter, the reconstruction is based on comparing external volume (can be defined by height, width and depth properties) and net storage volume. The accuracy of this method is limited.

⁵ This can easily be done with the technical model using the excel solver, select the specific heat loss as the parameter to minimise and the wall thickness as the parameter to vary.

In this note the following strategy has been used:

- A) The wall thickness of the fridges (Cat 1) serves as a base line.
- B) The wall thickness of the freezers (Cat 8) has been adjusted to achieve the same heat load as the fridges at the same equivalent volume⁶.
- C) The combi appliances (Cat 7) have the same insulation thicknesses as the corresponding fridge and/or freezer at the same total volume (e.g. if a fridge of 200 litre uses 55 mm wall thickness and a freezer of 200 litre uses 85 mm, then a combi of 200 litre uses 55 and 85 mm for the refrigerator and freezer compartment, respectively)

2.3. General

This note is accompanied with a spreadsheet model, which contains the model as proposed in the report together with the proposed modifications.

3. Category 1

The following modifications are suggested to the model:

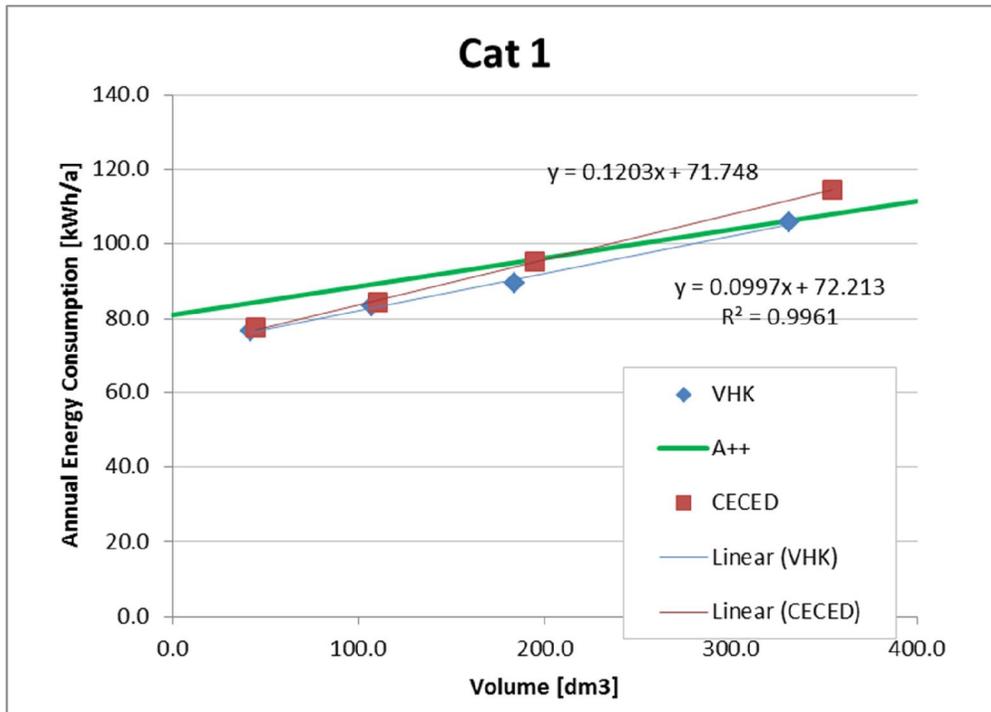
- a) Correction of area and volume
- b) The wall thickness of appliance 4 has been reduced from 70 to 65 mm. The spreadsheet contains the 70 mm data as well (Column 4A) which has 4.9 % less volume and 5.9 % more consumption. (The specific heat loss is therefore practically the same). Column 4B has been added using the optimal wall thickness, being 82 mm in this case. For similar reasons the wall thickness for appliance 3 has been reduced from 53 mm to 50 mm.
- c) Nominal cooling capacity has been made a function of product size. All these products should have to match a highest ambient specification which requires different capacities for each.

Other remarks (issues noted, but left unchanged):

- a) Nominal COP values have been kept the same, though typically the smaller appliances would have a lower COP value.
- b) Evaporation temperatures, especially for the large size are quite ambitious and are certainly only present on high efficient appliances.

Next figure shows the report data ("VHK") and the results using the modifications ("CECED"). The effect is a small change in the reference line. For comparison the A++ line is drawn, showing that the evaluation has led to products more or less on the A++ line. The increased inclination compared to the A++ line is very realistic as today reference line is unrealistically flat for refrigerators.

⁶ *Equivalent volume is the basis for compensating for temperature differences between compartment and ambient temperature. Representing fridge and freezer at the same equivalent volume is a way to compare "similar insulation quality" for different product categories.*

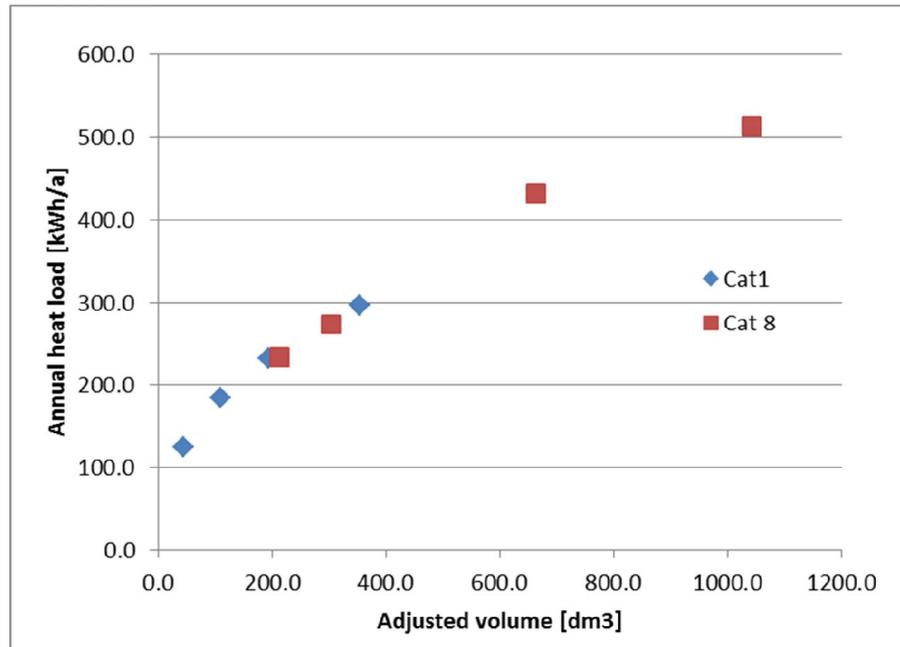


4. Category 8

The following modifications are suggested to the model:

- a) Correction of area and volume
- b) The wall thickness of this category has been revised. The thickness in the report varies from 75 to 120 mm for the smallest to the largest appliance. It can be shown that the latter values are above optimal wall thicknesses for a freezer (which is around 110 mm for the largest freezer and generally the wall thickness should be kept well below this value). In this version of the note a new approach is proposed, namely to match the wall thickness of the freezer to the values of the fridge, by requiring that the heat load must be the same at the same adjusted volume. By setting a wall thickness varying from 70 mm for the smallest freezer to 95 mm for the largest freezer, the following figure is

constructed:

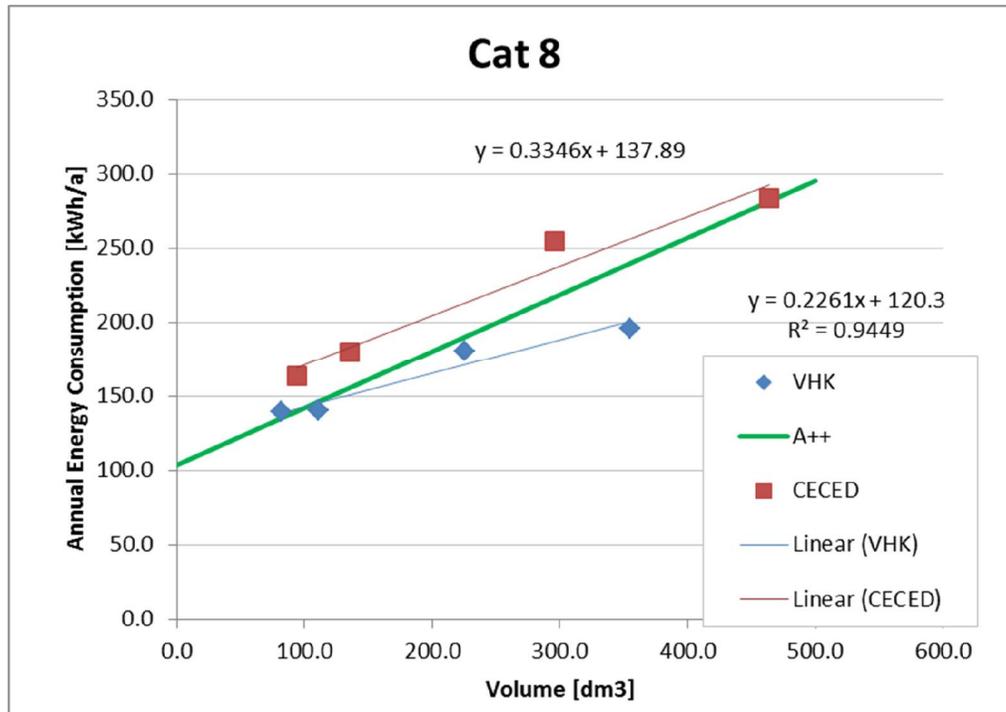


- c) The condensation temperature differences have been increased. The original values ranged from 11 to 6 K. At such low values the heat transfer for natural convection reduces considerably. Forced convection for this type of appliance and of this efficiency level (A++) is not common. The proposed values are from 15 to 13 K, which are more realistic for this category of products.

Other remarks (issues noted, but left unchanged):

- a) Nominal COP values have been unchanged, but note that for appliance 4 a very high efficient compressor has been used (COP=1.9).

Again, a figure is shown with the report data and the results using the modifications. Compared to the VHK data the modifications result in a steeper curve, which is believed to be more realistic. Compared to the present A++ line the curve is somewhat more flat.



5. Category 7

The more problematic category is formed by the combinations. These cannot be seen as simple additions of separate appliances as properly discussed on page 98 and page 99 of the report where the synergy effects are correctly listed and a number of possible benefits are explained. As mentioned for type I products (single control) the synergy effects are limited and proper operation over a wide ambient range requires additional elements such as a heater. For type II products (double control) it is mentioned that there are different options:

1. Two compressor systems: the report correctly mentions that these have the drawback of lower compressor efficiency at the low capacity levels.
2. Compressor + solenoid system: here it needs mentioning that, in contrast to the report, these are not typically using “consecutive regulation” of the compartments. Typically the solenoid valve swaps the system between running through fresh food and frozen food evaporator (in series) or only through the frozen food evaporator (using a cap tube which bypasses the fresh food evaporator). The reason for this are twofold:
 - a. The refrigerant charge: if the system would run only on the fresh food evaporator the required refrigerant charge would be typically very different from the charge needed to run only the freezer, resulting in inefficient operation. A second complication is that liquid refrigerant would migrate to the freezer evaporator during fresh food mode operation.
 - b. The compressor capacity would be much too large to run only the fresh food, resulting in inefficient operation.

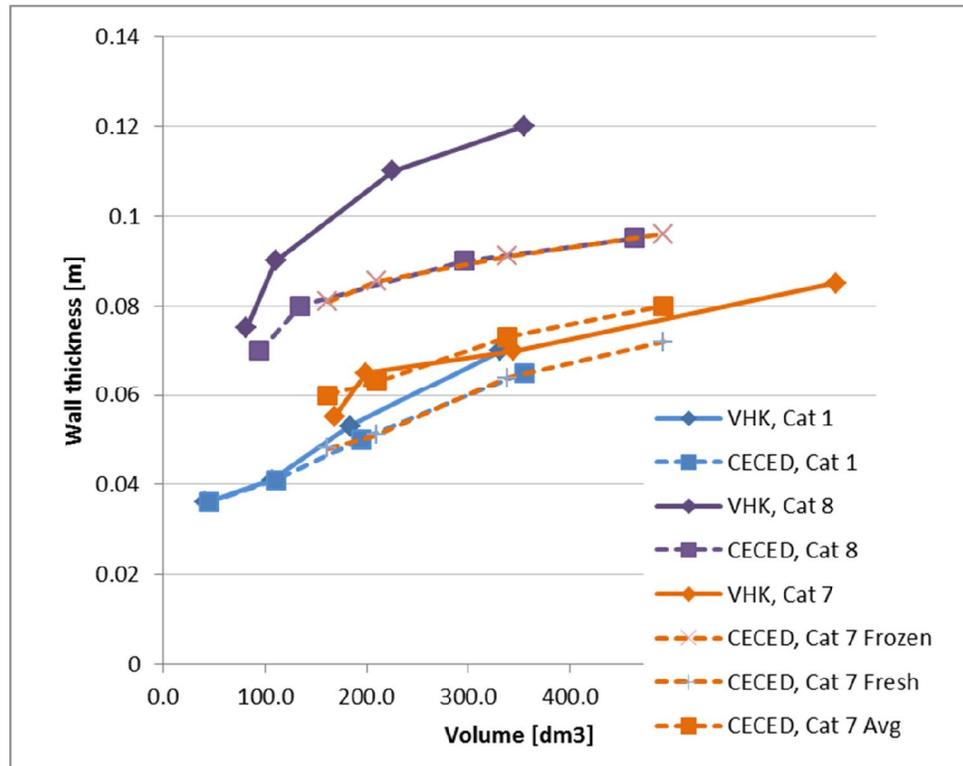
3. As a consequence of this, these systems operate with an evaporation temperature always below the freezer compartment temperature, also during what is called the “fresh food” mode operation⁷.
4. Using a variable speed compressor in a solenoid system does not solve the principle problem of the refrigerant charge, so most systems with variable speed compressor operate in the same way (so either fresh food + freezer or only freezer).

In the technical model discussion on page 100 it is mentioned that simplified modelling of a combi appliance is the most difficult, which is confirmed. The first approach has been to assume that the system can be presented by a single compartment appliance operating at an intermediate temperature level (e.g. -1 C for a product with 75 %/25% volume share of fresh food and frozen food respectively). Due to the reasons listed before, this will predict evaporator temperatures above freezer compartment temperatures and thus unrealistic low energy consumption values. The second alternative is to calculate the energy consumption of fresh food and frozen food as if it were separate products and use a multiplication factor of 0.8. Also here, the same problem arises as the fresh food compartment would operate with higher evaporation temperature in the model than in praxis achievable.

Here following modifications are suggested to the model:

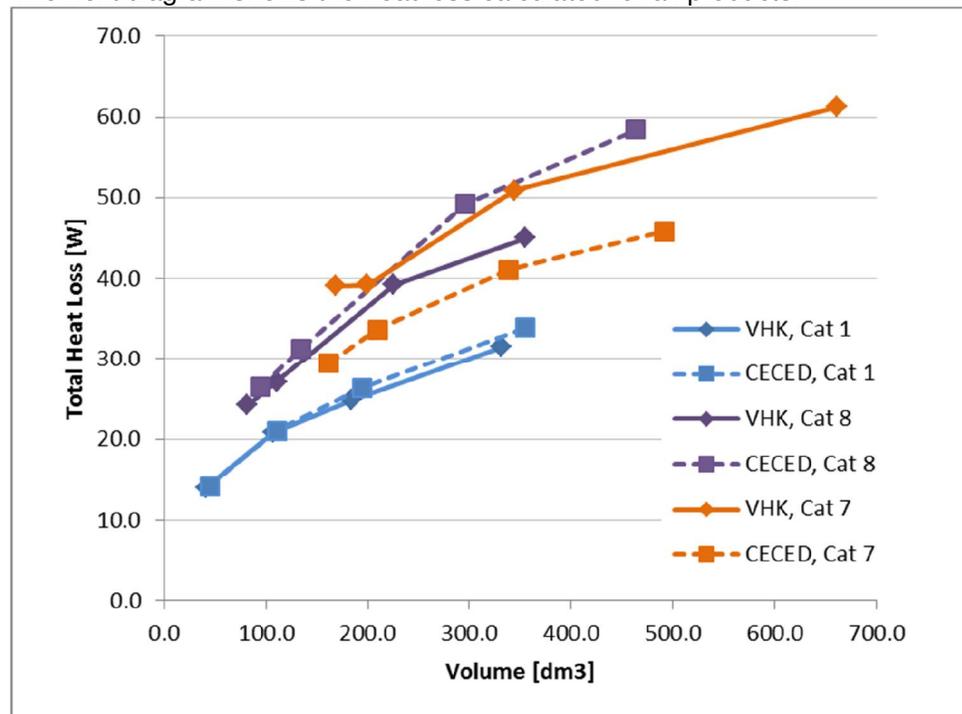
- a) Correction of area and volume
- b) The wall thickness of each appliance has been established by comparing the product with the same total net volume fridge or freezer. The result is presented in the next chart:

⁷ The term “fresh food mode” is somewhat misleading for these appliances as in this mode both the fresh food and frozen food compartment are being cooled. However, depending on refrigerant charge/ evaporator design, the largest fraction of the cooling power may go to the fridge during this mode.



Note that the wall thickness of the fresh food compartment of the combi coincides with the cat 1 wall thickness and similarly the wall thickness of the frozen food compartment with the cat 8 wall thickness. Note that the average wall thicknesses are close to the values used in the VHK model. Note that for build-in products the higher values may be difficult to achieve.

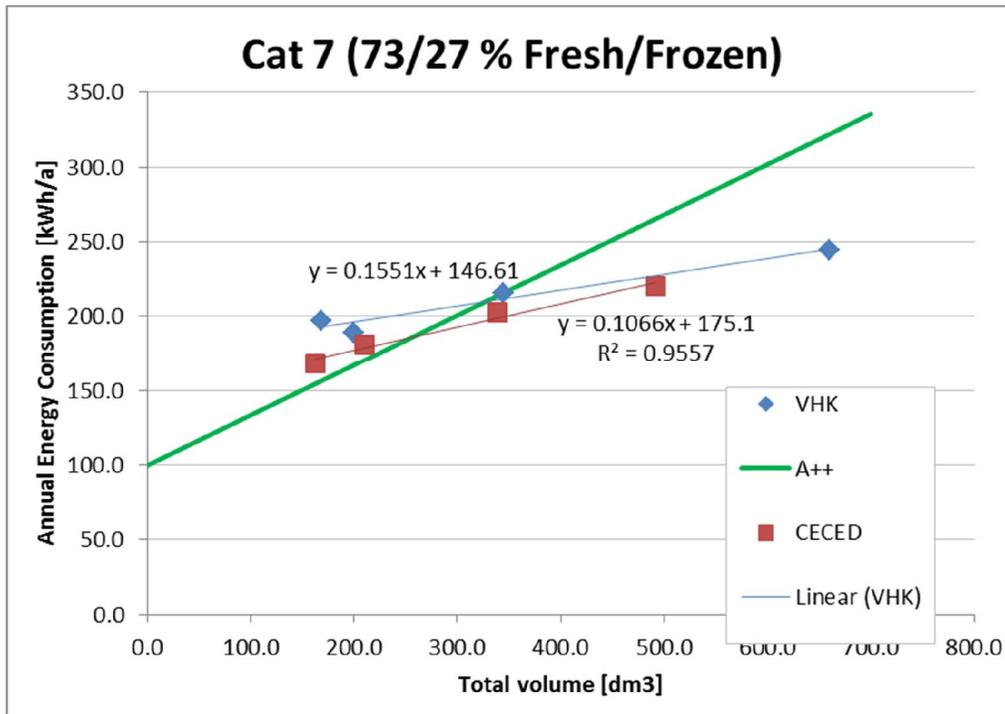
The next diagram shows the heat loss calculated for all products:



As can be seen, the combi according the CECED data is approximately midway between fresh food and freezer, while in the original VHK model, the heat loss of the combi was actually higher than for the freezer (at the same total net volume).

- c) Appliance 4 width and depth have been reduced from 800 to 700 mm as to keep its total volume more representative for the larger products on the market.
- d) In the model in the report, the compartment temperature has been volume rated using -20 C and +4 C as target (which differs from the other categories and have been reset to -20 C and +5 C). The average compartment temperature is then used for the heat loss calculation. In chapter 2.1 of this note it has been mentioned that this may not be accurate and a model modification is suggested which takes into account the different areas of the compartments and their different wall thicknesses.
- e) The evaporation temperatures have been set directly. The average temperature difference in the model is difficult to handle as neither compartment evaporator operates at this temperature difference. This becomes very clear when e.g. the fresh food volume ratio is changed to e.g. 50 %. The model in the report would reduce the evaporation temperature significantly, while in praxis similar evaporation temperature prevail on a product with 50 % fridge as with 80 %. The evaporation temperatures have now been set from -26 to -23 C, the reason for this temperature level has been explained before.
- f) The condenser temperature difference was scaled in the model as a function of the fresh food volume ratio. However, this temperature difference is only influenced by the heat the condenser has to reject. The temperature differences found in the VHK model for 73 % volume fraction (16.5 to 11.6 K) were retained for all volume ratio's.

Next figure shows the report data (“VHK”) and the results using the modifications (“CECED”):



Compared to the VHK data the curve is now more steep, bit still significantly flatter than the current A++ curve, so larger appliances are penalised compared to today.

6. Reference line

6.1. As proposed in VHK report

In the report regressions are made for category 1 and 8 which are subsequently used in a common reference line. Also regressions are made for category 7 but these are not used in the reference line, as category 7 should be based on coefficients for fresh food and freezers plus a possible correction for the combination.

Here the model presented in the report is unclear as has been communicated earlier. The model presented also does not fit to the technical data, at least not for category 7.

The basis of the reference line as presented in the report is that it can be composed from a summation over the different compartments and a correction factor for combi’s. In standard energy form this is represented by:

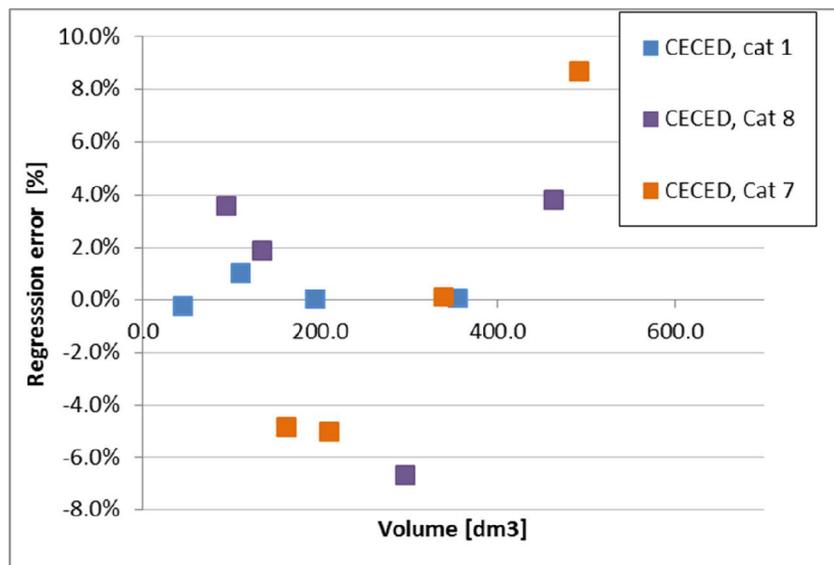
$$SAE = D \sum_{c=1}^n A_c B_c C (\tau_c M_c V + N_c) ; C = C_1 \frac{V_c}{V}$$

In words one could read this formula as follows:

The energy consumption of a combi is the weighted average of the energy use of a separate freezer and of a separate fridge each having the same net volume as the combi. The weighing is done in proportion to the volume ratio of each compartment. Anomalies may be corrected by the coefficient C1. This formula is referred to in this note as the VHK reference formula.

Various attempts have been made to work with the VHK reference formula or variations of it. This includes the formula's presented in version V2 of this note, which was recognised later to have several shortcomings as well as the formula presented in the report. In order to get good fits of the VHK reference formula with the technical model a high value of the coefficient C1 is required⁸. The following set of data has been derived and regression errors are shown in the chart:

Mfresh	0.12
Nfresh	72
Mfrozen	0.150 (obtained from 0.34/2.15)
Nfrozen	138
C1	1.35



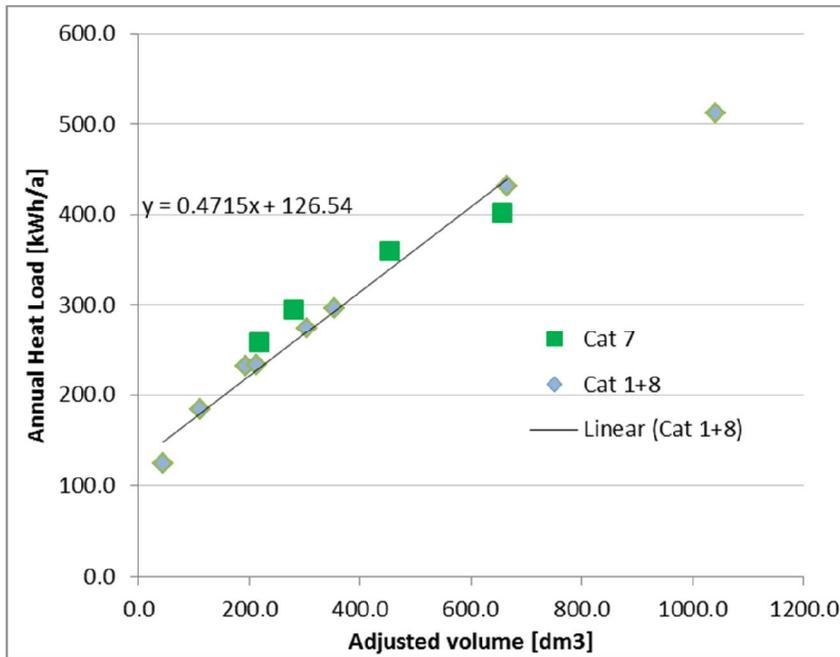
On itself there is reasonable agreement, but there are some concerns:

- a) The coefficient 1.35 lacks a good physical meaning, but it is the result of the formulation chosen.
- b) If a combi is constructed of two fresh food compartments (or of two frozen food compartments), the coefficient C1 leads to a large bonus.

6.2. As proposed in this note

⁸ In the stakeholder meeting, CECED presented a different formulation (see version V2 of this note) which required a combi factor of app. 0.85. On itself this is just a mathematical coefficient needed to fit the reference line to the technical model data.

To overcome these problems an alternative method has been developed which starts with presenting the heat losses of the three categories of appliances on the basis of equivalent volume:



As explained above the stand alone fridge and freezer were matched to each other so a line could be fitted through these products. This line then represents the standard annual heat load:

$$SAE_{HL} = MV_{eq} + N = M \sum_{c=1}^n r_c V_c + N$$

and with M=0.47 and N=127 a reasonable fit has been obtained. The largest freezer has been excluded from the regression in order to get a better fit for the more popular freezers sizes.

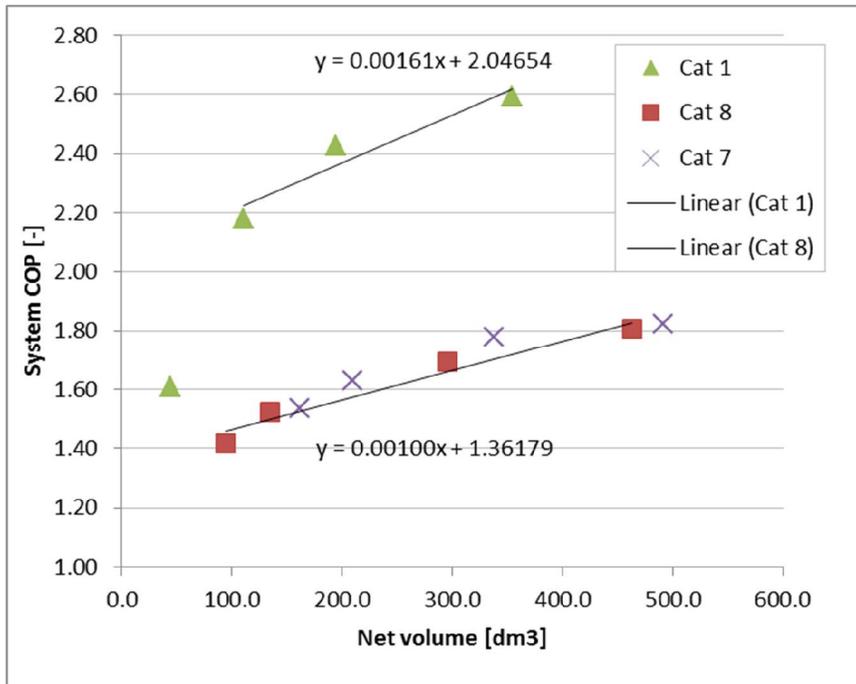
Note that the heat load of the combi is actually above this line for three of the four products, which is caused by the choice of the wall thicknesses to be the same as for the same net volume stand-alone fridge or freezer.

The step from heat load to electricity use can be made using the system efficiency (or COP) as follows:

$$SAE_{basis} = \frac{SAE_{HL}}{COP} = \frac{MV_{eq} + N}{COP} = \frac{M \sum_{c=1}^n r_c V_c + N_c}{COP}$$

The term basis is added as no compensations are yet introduced.

As can be seen in the technical model, the COP is a function of the product category and also of the size of the appliance (or better, the compressor capacity required). For the appliances studied regressions can be made of the system COPs (which include also auxiliary energy uses) as shown in the next diagram:



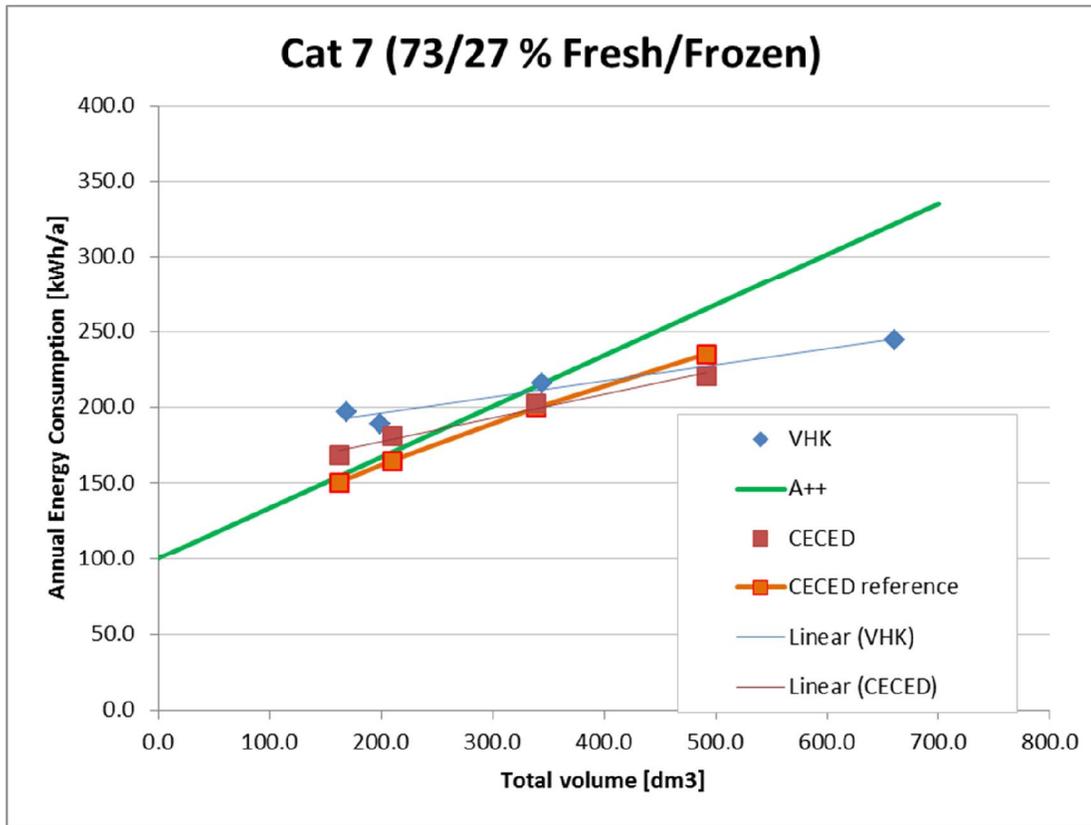
For both category 1 and 8, linear regression lines were made, where for category 1 the appliance with 40 litre volume was neglected:

$$COP = 0.00161V + 2.05 \text{ (fresh food)}$$

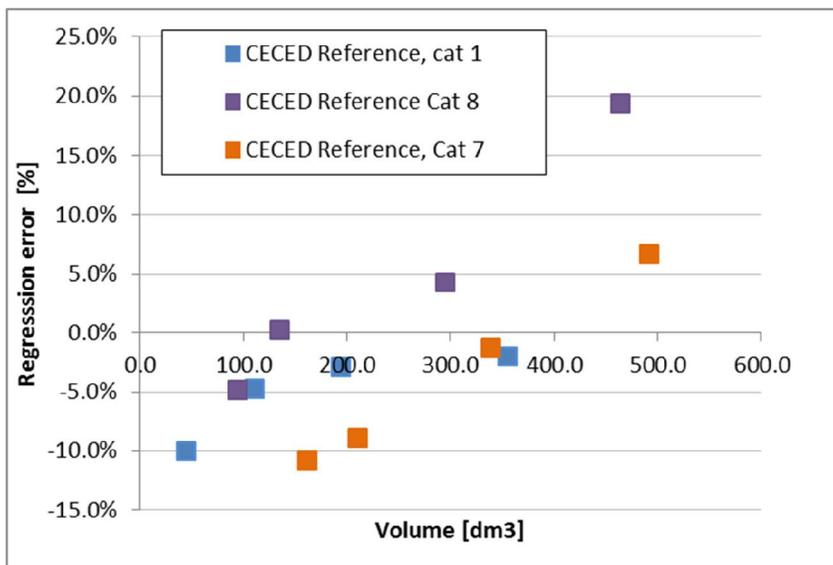
$$COP = 0.0010V + 1.36 \text{ (frozen food)}$$

The COP of the combi is quite close to the one of the freezer. As a rule, the COP of the coldest compartment should be chosen.

Using this formulation, a chart can be drawn for the annual energy of the combi appliances where a reasonable fitting is shown (curve "CECED reference").



The regression of all products is shown below:



This formulation represents the energy consumption of combination appliances if these are compared to single compartment fresh food or frozen food appliances with the same total net volume.

The average regression error has been established for different volume ratio's:

Volume ratio (fridge/freezer)	Average regression error [%]	Range [%]
73 %/ 27%	-3.6	-10.8 to 6.7 (see chart above)
50 %/ 50 %	1.3	-6.8 to +12.8
90 % / 10 %	-7.8	-13.7 to 0.6

Note that this result has been obtained with in total 6 regression coefficients (M and N and two coefficients for each of the COP lines), against 5 in the VHK reference model (two sets of M and N and C1).

6.3. Mathematical formulation

Note that the CECED reference formula seems very different to the VHK formula, however, this is not the case. In appendix 2 a derivation is given which actually shows that the formula's are in principle the same.

The complete CECED formulation including compensations⁹ becomes:

$$SAE = D \frac{\sum_{c=1}^n A_c B_c \left(M r_c V_c + N \frac{V_c}{V} \right)}{COP}$$

In the report the analysis has been presented in specific electricity use (q). This can also be done with the CECED formulation resulting in:

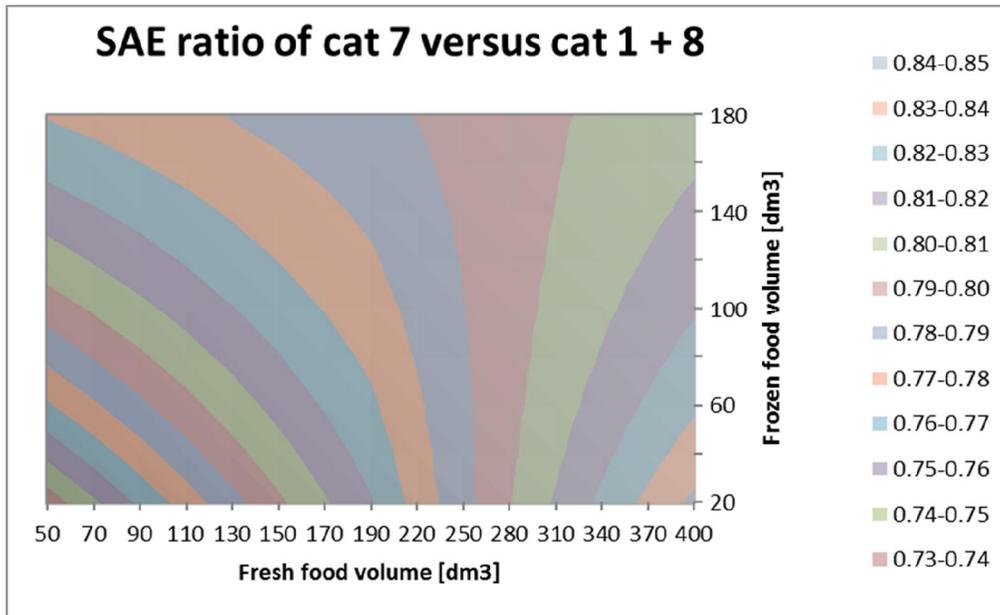
$$q_{ref} = \frac{D \sum_{c=1}^n A_c B_c \left(M r_c V_c + N \frac{V_c}{V} \right)}{V COP} = D \frac{\sum_{c=1}^n A_c B_c \frac{V_c}{V} \left(M r_c + \frac{N}{V} \right)}{COP}$$

As q-ref shows better the effect that the larger appliances need to be significantly more efficient per litre than smaller ones, it is agreed to use this formula.

7. Combi effect

In the previous chapter, the combi's have been analysed and compared on the basis of equal net volume. If this approach is chosen, this may lead to an undesirable effect. Namely a combi with index 100 may now be equivalent following the technical model with a fridge or freezer of the same net volume, but it is still much more efficient to use one combi instead of two separate appliances with in total the same net volume. The effect can be shown if the SAE value of the combi is compared with the SAE value of separate appliances having the compartment volumes:

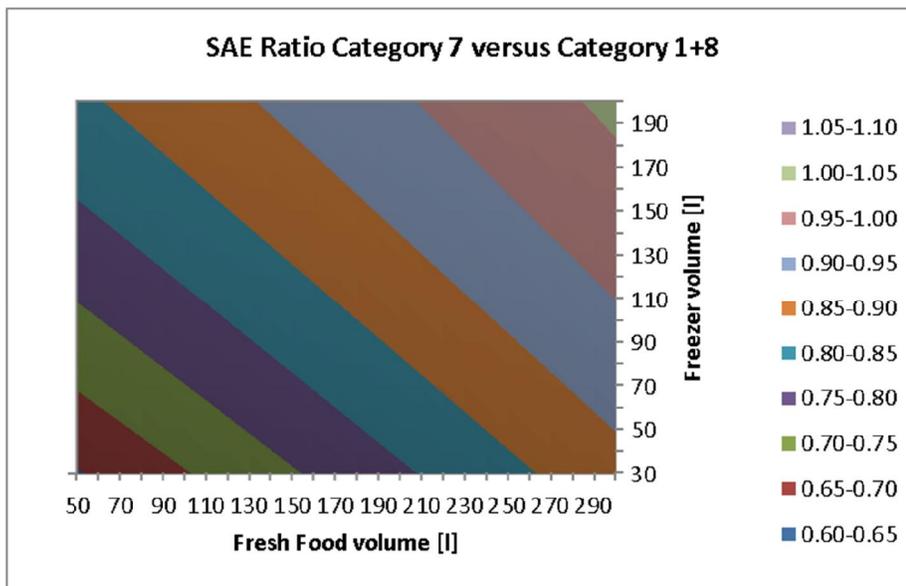
⁹ Note that no compensation has yet been added for chill compartments, which is discussed in a separate document.



As can be seen the SAE value of a combi is on average only 80 % of the value of two separate appliances.

It is therefore proposed to add a combi factor of 1.2 to the calculation of the standard energy consumption of combi's having a frozen food compartment and a fresh food compartment. This is generalised by stating that the combi factor shall only be used if the temperature spread between highest and lowest temperature compartment is larger or equal to 20 K.

Note that in the current regulation the SAE for a combi also deviates strongly from the added SAE values of the single appliances as shown below:



If appliances are used with different (higher) temperature levels, in general the SAE value becomes more relaxed. An extreme example is e.g. a pantry appliance. E.g. for a fresh food appliance of 200 litre the SAE_{HL} value is $1 \cdot 0.47 \cdot 200 + 127 = 221$ kWh/y. The COP is $0.00161 \cdot 200 + 2.05 = 2.372$ and the resulting SAE value = 93.2 kWh/y. For a pantry this would be $SAE_{HL} = 0.35 \cdot 0.47 \cdot 200 + 127 = 179.9$ kWh/y, and the COP remains the same, so SAE = 75.8 kWh/y so approximately 20 % less, while the heat load is 60 % less than for the fresh food appliance. Note that this effect is also present in today standard annual energy equations and it is questionable whether this needs correction (it actually promotes using higher temperature compartments, hereby reducing energy demand).

8. Summary of proposed model

$$SAE = CH + CD \frac{CH_B + \sum_{c=1}^n A_c B_c (Mr_c V_c + N \frac{V_c}{V})}{COP_x} \quad \text{or} \quad q_{ref} = \frac{CH}{V} + CD \frac{CH_B + \sum_{c=1}^n A_c B_c \frac{V_c}{V} (Mr_c + \frac{N}{V})}{COP}$$

$$M = 0.47, N = 127$$

$$COP_{FF} = 0.00161V + 2.05 \text{ (unfrozen compartment)}$$

$$COP_{FR} = 0.0010V + 1.36 \text{ (frozen compartment)}$$

If the appliance has a frozen food compartment, then COP_{FR} has to be used, otherwise COP_{FF} .

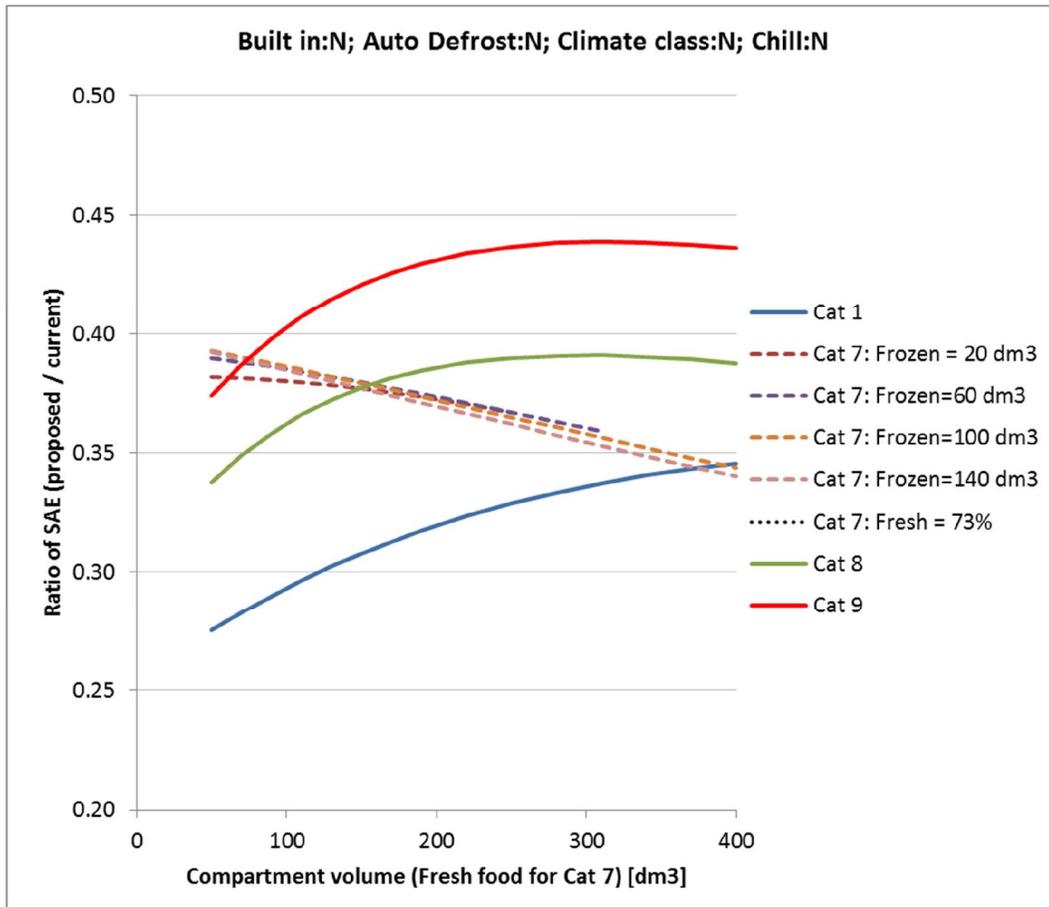
$C = 1.2$ if the temperature spread between highest and lowest compartment ≥ 20 K, otherwise $C = 1.0$.

The compensations for defrost (A) and for built-in B have been assumed to be the values from the report. (A = 1.2 for frozen compartments, B = 1.04 for unfrozen compartments and 1.1 for frozen compartments).

The formula includes compensation for chill still to be defined (CH). This is further discussed in note 16104/CE17/V1. Note the, apart from other negative factors, chill compartment is the only compartment which would suffer from the proposed reference line (as in the proposals of the report) as it has to deal with a reference derived from a product with a higher temperature (the fresh food compartment).

9. Comparison of proposed reference line with actual reference line

It is possible to evaluate the new reference line with current references. This is done for all categories in the next figure:



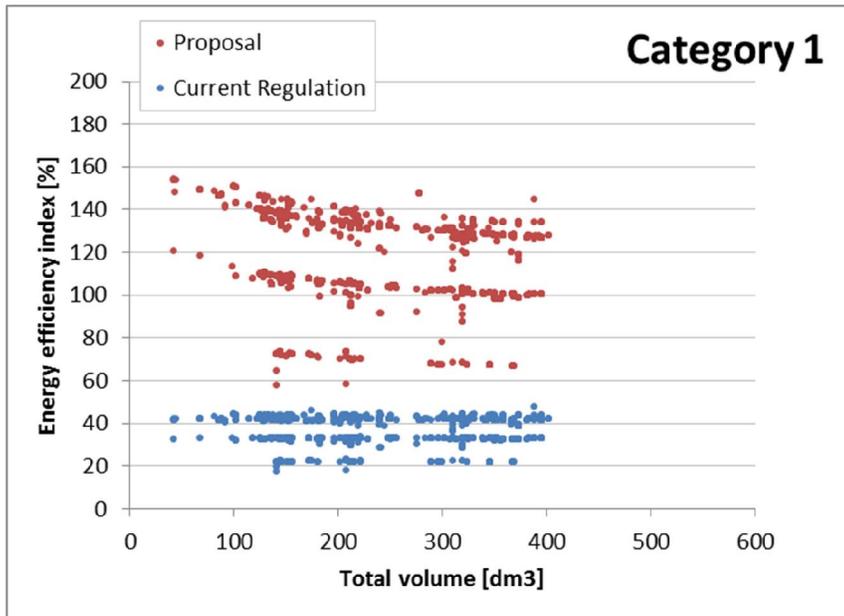
Taking the current A++ level as reference (ratio = 0.33), one can conclude the following:

- Some relaxation for larger fridges, which is realistic given the much too low inclination of the reference line today. In fact, the technical model demonstrates this.
- Less stringent requirements for all freezers. This is supported by the fact that it is generally known that it is most difficult to get freezers in the highest efficiency class.
- Chest freezers are relaxed compared to upright freezers, which is realistic given their lower energy consumption.
- The large combi appliances will have more stringent requirement compared to the small ones, though less than in the original analysis presented in the report.

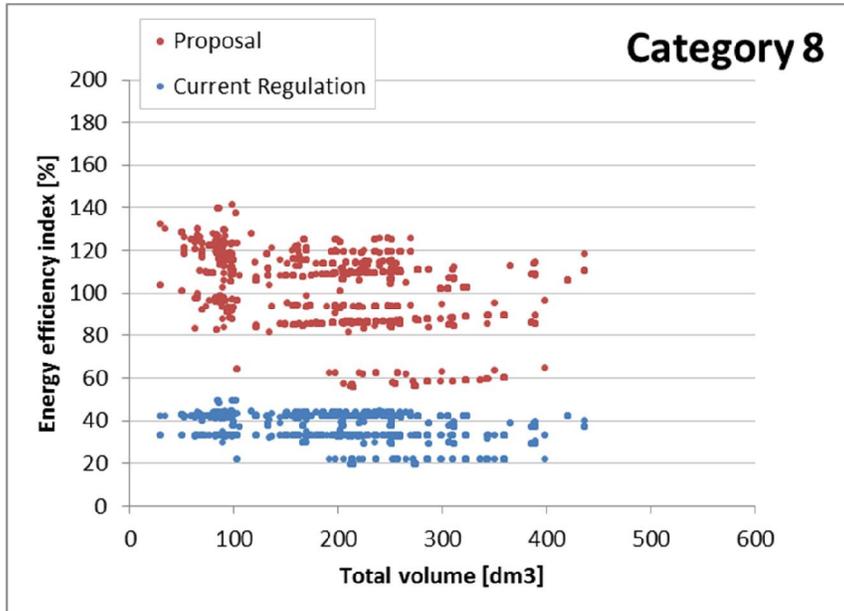
10. Consequence on actual appliances

Using the above definition of the reference line it is possible to plot the energy efficiency index as a function of total volume and compare this to the actual energy efficiency indices. This is done using the CECED database 2015 (listed as database 2014 within CECED). Separate figures are made for cat 1, 7, and 8. In all cases the compensations as listed in the report have been applied (note that this means that no

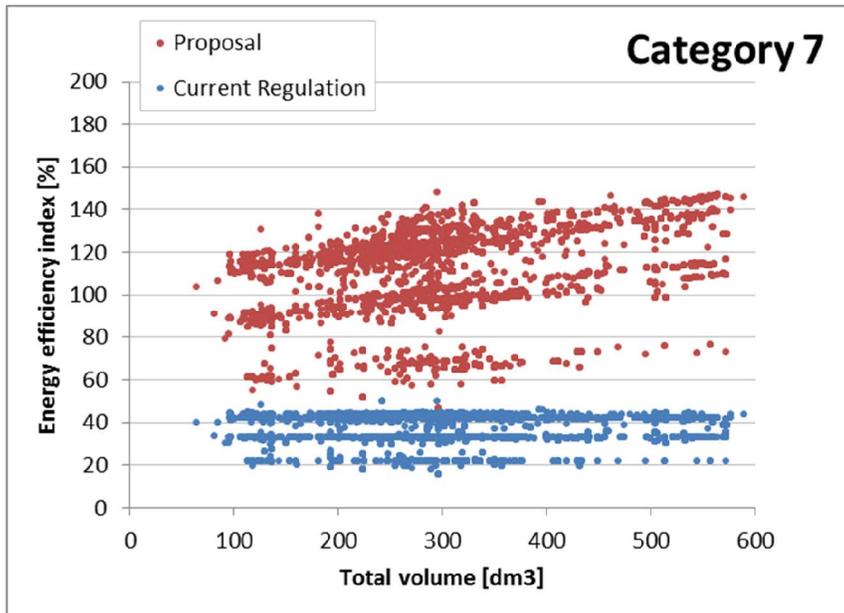
compensation is made for chill compartment or climate class). Further the energy consumption has not yet been corrected for the new global standard.



For these products the index 100 corresponds roughly with current A++ appliances. However, using the new standard the consumption will increase.



For category 8 the index of 100 correlates with the current appliances between A+ and A++. Due to the new standard the standard energy consumption needs to be reduced so the indices will increase somewhat.



The final result on category 7 shows a steep increase as function of the volume. A limit at index 100 would cancel out all current A++ appliances with a total volume larger than app. 300 litre (uncorrected for the global standard). If the combi factor of 1.2 would not have been introduced then the complete group of A++ appliances would be above 100.

11. Impact of new global standard

All previous analysis have been carried out using the current standard (i.e. the ambient reference temperature was 25 C, the freezer average temperature set at -20 C assuming a warmest package at -18 C and a fresh food compartment temperature of 5 C.

This means that the formulation needs to be converted to the new global standard, which is yet to be performed. This involves the following steps:

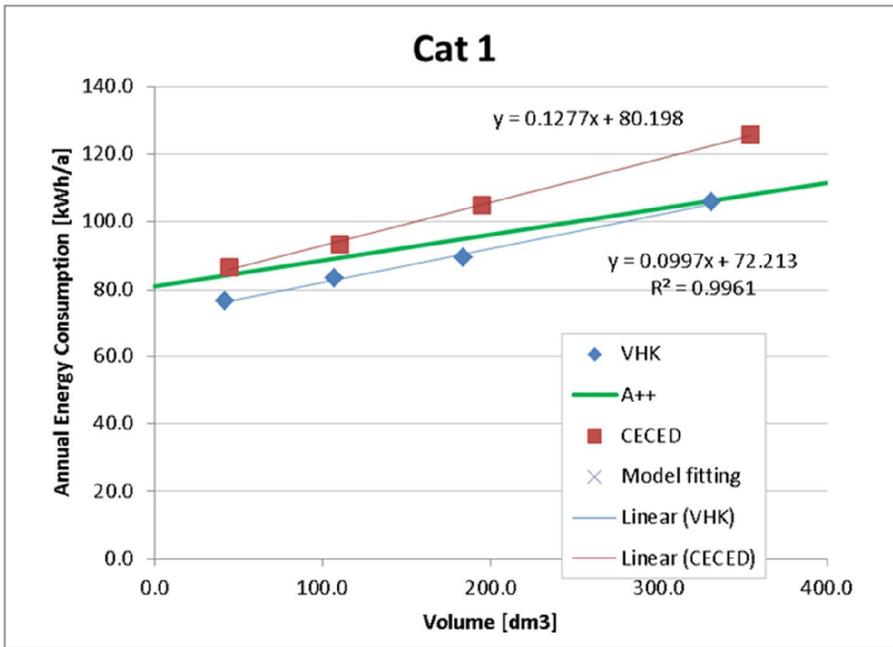
- a) Calculate the impact of the new global standard using the technical model by setting the temperatures at 25 C¹⁰, -18 C average freezer, 4 C fresh food and check this with the experimental findings of CECED presented in report 15127 / CE40 / V2 “the impact of the new global standard”).
- b) Revise the M and N coefficients in the heat loss formula.
- c) Revise the COP coefficients as some temperature levels have changed
- d) Recheck the impact on the energy efficiency index with the CECED data base. For this check each product in the data base must be adjusted following the earlier study on the impact of the new global standard.

For category 1 the following adaptations were made:

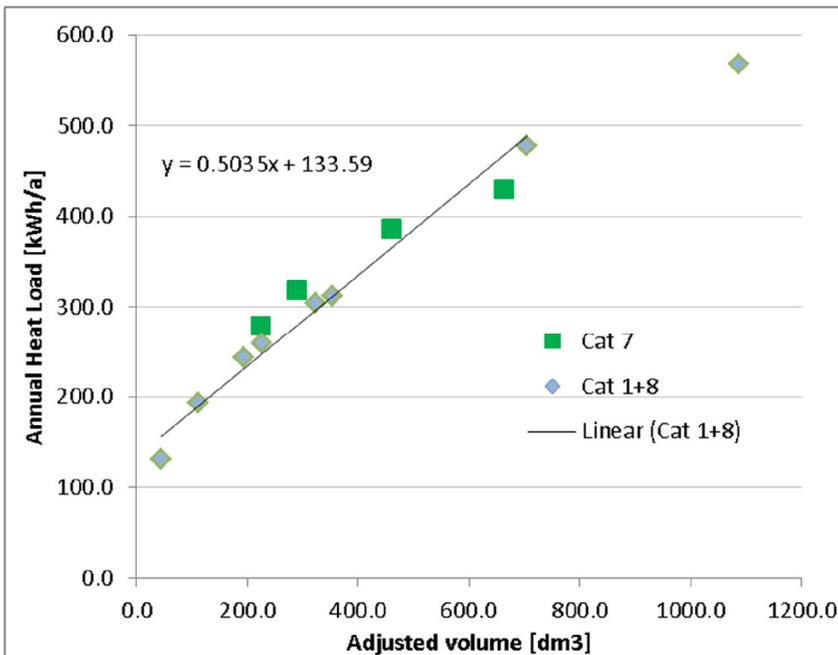
- a) The temperature difference over the evaporator and condenser where increased with 5 %, in line with the increased heat load.

¹⁰ It has been shown in earlier studies that testing (or simulating) at 25 C ambient gives results very close to an interpolation at 24 C.

The average increase in consumption of the 4 products in the model is 10 % compared to 12 % in the impact study.

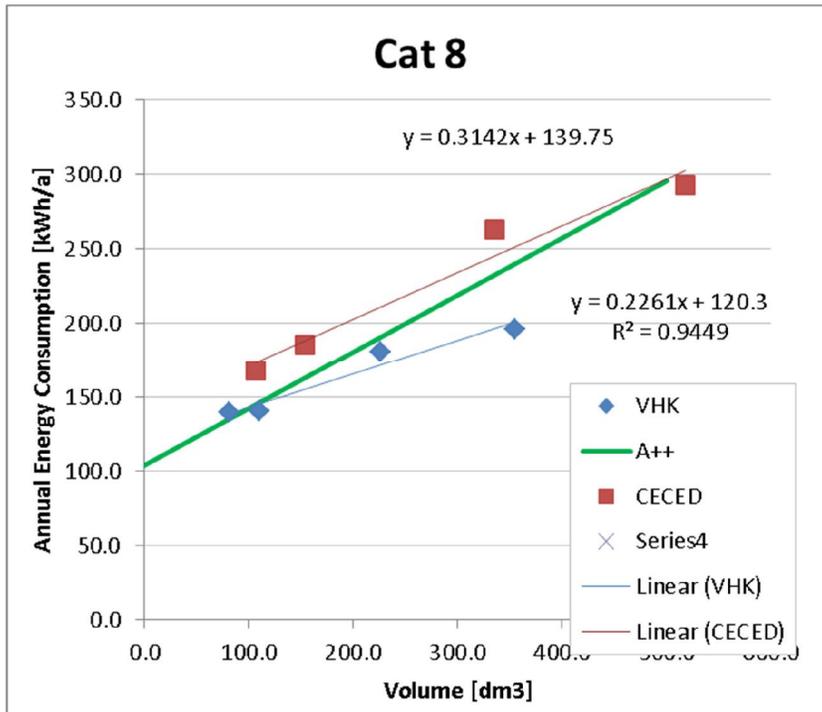


Due to the change in temperature, the base case freezer has to be adapted again. In fact the wall thicknesses of the base case freezers was reduced with 15 % which brings the fridge and freezer again in one line, so that a regression of the M and N coefficient is feasible:

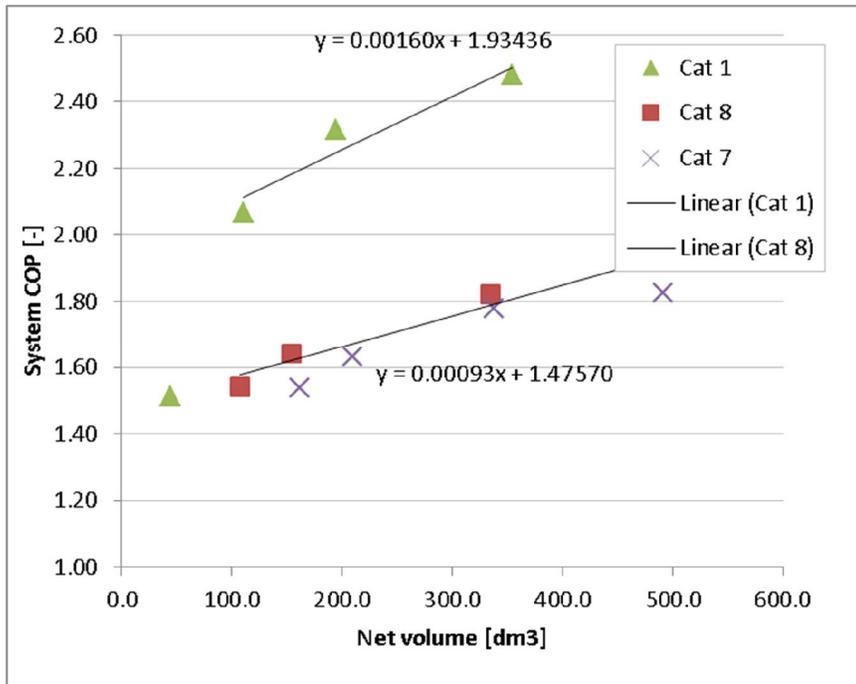


For the resulting freezers the temperature difference over the evaporator and condenser where reduced with 5 % due to the reduced heat load (the inner temperature was set to -18 °C instead of -20 °C).

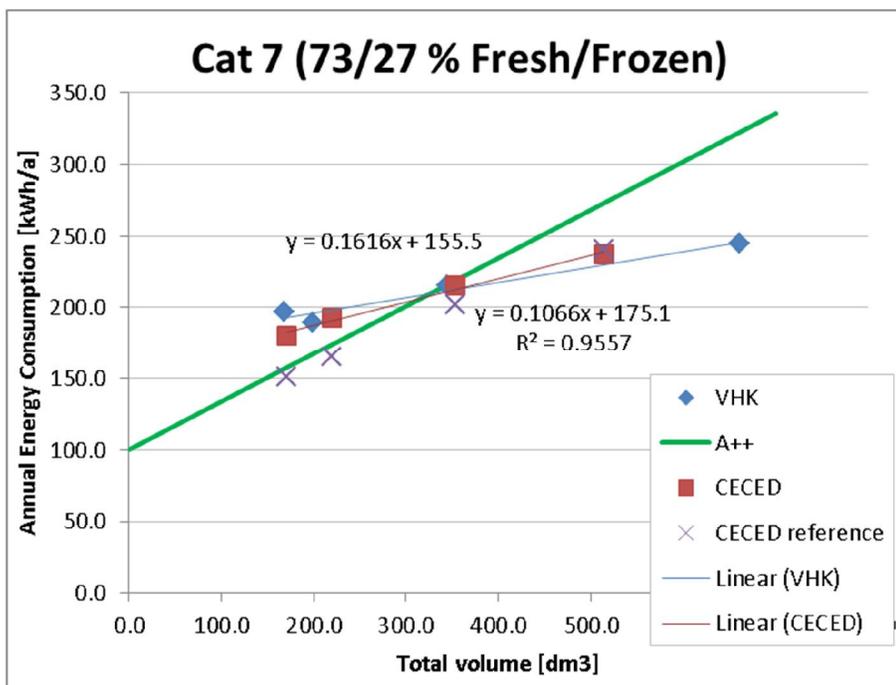
The results are shown in the next picture, where the freezers have increased in consumption (the increase in compartment temperature has been negated by the reduction in wall thickness).



The systems COPs have changed for both freezers and refrigerators and are now as follows:



Using these COP curves and the curve for the heat load versus adjusted volume, the a comparison can be made for the combi appliance:



The fitting between the CECED reference and the technical model is worse than before correcting for the global standard, but is still reasonable.

Summarising, this leads to the following reference model:

$$SAE = CH + CD \frac{CH_B + \sum_{c=1}^n A_c B_c (Mr_c V_c + N \frac{V_c}{V})}{COP_x} \quad \text{or} \quad q_{ref} = \frac{CH}{V} + CD \frac{CH_B + \sum_{c=1}^n A_c B_c \frac{V_c}{V} (Mr_c + \frac{N}{V})}{COP}$$

$$M = 0.5, N = 134$$

$$COP_{FF} = 0.0016V + 1.93 \text{ (unfrozen compartment)}$$

$$COP_{FR} = 0.00093V + 1.47 \text{ (frozen compartment)}$$

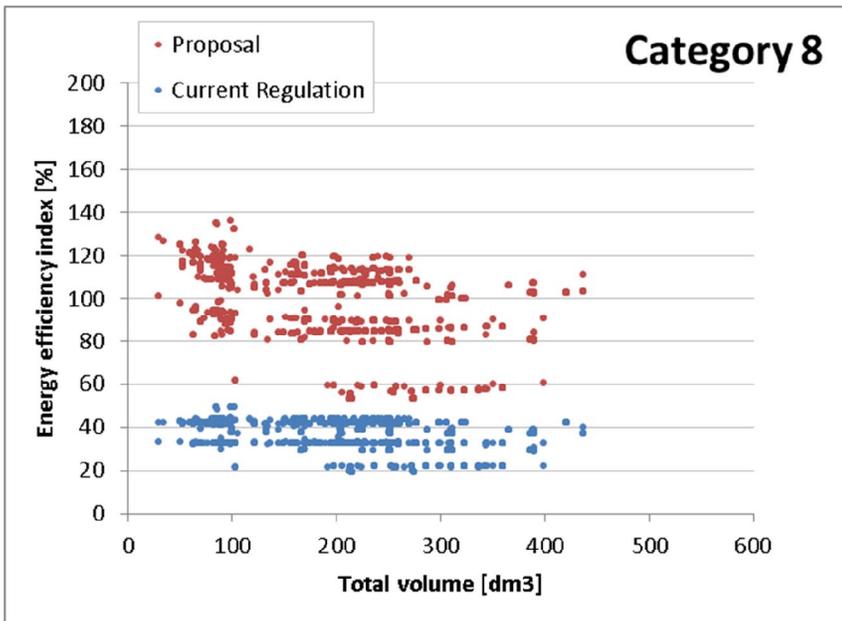
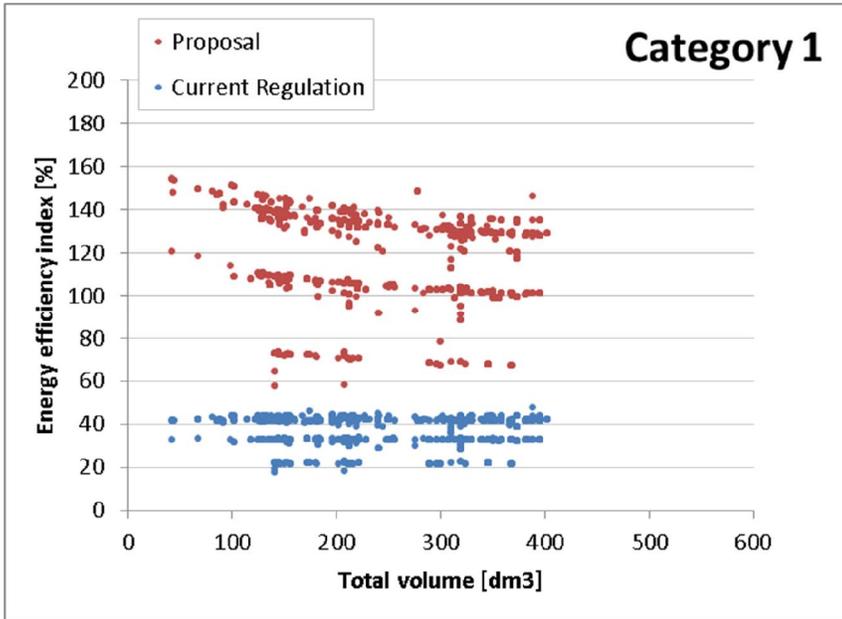
If the appliance has a frozen food compartment, then COP_{FR} has to be used, otherwise COP_{FF} .

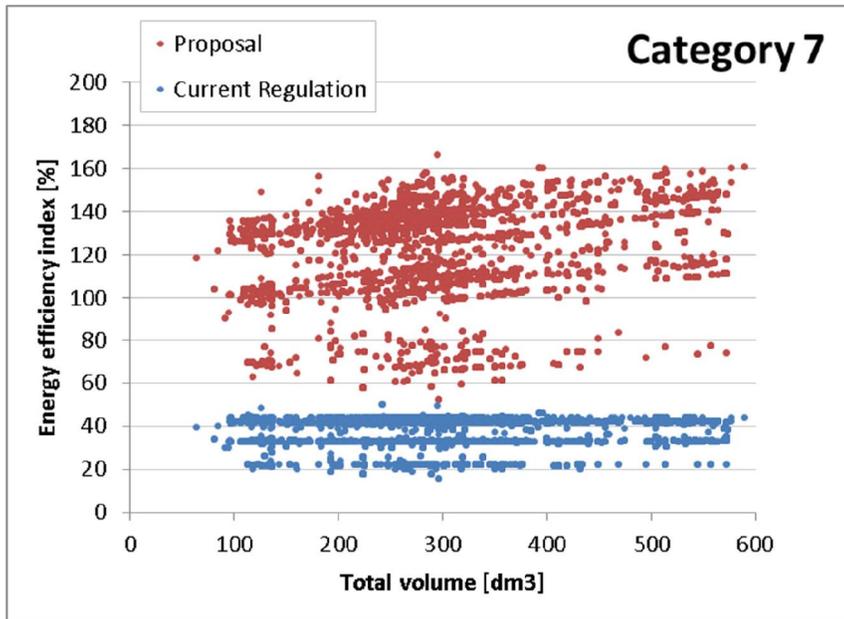
$C = 1.2$ if the temperature spread between highest and lowest compartment ≥ 20 K, otherwise $C = 1.0$.

Again the effect of this model can be studied using the data base. For the products in the data base the following corrections have been made (using interpolation at 24 °C)

Category	Change in consumption (interpolation at 24 °C)	Change in consumption (interpolation at 25 °C as listed in report 15127 / CE40 / V2, rounded values as presented in the conclusion)
1, 2 and 3	+11.9 %	+19 %
7, type I	+12.7 %	+19 %
7, type II static	+1.6 %	+ 7 %
7, type II frost free	+ 3.6 %	+ 9 %
8, static	-4.7 %	- 1 %
8, frost free	-1.8 %	+ 2 %
9	-6 %	-2 %
10	+2.6 (average of cat 7, type II)	

The following charts show the effect for the different categories:





Compared to the previous analysis before using the new global standard following observations can be made:

- a) The picture for the fridges remains approximately the same as expected.
- b) The freezers have also remained more or less the same
- c) For the combi there is more dispersion between the data points, caused by the different correction for type I and type II appliances. On average the indices have increased due to the fact that the reference model under predicted the technical model here.

Appendix 1: Heat load model for combinations

To calculate the volumes and areas for a combi with a fresh food on top and a frozen food at the bottom, the following formulas have been applied:

$$\begin{aligned}
 V_s &= (w - 2t)(d - 2t)t \\
 V_{FF} &= (w - 2t)(d - 2t)(h - t - h_s) - 0.5V_s \\
 V_{FR} &= (w - 2t)(d - 2t)(h_s - a - t) - b^2(w - 2t) - 0.5V_s \\
 A_{FF} &= (w - t)(d - t) + 2(h - 0.5t - h_s)(d - t) + 2(w - t)(h - 0.5t - h_s) \\
 A_{FR} &= (w - t)(d - t) + 2[(h_s - 0.5t - a)(d - t) - b^2] + 2(w - t)(h_s - 0.5t - a)
 \end{aligned}$$

Where V_s is the separator volume and h_s is the height at the separator position (average height measured from the floor). FF = fresh food and FR= frozen food.

To calculate the heat loss, it has further been assumed that the fresh food compartment is less insulated than the frozen food. In the model, the fresh food wall thickness needs to be set as well as the average. The resulting frozen food average wall thickness can then be found from the following equation which assumes that the total foam volume is the total surface area multiplied by the average wall thickness.

$$At = A_{FF}t_{FF} + A_{FR}t_{FR}$$

With the model it is then actually possible to optimize the foam distribution between fresh food and frozen food. This can be done by running the solver, selecting the heat load as the parameter to be minimised and the refrigerator wall thickness as the parameter to vary.

The total heat load is calculated as follows:

$$Q = \frac{k}{t_{FF}} A_{FF} (T_{amb} - T_{FF}) + \frac{k}{t_{FR}} A_{FR} (T_{amb} - T_{FR})$$

The basic model did contain only one parameter for the perimeter heat flow. This has been changed to using this given parameter for the fridge compartment only and a fixed parameter (0.03 W/(mK)) for the frozen food compartment.

Appendix 2: Reference formula's

The CECED formulation of using equivalent volume for calculating the heat load and subsequently the annual energy consumption using COPs is not very different from the VHK reference formula. This can be shown by the following evaluation:

$$SAE_{basis} = \frac{SAE_{HL}}{COP} = \frac{MV_{eq} + N}{COP} = \frac{M \sum_{c=1}^n r_c V_c + N_c}{COP}$$

Which can also be written in a different form

$$SAE_{basis} = \frac{M \sum_{c=1}^n r_c V_c + \sum_{c=1}^n N \frac{V_c}{V}}{COP} = \frac{M \sum_{c=1}^n \left(r_c V_c M + N \frac{V_c}{V} \right)}{COP}$$

In the total energy, the compensations for auto-defrost and build-in (and possibly others) need to be integrated, which are compensations on the energy. If these are integrated into the sum function than the compensations are weighted by the heat load of the different compartments:

$$SAE = D \frac{\sum_{c=1}^n A_c B_c \left(M r_c V_c + N \frac{V_c}{V} \right)}{COP}$$

Which is in fact the same formula as in the VHK reference formula (where C1 = 1/COP).

The difference is that now the coefficient C1 has become a meaningful value, namely the reciprocal of COP. Due to the linear regressions of COP and heat load, the final values resulting from the two formulations are different.

Re/genT Note ¹ :16104 / CE17 / V2		Technical Note
Project	Ecodesign & Labelling Review Household Refrigeration, preparatory/review study	
Subject	CECED Comments to Interim report (14.11.2015) Topic: Chill compensation	
Author	Martien Janssen of Re/genT BV Lage Dijk 22 5705 BZ Helmond The Netherlands martien.janssen@re-gent.nl	
To	CECED WG Cold and Review study team	

1. Introduction

1.1. Document revision history

Release date	Author	Version	Remark / document change
15-1-2016	MJ	D1	First draft for internal CECED discussion
21-1-2016	MJ	V1	Update after WG cold meeting 19-01-2016; references still to add.
24-1-2016	MJ	V2	<ul style="list-style-type: none"> References and quotations added. Editorial changes

1.2. General

The EU commission, DG Energy has ordered a review study of current eco-design requirements (regulation 643/2009) and labelling (delegated regulation 1060/2010) for cold appliances. A study team lead by VHK, the Netherlands, has presented a second interim report (dated 14-11-2015) which has been discussed in a second stakeholder meeting, held in Brussels, 14-12-2015 (further referred to as “the report”).

This notes collects observations from CECED, with respect to the chill compartment. Though such compartment receives compensation in the current legal framework, the report does not present any compensation. It is stated that the equivalent volume calculation (r_c) should give enough compensation. Its value is currently given as 1.25, however, with the new global standard this will reduce to $(24-2)/20 = 1.1$ as the target temperature has been set to $+2\text{ }^{\circ}\text{C}^2$. During the stakeholder meeting CECED has presented the need for a compensation for such compartment, as there are savings and advantages related to the use of such compartment, which are not expressed in the energy efficiency of a product.

During the stakeholder meeting it was questioned whether a compensation is really needed, and whether it would not open the door for requesting other compensations for other compartments. This note addresses this concern and presents the unique characteristics of the chill compartment and makes also reference to proposed

¹ The last digits refer to the version number of this note

² Instead of the warmest package temperature which should be below $+3\text{ }^{\circ}\text{C}$.

reference lines, illustrating that without compensation, chill compartments will be negatively presented.

1.3. Background

To date products with a chill compartment above 15 litre receive a bonus on the reference line of 50 kWh/y. At the current energy efficiency limit (A+ at index 42) this means that, for the worst appliances on the market, the bonus has already reduced to 21 kWh/y.

The main motivation for continuation of a special treatment for chill compartments is based on the following:

1. There are strict rules given in the performance standard regarding temperature stratification and fluctuation with challenging targets (the instantaneous temperature is evaluated and is limited to be within -2°C and +3°C). These strict rules are maintained in the new global standard.
2. In order to fulfil these requirements more sophisticated cooling systems are required with additional components (air circulation fan/ air guidance) which generally also reduce the volume.
3. With the chill compartment the customer can store perishable food longer which leads to less food spoilage, an aspect which is not considered in the energy and performance standards.

Food preservation techniques are becoming more and more relevant. There are no international standards currently for domestic refrigeration which are used to quantify the effect of these techniques. Published data on prolonged storage time is based on tests performed by manufacturer or test institutes specialised in food preservation. Within IEC SC59M³ a new working group has been started recently (WG4) with the aim to quantify the effect of food preservation techniques.

To date, the chill compartment is the most relevant technique available for achieving prolonged storage times, in particular of highly perishable foodstuff. CECED does not expect that for any other compartment or technique a special treatment is needed in the energy efficiency and labelling regulations update at this moment in time.

Chill compartments generally form only a part of a product, treatment in separate categories is therefore difficult and not consistent with the approach followed in the report. It is therefore proposed to maintain the bonus for a chill compartment.

2. Present situation

To date the chill compartment receives two corrections:

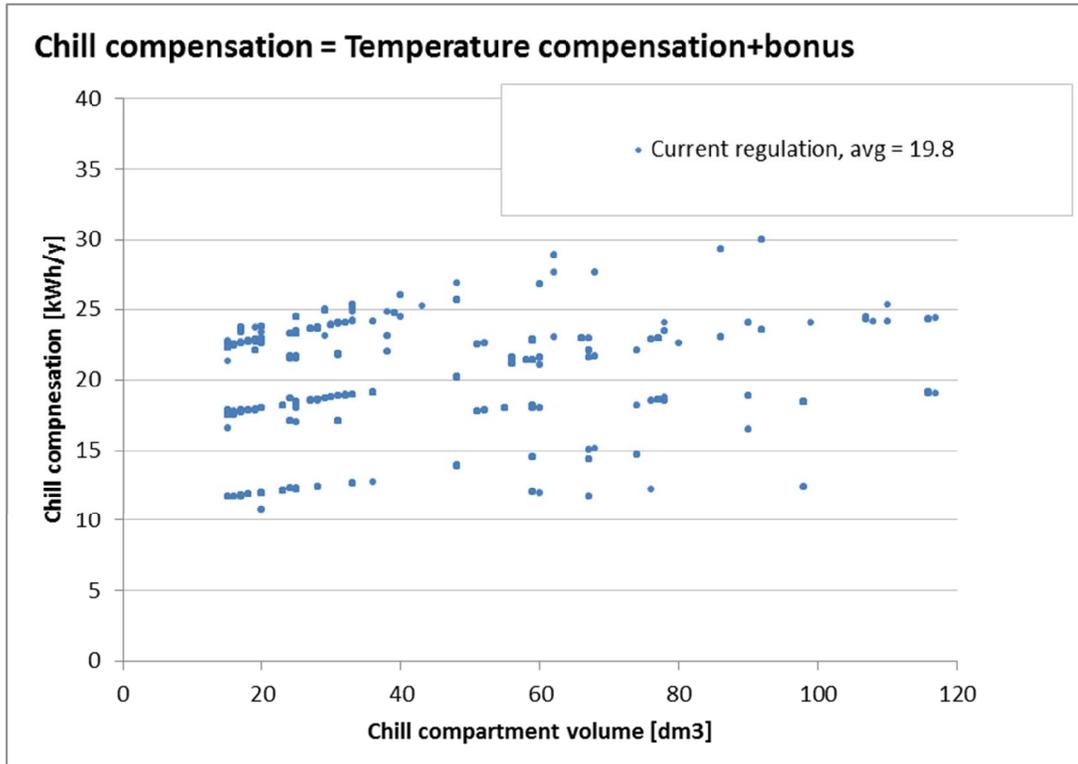
- a) The standard temperature correction based on a target temperature of 0 °C which gives a correction on volume of 25 %.
- b) The bonus of 50 kWh/y on the reference line if a chill compartment is present.

This can be analysed on the current database (CECED data base 2014) as follows:

- a) For each appliance with chill the standard annual energy (SAE) has been calculated.

³ This is the IEC subcommittee dealing (amongst others) with the new global energy test (IEC62552-1,-2,-3:2015).

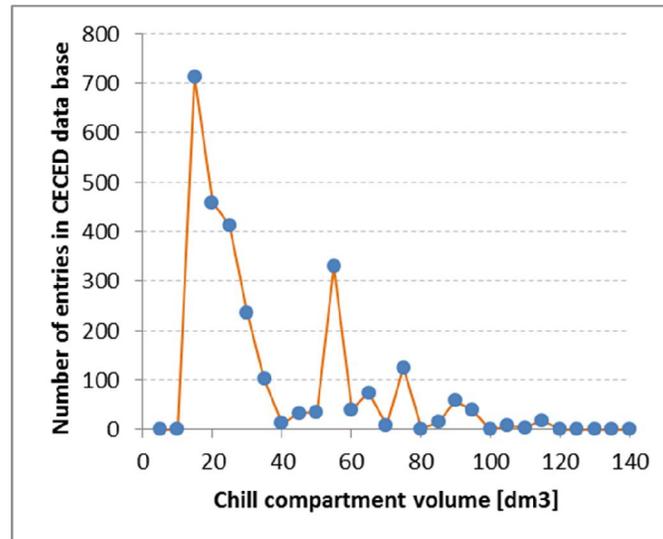
- b) For the same appliances the SAE is also calculated as if this chill compartment would have been declared as a fresh food compartment.
- c) The difference between the two SAE values is multiplied with the energy efficiency index⁴ and then can be seen as the effective compensation (in kWh/y), which is plotted in the diagram below.



The CECED database 2014 contains 2715 appliances with chill compartment out of the app. 18000 appliances (15 % of the total). These are distributed according volume as shown below. As can be seen the majority of chill compartments are below 35 dm3. Out of all products with a chill compartment, 82 % also contains a freezer compartment; the typical product is a combi having a fresh food compartment with internal⁵ chill compartment and a freezer at the bottom.

⁴ The difference between the SAE values is 50 kWh/y +/- the effect of the temperature compensation. If an appliance with a fresh food compartment has an index of 42 % it may only increase by 21 kWh/y + temperature effect if part of the fresh food compartment is converted to a chill and the net volume is retained (which is only possible by increasing the size of the total product).

⁵ Though a chill compartment using a third door on the appliance is feasible, this is not typical in Europe. This increases the product costs and increases also the energy consumption (increased perimeter losses).



There is some CECECED data available (also used in the Defra study) of comparing products with and without chill compartment, but this data is from 2002 and limited to two products having efficiency indices above 55 and are not relevant to the current situation. Nevertheless, it is concluded that the current compensation is in any case too low to compensate for the loss in volume and additional energy use of the chill compartment⁶.

Attempts have been made to check further equivalent appliances with and without chill, but this has failed. Appliances with chill have already specific measures in place (e.g. adaptation of insulation locally), making a direct comparison on actual appliances very difficult.

A proper technical and theoretical analysis for the impact of introducing a chill compartment would be the best basis for a correct definition of chill compensation. This should be done using actual appliances with state of the art technology. However, such detailed study has never been performed. Also the Defra study on correction factors did not include a proper analysis. In that study it was concluded that the bonus for chill can be removed, however, the Defra study lacked any technical background for this conclusion.

3. Motivation for chill compartments

The main motivation for a continuation of special treatment for chill compartments is based on the following:

1. Chill compartments have a definite contribution to food preservation and health. Perishable food can be stored longer which leads to less food spoilage, an aspect which is not considered in the performance standards.

⁶ E.g. if a very efficient fan of 1 [W] is introduced, it will increase the consumption with 1 [W] plus extra compressor energy (estimated at 0.5 [W] if the system efficiency = 2) so in total 1.5 [W]. Assuming a fan duty cycle of 30 % this on itself already constitutes 13 [kWh/y], being the effective chill compensation today for an A+++ appliance. This simple calculation does not include the fact that the temperature reduces resulting in a less efficient refrigeration system.

2. Chill compartments are the only fresh food compartments which fulfil the French Listeria decree ($T < 4^{\circ}\text{C}$).
3. Due to the strict rules for temperature an increment in energy consumption results compared to a fresh food compartment.
4. To achieve the temperature requirements, typically ventilation and ducting is needed reducing the volume.

These requirements are very unique for a chill compartment.

3.1. Advantages of chill in comparison to fresh food

1. Highly perishable food can be stored much longer (around two times longer). The longer storage time result in the following positive indirect effects:
 - a. The buying interval will be lengthened. This will reduce the energy consumption in private traffic to the shop. In appendix 1 a calculation is included of this effect which amounts to a saving of 36 kg CO₂/a (note that a typical A+++ refrigerator causes an emission of 35 kg CO₂/a). This calculation is based on an average amount of shopping trips saved of 3 per month. Even if this is considered too high, a saving of 1 trip per month would already result in a very significant CO₂ saving compared to the annual emission of the fridge.
 - b. The cleaning waste of vegetables and fruits will be reduced. The cost for waste recycling will be reduced, because less waste is produced. As the consumable share of the food will increase, the total cost for food will reduce. Further the food will stay longer fresh and healthy.
2. The topic of food waste is described in detail in a fact sheet from the Netherlands Nutrition Centre (which can be found at http://ec.europa.eu/food/safety/food_waste/library/docs/vc_sheet_voedselverspilling_en.pdf). The fact sheet mentions that 30 % of consumers need to throw away food because of using the wrong storage method leading to food spoilage.
3. Reduces reproduction of microbes (French Listeria decree). The lower temperatures reduce the reproduction rate of microbes significantly. Below +4 °C reproduction of most kind of microbes stay on a very low level. The French Listeria decree is one well-known example for this tendency, where temperatures of less than +4 °C are claimed. The chill compartment over-fulfils this temperature requirement with its allowed temperature range between -2 °C and +3 °C.
4. External references are available as to the advantages of storing at lower temperature. An example is the information from the German BfR (Bundesanstalt für Risikobewertung) website about poultry, from which the following excerpt has been copied: ***Why does poultry meat spoil quickly?*** *Poultry meat is generally susceptible to spoilage, and this also applies to chilled poultry products. The reason is that some of the bacteria can tolerate cold temperature and have protein-decomposing properties. At a temperature of +4° C, the number of these bacteria can double every 7 to 8 hours, whereas at 2° C this takes 13 to 14 hours, and at 0° C they can increase twofold within 24 hours. The bacteria can include pathogens such as Salmonella, Campylobacter, Listeria monocytogenes or Yersinia enterocolitica. For this reason, interruptions in the cold chain are especially risky: at room temperature, as a result of the multiplication of bacteria, putrefaction on the surface begins after as little as 4 to 6 hours. Because*

bacteria may be present in the deeper layers of the muscle as well, germ multiplication on the surface is typically accompanied by an increase in the number of germs in the deeper muscle tissue. At the same time, more and more bacteria enter the deeper layers from the surface. For more details, see http://www.bfr.bund.de/en/selected_faqs_on_poultry_meat-54623.html.

5. The lower the temperature the slower chemical, biological and biochemical (enzymatic) processes run because of reduced reaction time (Arrhenius). Of course freezing must be avoided, hence temperature below freezing point of produce could destroy cell walls and valuable ingredients could leak out. For this reason the actual temperature spread in chill compartments is mostly lower than the range allowed.

3.2. Technical justifications

- 1) The temperature requirements are very stringent. The temperature in the compartment must stay at all ambient temperatures, all thermostat settings, at any point in the compartment and at any time between $-2\text{ }^{\circ}\text{C}$ and $+3\text{ }^{\circ}\text{C}$. In a normal refrigerator compartment the mean value of the temperature has to be between $0\text{ }^{\circ}\text{C}$ and $+10\text{ }^{\circ}\text{C}$ (lower min. and max. values of e.g. $-4\text{ }^{\circ}\text{C}$ and $+14\text{ }^{\circ}\text{C}$ are allowed as long as the mean value is in the range between $0\text{ }^{\circ}\text{C}$ and $+10\text{ }^{\circ}\text{C}$).
- 2) Not realizable without fan. There is no known other technique that allows fulfilling the requirements of the above-mentioned standard of chill compartments. The fan needs extra energy and extra space in the appliance and affects therefore the index calculation twice. The acceleration of air by the fan results in a "high" velocity airstream inside the appliance, which increases the heat-transfer-rate between the sidewalls and the airstream in the appliance. A further increase of energy consumption results from this phenomenon.
- 3) Special air ducting is necessary. Without ducting it is not possible to reach the very small allowed local temperature interval. The consequence of this additional air ducting is a loss of net volume in the appliance and thus an increase of the energy efficiency index.
- 4) If there is no separate chill compartment evaporator, then the chill compartment is supplied by the (humid) fridge compartment air. Therefore the air from the fridge compartment evaporator has to be cooled down further than in case only the fridge compartment would be supplied. The energy consumption increases about 5 to 7% for the total appliance (each degree K corresponds roughly to 3% increase in consumption). If there is a separate chill compartment evaporator which is fed through one or more solenoid valves to ensure efficient operation conditions, this will be very small and it will be difficult to achieve optimum refrigerant charging. This results in switching losses (which are estimated to result in an energy consumption increase of about 4 % for an A+++ appliance).
- 5) Not realizable without electronic control. Because of the complexity of the appliance control it is not possible to use a mechanical thermostat, which has less energy consumption during compressor off-periods than an electronic control board.

3.3. Recognition of chill compartments

The chill compartment is recognised also internationally as a food preserving technology. China has introduced with their reworked Energy Label the chill compartment compensation factor like in present EU regulation 1060/2010. In Japan special preservation compartments are very common.

4. Effect of new global standard and regulations

With the introduction of the new global standard the temperature requirements of a chill compartment have not changed in terms of stability and spread (these are handled in the storage temperature test). In general all packages must remain between -2 and +3 °C throughout the entire test, so maximum and minimum peak temperatures are relevant here.

For the energy test the target temperature has been set to +2 °C in the new global standard. In the current energy test the target is not 0 °C as one may think, but it is defined that the warmest package must remain below +3 °C for a valid energy test. The confusion regarding the 0 °C target comes from the fact that this temperature is used in the label and eco-design regulation for the temperature compensation calculation. Most chill compartments in praxis do not use the entire range from -2 to +3 °C because of food preservation concerns, which limits the actual temperature range from 0 to +3 °C. This means that in actual tests following the current standard, the average chill compartment will be close to +2 °C. The apparent move to the new target of +2 °C in the new global standard will therefore not lead to any energy reduction.

The 0 °C target in the current regulation in combination with an ambient temperature of 25 °C leads to a temperature correction on volume of 1.25. According the new global standard with a 2 °C target in combination with a proposed interpolation at 24 °C, this temperature correction will become 1.1.

One of the arguments against compensation of a chill compartment is that it is typically contained between fresh food and freezer compartments and thus is experiencing a much lower ambient temperature than 24 °C. This is not considered to be a valid argument as this holds for any compartment in an appliance (in a regular combi also the fresh food has a different average ambient temperature, in fact, it is even cooled by the neighbouring freezer compartment). An appliance with a chill compartment in contact with a fresh food compartment actually suffers from the heat flowing from fresh food to chill compartment as the heat has to be removed at a lower temperature, hereby reducing the refrigeration system efficiency. Considering all these kind of cross-effects becomes very complex and has not been performed from any of the other compartments and it therefore not recommended.

5. Data base analysis using proposed regression lines

In the technical analysis of the report (Chapter 9) a model is presented for the reference line. This is discussed in detail in Re/genT Note :15423 / CE15 / V5. If the model proposed in the report or the one presented by CECED in the note is applied, there would be no compensation for a chill compartment other than a small temperature compensation on volume.

The proposed method of fitting combination appliances by making references to single door refrigerators and freezers introduces a further negative effect for chill compartment. Namely the method uses efficiency (or energy data) based on typical refrigerator efficiency levels. Efficiency levels of chill compartment are typically lower due to the lower temperature level. The chill would be then the only compartment which is referred to a compartment with a higher temperature, while all other compartments are allowed to use efficiencies (or typical energy use) of lower temperature rated compartments⁷.

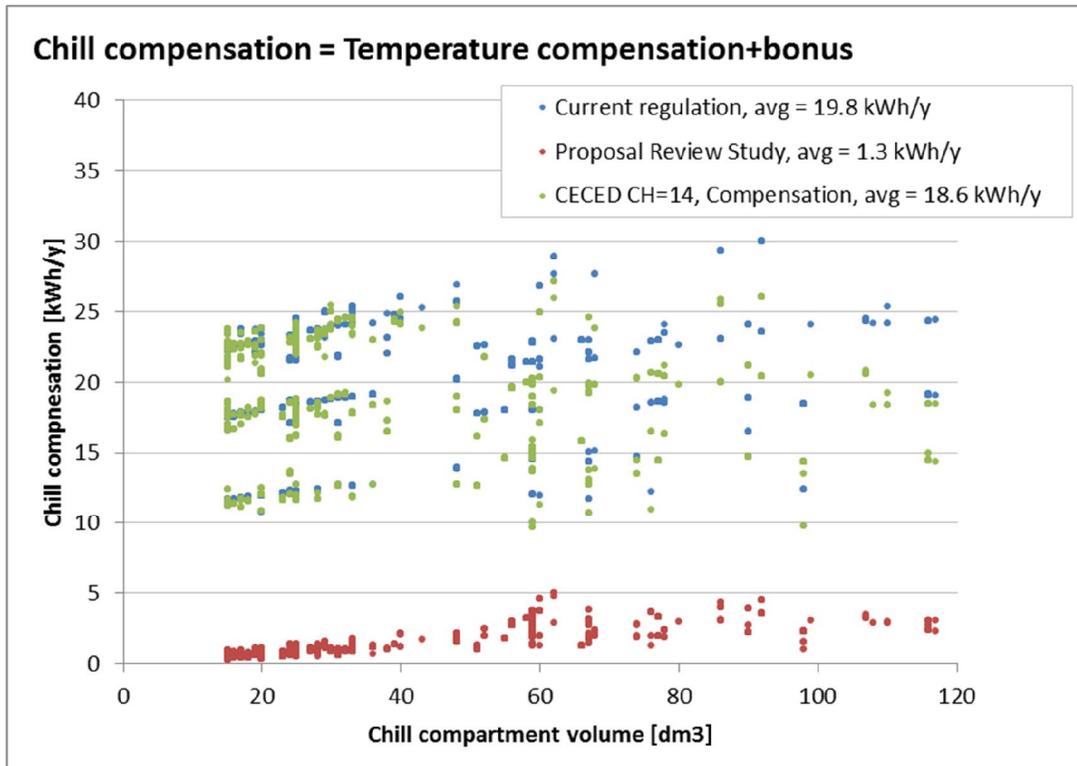
Compensation similar to the current situation can be obtained by introducing a parameter for the chill. If the CECED proposed reference line is used, this results in the following equation:

$$SAE = CH + CD \frac{\sum_{c=1}^n A_c B_c \left(M r_c V_c + N \frac{V_c}{V} \right)}{COP_x}$$

The parameter CH is a bonus expressed in kWh/y on the heat load of the appliance. For a chill compartment of small volume a compensation based on its volume does give an almost negligible effect. As many measures are needed to satisfy chill requirements also for small compartments, a constant compensation is needed next to a volume dependent one. In order not to introduce two coefficients for chill, here only the constant compensation is evaluated.

With $CH = 16$ kWh/y the results in the following figure are obtained using the CECED database. The red dots are the compensations on temperature only (which are very marginal). The green dots include the compensation proposed, which fits more or less to the current situation (in blue).

⁷ E.g. a cellar compartment uses the efficiency level of a fresh food compartment. A two star compartment the level of a 4 star compartment.



As a constant bonus is requested here, the current limit of 15 dm3 should be retained.

With the given bonus, the average effective bonus (18.8 kWh/y) is slightly less than today (19.8 kWh/d).

Appendix 1: Chill compartment analysis of indirect CO2 emission saving

In table 1 the indirect savings due to avoided shopping tours is calculated. In table 2 the emission of an A+++ refrigerator is calculated.

Table 1

average driving distance per daily shopping (one way) source: estimation CECED	4	km
average CO ₂ emission from car per shopping average CO ₂ emission per car in EU in 2015 per km*	987 123,4	g CO ₂ g CO ₂ /km
amount of shopping's per month saved due to chill compartment source: estimation CECED	3	per month
indirect CO₂ emission saving of refrigerator with chill compartment in comparison to without chill compartment	36	kg CO₂ / a

* European Environment Agency:
<http://www.eea.europa.eu/highlights/new-cars2019-co2-emissions-well>
 "A new car sold in 2014 emitted on average 123.4 grams of g CO₂/km"

Table 2

CO₂ emission caused by a A+++ refrigerator with energy consumption of 100 kWh/a	35	kg CO₂ / a
specific CO ₂ emission due to power generation in EU**	0,352	kg CO ₂ / kWh

** IAE Statistics 2013
 "specific emissions due to power generation in Europe (352 gCO₂/kWh in 2011 [1])"
<https://www.sfpnet.fr/european-energy-policy-and-global-reduction-of-co2-emissions-how-long-can-europe-afford-to-act-alone>
 [1] CO₂ Emissions from fuel combustion, Highlights, IEA Statistics, 2013 Edition



To: Rene Kemna, VHK

From: Jeremy Tait, Tait Consulting Ltd.
Marie Baton, CLASP Europe

Cc: Andras Toth, DG Energy

Date: 15 January 2016

Subject: **Comments on draft Task 1-6 Report of the Preparatory/review study for the Ecodesign & Labelling Review of Household Refrigeration Appliances**

Thank you for the opportunity to review and comment on the on draft Task 1-6 Report of the 'Ecodesign & labelling review household refrigeration – preparatory/review study'. We would also very much welcome an opportunity to provide comments on the last task of the study when the draft becomes available.

The following comments were prepared by CLASP Europe based on both the draft Task 1-6 Report posted on the review project website¹ in June 2015 and the discussions that took place during the second stakeholder meeting on 14 December 2015 in Brussels.

1. Comments on overall approach to MEPS and label thresholds

We note that there is significant scope for improvement with a further 30% to 50% of energy savings between LLCC measures and the current base case (Table 69 of the Task 1-6 report). To ensure that this scope is indeed exploited, the regulatory framework must encourage deployment of all of the noted technologies. The measures should also steer citizens towards smaller appliances as well as towards more efficient appliances.

However, the Tasks 1 to 6 report so far raises some concerns that we suggest should be either further explained, or addressed through additional analysis. It appears that the proposals made to date:

- a) **Are not intrinsically able to encourage highest efficiency of the smallest internal volume appliances and the largest internal volume appliances** because they remain based upon a 'straight line' requirement of kW/annum against adjusted volume. This approach has for many years attracted criticism for being unable to apply pressure on both small and large appliances. The EU now has very efficient small appliances but its large appliances are far less efficient than

¹ <http://www.ecodesign-fridges.eu/Pages/documents.aspx>.

those of the USA². This is why a curved line is advocated by IEA4E, CLASP and other stakeholders. Australia is now considering a practical and thoroughly researched proposal for this very issue³. There are precedents in Europe of such curved lines in ecodesign requirements or energy label thresholds, for example in the lighting regulations in place or in the Commission Working Documents presented to the Consultation Forum on 10 December 2014 for ecodesign and energy labelling regulations of electronic displays. If necessary, a different equation could be used for the smaller volume appliances as compared to the larger volume appliances, as used for directional lamps for above and below lumen output of 1,300 lumen. It is not clear to us from the Review Study report how this can be addressed by the EU proposal.

Requirements based upon surface area could be one way to tackle this: the vast majority of heat load is proportional to the surface area (i.e. heat gain through the insulation) and not to the internal volume of the appliance (on which the metric is based). The desirability of a metric based on surface area is accepted in several economies and whilst we are not aware of this yet being implemented anywhere, the EU could pioneer this and so directly address problems such as relative stringency for large and small appliances.

We would also advocate plotting the threshold development graphs as kWh/annum versus adjusted volume, which more transparently reflects the practical situation. The curves of kWh/litre versus volume give a potentially *false* impression that stringency is adequately increasing for larger appliances. Graphs in the IEA4E benchmarking study of May 2014 show clearly how much more efficient larger appliances are in the USA where thresholds are more stringent for larger appliances. The rationale for plotting kWh/litre/annum versus adjusted volume is not clear to us.

- b) **Could encourage manufacturers to make appliances with an even larger internal volume**, rather than invest in the new technologies. Due to the 'straight line' requirements, suppliers could use the previous technologies in an appliance with a much larger internal volume and so improve the energy label or meet the MEPS – this will also mean larger consumption (even if *efficiency* is better).
- c) **May not enable manufacturers to justify investment in variable speed drives and dual thermostats** because they use a 'static' energy test with no variability of the load during testing. Static testing suggests a risk that it will not adequately reveal the energy savings of variable speed drives (16% to 23%, Table 54 of the Review Study report) and dual thermostats, both of which make significant savings in real usage. Manufacturers may therefore not have the means to justify moving to those technologies, especially if increasing the internal volume is much cheaper. Testing and regulations in Japan have incorporated the load processing part of IEC 62552: 2015 (as also in the predecessor standard in Japan) and this has arguably helped to ensure recognition and therefore deployment of these technologies. The VHK report notes on p31 that "*it is perceived that the load processing test has little added value*" but it is not clear what alternative requirements of the regulation or test can be shown to encourage these technologies.

² See IEA4E Benchmarking report for Domestic Refrigerated Appliances, May 2014.

³ See Household Refrigeration Appliances: New Star Rating Algorithm Proposal for the IEC Test Method, Development of a new star rating system for household refrigerators and freezers in Australia and New Zealand using test method IEC62552-3, Energy Efficient Strategies for the Australian government, EECA and E3, May 2015. Available from <http://www.energyrating.gov.au/document/report-household-refrigeration-appliances-new-star-rating-algorithm-proposal-iec-test>.

(Note: We accept that the ambient temperature of test is slightly elevated (25°C is “3 °C to 4 °C higher than the actual EU average ambient”⁴) and so will ensure that the annual consumption seen on the label is inflated to compensate for absence of door openings and no loading of ambient temperature foodstuff during test.

Note: we also recognise that the load processing test also has disadvantages that must be weighed up: it could cancel out the substantial reduction in cost of testing that would otherwise result from EN 62552: 2016; however, the cost of testing refrigerators remains substantially less than that of testing dishwashers and washing machines, despite the refrigerator accounting for a much higher proportion of EU consumption which could justify more exacting and effective tests. The load processing test also introduces risk of reduced repeatability due to necessary intervention of test technicians during the test).

- d) **Do not attempt to address energy consumption of auxiliary functionalities.** Information requirements are likely to be appropriate for some functionalities, but this is not possible in the short or medium term because EN 62552: 2016 is not planned to include transposition of the energy testing of auxiliary functions which is provided in IEC 62552: 2015. This gap would have to be corrected before policy-makers could even consider tackling this growing part of the market.

CLASP recommends that the study team reviews the proposed new algorithm for Australian MEPS and labels (report from May 2015 as noted above) as this provides insight into several issues raised in these notes. The specific equation proposal for Australia is tailored to that market and is not appropriate for the EU, but valuable lessons and insights can be gained from that research.

2. Label class design

The consultation forum was invited to submit comments on how the energy label classes should be set. We offer some pointers on this from our experience:

- a) The declared annual consumption and label class should accurately reflect the annual consumption that the typical citizen should expect from the appliance; similarly, the label class achieved by two appliances should accurately reflect their actual relative consumption. This is emphasised because use of adjustment factors (for glass door, built-in etc.) can distort this principle. Concessions or factors can be applied for MEPS in order to avoid removing necessary functionality from the market, but these concessions should not be applied to energy labels.
- b) The classes must leave substantial scope for the potential cost-effective improvement of 30% to 50% identified in the study, which could imply leaving the top three classes empty: it seems reasonable to assume continuation of the long term trend for improvement of energy consumption of around 3% per annum (observed trend over the last 25 years). Another 10 years at this rate would only reach the lower estimate of available potential.
- c) Classes should become slightly narrower in range towards the higher classes, to ensure sustained incentive to improve, rather than risk stalling the market due to too high a jump to the next highest level.

⁴ VHK report on Tasks 1-6, page 31.

- d) Width of classes must be substantially larger than the measurement tolerances to avoid encouraging exploitation of tolerances.
- e) The upper class(es) should be set well above current BAT.

3. Comments on specific technical issues:

3.1. Scope

3.1.1. Inclusion of non-household

The interdependency of the regulations for household refrigerators and professional refrigerators has been discussed at the consultation forum. It was a pragmatic choice to exclude professional chest freezers from regulations 2015/1094 (energy labels) and 2015/1095 (eco-design) as these appliances are technically indistinguishable from household chest freezers and the testing and efficiency requirements would and should be identical. If non-household appliances were to be excluded from the household refrigerator regulations, then this would open up a loophole and the professional refrigeration regulations would have to be updated to replicate the household requirements for chest freezers (a substantial addition to the documents).

3.1.2. Wine storage appliances

We strongly support the introduction of MEPS for wine storage appliances with continuation of the current definition for wine storage appliances. We have no strong objection to the interim use of an adjustment factor to set less stringent MEPS for wine storage appliances with a glass door in order to allow suppliers additional time to adapt their designs, since wine storage appliances represent a minor part of the market and engineering effort is more usefully focused on the better-selling products during the initial period of the new regulation. Stringency should be increased for wine storage appliances with a glass door at Tier 2, then matching the Tier 1 requirement for solid doors. However, as noted above regarding label class design, we oppose the use of such adjustment factors for energy labels, which should from the outset reflect the actual relative consumption of the appliances.

3.1.3. Absorption and other cooling cycle appliances

The Task 1 to 6 report does not yet mention what is intended in the new regulation for absorption type and other cycle appliances, representing perhaps 1% to 2% of sales. CLASP supports their continued inclusion and an increase in stringency in proportion with the technology options that are relevant to those appliances. The energy label earned should accurately reflect the relative consumption of these appliances compared with conventional appliances. In addition, clarification will be necessary on how these appliances are to be tested since it will not be possible for them to achieve the required storage temperatures in the high ambient temperature test (at 32°C). Our understanding is that they can be tested in a single test at 25°C, but the implications of this to relative efficiency should be clarified.

3.1.4. Camping/mobile-home multi-fuel refrigerators

The VHK report notes that the typical camping/mobile-home multi-fuel refrigerators that can run on AC or DC electricity or on butane are not mentioned in the current regulation (page 17). CLASP supports their exclusion from MEPS at least until regulatory review. Since a proportion of these products are likely to be in permanent usage for mobile homes (that sub-type could perhaps be defined and become a focus of policy), information requirements could be justified from a suitable date before review so that data can be gathered.

3.2. Correction factors

3.2.1. Frost free factor

Section 8.2.3 of the Review Study report concludes that a correction factor of around 1.2 is appropriate when applied only to the freezer volume. However, the Australian data presented in section 9.3.7 of the Review Study report, *Compensation for no-frost*, is in line with the data and conclusion presented in the 2012 Defra report⁵, supporting a reduced correction factor. Moreover, the Defra report indicates that “market data has shown that it is possible to make frost-free appliances that are as efficient as static appliances when comparing energy consumption claims”. If there is no risk that ecodesign requirements based on static appliances would compromise the availability of this feature, a correction factor could only be justified if proportional savings are demonstrated in real-life conditions. We could however not find sufficient data to defend this option.

The conclusion of the Defra report on the question of the frost free correction factor is still valid:

There is a need for robust information on the performance of frosted up static appliances before the possible scenario of a move back to static appliances is considered. It is generally expected that the market will find a way of continuing to make frost-free appliances competitive and attractive to consumers with or without the correction factor.

As for other correction factors, we in any case recommend not to include it in the label in order to guarantee transparency and comparability. This could be re-considered should the real life efficiency benefits of frost free be demonstrated and quantified.

We recommend that an information requirement should be defined that would enable to European Commission to collect information on the extra energy consumption due to the frost free function, and that the consumption of the frost free function should be a specific focus of the review

3.2.2. Built-in appliances and associated factors

CLASP supports adoption of the CECED improved definition and removal of the width restriction. We emphasise the expectation that the energy label should reflect the actual relative consumption of the

⁵ “Assessment of the applicability of current EC correction factors and tolerance levels for domestic refrigerating appliances, Final Report Version 1.0”, Intertek, A research report completed for the Department for Environment, Food and Rural Affairs, London, UK. August 2012

appliance in its intended location of use. As the report indicates that “built-in appliances are showing a steady growth” we find it all the more important to make sure that consumers understand that these appliances consume more than their stand-alone counterparts. The Review Study report suggests that a factor must be applied to compensate for design constraints (side-wall thickness limitation) and to reverse the effect of differences between the test for built-in units and the test for free-standing units that are inherent in IEC 62552: 2015. Our understanding is however that these differences in test methods are meant to reflect the real use conditions (placed in an enclosed space). In this case, CLASP does not support the use of that factor for the label and would only support it for MEPS if needed to avoid availability issues.

3.2.3. Glass doors

CLASP accepts the interim use of an adjustment factor to set less stringent MEPS for wine storage appliances with a glass door, but CLASP does not support concessions for glass doors on conventional refrigerators for MEPS or for labels due to glass doors having less effective insulation.

3.2.4. Chill compartment

(Our understanding is that this section of the Review Study report requires updating – comment on the current content appears inappropriate for this complex area and we would appreciate an opportunity to comment on the updated version).

3.3. Testing

3.3.1. Circumvention devices

This issue is a growing concern that appliances could be put on the market that includes a device that modifies or affects its consumption pattern during testing making the efficiency test results look more advantageous than they should. This issue does not only concern refrigerators and should be addressed in a horizontal policy piece, potentially at Member State level. However, in order to prevent any loophole, we recommend that the regulations should specify that if circumvention is detected the product is non-compliant.

4. Life cycle impacts and costs

4.1. Impact of an improved durability

Concerning product durability, the recent Ricardo-AEA study *The Durability of Products* – like many others – “uses the best available literature data, Preparatory Study for Eco-design Lot 13” as input to their model. This demonstrates the importance of what will be stated in the report as it may be used as a reference for the many years to come. For this reason, we would recommend to clearly indicate the limitations on the analysis presented in the report of the Review Study.

For example, the Ricardo-AEA study is quoted in the Review study to confirm that extending the durability of refrigerators does not lead to significant environmental benefits. However, the Ricardo-AEA study is based on the 2007 Preparatory Study for Refrigerators which describes models from 2005. This constitutes an outdated reference that should at least be flagged in the report, and one of the consequences is that the conclusions are based on outdated product information. In particular, the yearly energy consumption of the initial product is as high as 324.4 kWh/year, which corresponds to the 2005 base-case whereas the analysis for the Review study should rather be based on the characteristics of the products that will be affected by the regulations, i.e. put on the market around 2018.

Besides energy efficiency in use, another feature that could have a significant impact on the benefits of extending the durability of refrigerator, at least in terms of their CO₂-eq impact, is the Global Warming Potential (GWP) and management of their refrigerant gases. We suggest that the Review Study report should at least discuss the impact of the F-gas regulation when referring to the life cycle assessment of 1999 or 2005 products. This particular addition would tend to support the conclusion presented in the Review Study that there is no benefit to lifetime extension, however we find it important to highlight for stakeholders all aspects that should be considered to estimate the impact of a lifetime extension for a 2018 refrigerators.

In terms of potential requirements concerning the durability of products, the JRC report *Integration of resource efficiency and waste management criteria in European product policies – Second phase – Report n° 2 Application of the project's methods to three product groups*⁶ provides some examples of requirements in Ecolabel criteria for energy related products.

⁶ <http://publications.jrc.ec.europa.eu/repository/handle/JRC77186>



Comments on the draft Ecodesign & Labelling review study on household refrigeration (tasks 1-6)

January 2016

Draft tasks 1 to 6 include some solid analysis and refined technical modelling, as well as interesting recommendations that confirm the need for a substantial revision of the Regulations for household refrigeration, both in terms of metrics and level of requirements.

We would like to stress a number of pending issues or need for clarification.

▪ Scope

We reiterate our concerns about ‘simplifying’ the scope by referring to ‘*household use*’ only.

On page 18, the reaction of Environmental NGOs has been summarised as ‘*non-household appliances should remain included*’. In reality, what we called for is also making sure that **household and similar appliances that are sold in non-household environments are still considered covered by Ecodesign and Energy labels by market players**. This was not only supported by NGOs, but also other stakeholders who raised the risks of loopholes if the scope only refers to ‘*household use*.’

Additionally, in meetings for Lot 12 (commercial refrigeration), it has been mentioned that all wine coolers and minibars (no matter if sold for household or professional use) are supposed to be covered by the regulations for household cold appliances. These products have been excluded from the scope of the regulations for professional and commercial refrigerating appliances. In this context, **the scope for household appliances should remain as broad as it was, to avoid grey areas and loopholes** (such as for minibars, wine coolers, or professional chest freezers). We consider that these issues are still not fully clarified in the study.

On page 21, the fifth consideration sounds contradictory. It states that setting minimum requirements on wine storage appliances is fully feasible and would not entail extra administrative burden. On the other hand, it refrains from doing so and reaches a conclusion about the current exemption.

▪ Categories and reference lines

On page 44, the problems with the current categories and metrics are highlighted, but only the CECED proposal is introduced and described in details. **We are surprised that the joint ECOS-Topten alternative presented during the first stakeholder meeting¹ – based on robust principles and technical justifications about the various factors and compensations – is not mentioned at all**. Our proposal should be acknowledged and its benefits put in perspective with the CECED approach.

In this regard, we still oppose describing the CECED proposal as a ‘*simplification*’ and ‘*reduction of the current 10 categories to 4 or 5*’, because in reality their proposal would still include 8 or 9 categories in total, nothing more simple than today.

¹ http://www.ecodesign-fridges.eu/Documents/Topten_input_HH-cold_stakeholder_meeting.pdf

- **Measurement standard**

In the EN standard, the proposed reaction to circumvention devices potentially found in appliances appears way too weak (only including a mention in the test report, and penalty factors on the measured energy consumption). If circumvention devices are detected during a test, national authorities should **immediately be alerted**, the manufacturer **prosecuted** and **legal sanctions** applied.

This is what should have been done in the first place with Volkswagen. No tolerance or arrangement can be justified in this matter.

- **Market data**

On page 52, more recent data is available for 2014. See for instance:

http://www.topten.eu/uploads/File/WhiteGoods_in_Europe_June15.pdf (figure 1), and

http://iet.jrc.ec.europa.eu/energyefficiency/sites/energyefficiency/files/events/EEDAL15/S7_Policies_7/eedal15_submission_49.pdf (figure 4).

It confirms that the sales in the top two classes are significantly trailing behind model availability, and this should be highlighted as a concern and strong reason to swiftly revise the energy labels for this product group.

In the first study mentioned above, published in early June 2015, there is also information on EU average price, energy consumption and volume, for the total sales and per class (based on sales data from GfK).

- **Durability**

On page 64, the report maintains that provisions to extend the reparability and prolong product lifetime would be very negative in environmental terms, and therefore should not be considered.

In any case, the ultimate balance between saving energy and saving other material resources or increasing consumer interest (through prolonged lifetime) will be decided by decision-makers. For this, they need to have access to a precise and up-to-date assessment of what is at stake and what the actual benefits and negative impacts in both cases would be.

Again, **we do not consider that the study provides this at the moment**. The topic is too lightly covered (only a couple of pages), and lacks comprehensive analysis and illustrations. Notably on the following aspects:

Actual and future product lifetime

When discussing potentials for prolonged lifetime, it is essential to first agree on the actual lifetime of appliances on the market. The draft study takes for granted an average lifetime of 16 years for refrigerating appliances. The reference given is VHK's Ecodesign Impact Accounting, but no details could be found in this study as to where the '16 years' came from.

The original 2008 preparatory study on household refrigeration considered an average lifetime of 15 years as a '*commonly agreed figure*', but also showed that less than 10% of cold appliances found in EU households are older than 10 years, and less than 5% older than 16 years. A 2011 French study² concluded that the average lifetime of a refrigerator before unrepairable failure is 11 years. The 2015 Ricardo-AEA study on durability³ reported that around 50% of refrigerators purchased in UK in 2012

² <http://www.tns-sofres.com/sites/default/files/2011.06.29-durabilite.pdf>

³ <http://www.productdurability.eu/assets/Product-Durability-Full-Report-logo-updated.pdf>

were replacing existing appliances of less than 8 years, and that in a large majority of cases the reason for the replacement was that their previous appliance had broken down or was unreliable.

Therefore, **we have some doubts regarding the assumption of 16 years**. Besides, the products of today are becoming different than the ones considered in past studies. They include increasingly sophisticated controls and electronics, displays, and potential new innovations that could increase the fragility of the appliance. There is no guarantee that the average lifetime before failure will remain stable in the future.

In addition, the average lifetime is not the only important parameter. The standard deviation also matters. How many products fail after e.g. 5 years, 7 years, or 8 years? **Improving durability also means ensuring that as many products as possible live up to their expectations**. Too many products are not repairable anymore (or subject to prohibitive reparation costs) even if they fail after only 5 years.

All this is important because discussing means for prolonging the lifetime of products from e.g. 8 to 10 years probably leads to significantly different life-cycle results than a prolongation from 16 to 18 years.

Credible quantification

The quantified illustration that is provided in the draft report is a 1999 Japanese fridge in a one-to-one replacement case. As we have already mentioned, this is not representative of a 2017 EU fridge model that would be replaced in 2025 or later. By that time, the use phase of products will have a significantly lower share in total product life-cycle impacts, energy efficiency gaps between old and new products will probably be smaller, and the EU electricity mix will have changed to higher renewable content.

A more representative calculation would be welcome to properly inform decision-makers in a fair way on the impact of prolonged lifetime. It is possible that prolonging lifetime is still not favourable – and we are ready to accept that, but it will not be as high as a 40% increase in environmental burden as currently suggested.

Policy recommendations

In terms of policy recommendations, **an exchange with the JRC team in charge of the review of the dishwasher and washing machine regulations would help**, as they are looking into this issue and some aspects are probably common with refrigerating appliances.

Here are examples of policy provisions that could improve resource efficiency and end-of-life impact, and could be discussed in the study:

- Longer legal warranty, and/or mandatory indication (possibly on the energy label) of the legal warranty duration and potential commercial/extended warranty duration offered by the manufacturer;
- Obligation related to the availability of spare parts for a sufficient period of time, and indication of the availability time in the product fiche and on the manufacturer website
- Potential design requirements for the durability of most critical components, such as the compressor;
- Making repair manuals (and tools) available to independent repair services beyond the sole OEM's customer services
- Forbidding the use of proprietary screws or other fixing techniques that cannot be set or unset with commonly used tools;
- Discouraging the gluing and welding of parts, notably fixing two different types of materials together (that, if so, cannot be changed/recycled);
- Mandatory marking of plastic parts above 25 g;

- Obligation to make each plastic part above 100 g in one single polymer, or a polymer blend that can be recycled without need for prior depollution.

- **Compensation factors**

As we already stated, **we generally oppose compensation factors for transparency reasons, notably for energy labels**. Energy labels are meant to inform people, and ensure they can compare models in a fair way. Whatever increases the energy consumption of a product should be reflected as lowering efficiency. The current Regulation requests an assessment of *‘the possibilities for removing or reducing the values of the correction factors’* in the review process, there is no notion of introducing additional correction factors.

There are other specific reasons:

Multi-door compensation

We believe no multi-door compensation should be included, for the following reasons:

- As explained in the draft study, the losses due to an additional door depends on the type of compartment and can be as low as 1.5% and sometimes even compensated by the temperature correction. Thus, a generic compensation of 3% is technically unjustified, and would most of the time be a free bonus.
- Multi-door models belong to the most expensive models with high overall energy consumption (the average consumption of the 22 multi-door models currently offered on a popular French retailer website is 400 kWh/year⁴, far above the level of a standard 2-door). There is no need to grant this market segment with compensations, as in this segment costs for higher efficiency can be more easily borne. Compensations may even be counter-productive by stimulating the sales of this segment and increasing overall energy consumption.

Glass door compensation

We still do not see any acceptable technical or environmental justification as to why equations should be tweaked to grant a ‘compensation’ to wine storage appliances that are less efficient due to glass doors. As a comparison, professional and commercial refrigeration appliances are treated in the same way irrespective of a transparent door or not in EU regulations for professional storage refrigeration already in force and draft regulations for commercial refrigeration.

No-frost compensation

We oppose defrosting compensation, but if it is deemed indispensable, then it should at least be reflected on the energy label. The annual extra energy consumption due to no-frost should be indicated on the label (as it is supposed to be measured under the new measurement standard).

Chill compartments

We do not see a reason to treat chill compartments differently from other compartments. Their lower temperature is accounted for in the temperature correction factor r (proposed formula), so there is no need for an additional compensation. The industry point of view that a chill compartment lowers CO₂ emissions because it leads people to potentially drive less to supermarkets is far-fetched and out of the scope.

⁴ www.darty.com

- **Proposal for new metrics**

We welcome the attempt in chapter 9 to ground future metrics and reference lines on a more solid technical basis than on perishable market-based data. We also welcome the principle of reducing the number of product/compartments categories and to approach efficiency by compartments rather than entire models.

However, if there still are many compensations offered, as in the equation proposed on page 107, the final metrics will remain particularly complex. Market surveillance would not be simplified. On top of that, the accumulation of compensations could still allow certain models to consume 30% more than others with a similar basic performance, and get the same energy rating. **A percentage that we consider way too high.**

We understand that the so-called 'combi factor C_c ' could still be modified. We are expecting that whatever the final decision, this factor will not allow a model with multiple compartments of the same type (for instance a model that would have a standard fresh food part and another one with a transparent door for e.g. drinks) to have more relaxed requirements compared to a similar model with a single compartment. Otherwise, it would encourage manufacturers to add internal walls and doors to be in the combi class. Specifically, we are not convinced that the temperature correction factor r_c should be squared (r_c^2) in the formula for combi models.

- **Improvements options and LLCC calculations**

The analysis in chapter 12 does not seem to take into consideration learning curves, although it is recommended to do so in the MEErP.

For instance, the determination of additional costs related to possible improvement options (p. 137) seems to have been done considering flat costs, based on data from past years. This does not take into account industrial learning / experience effects, that is progressive cost reductions as the identified improvement options start to be more massively deployed by manufacturers.

As a consequence, the LLCC determination may be valid for 2015, but not necessarily for 2018 or 2019 when future Ecodesign requirements and labelling classes supposedly enter into force.

A clarification should be provided as to why learning curve aspects have not been considered. At least, it should be clarified in the text that the calculations have been made using flat costs, and that the result is most probably conservative because it does not take into account cost reduction trends due to learning and mass deployment effects.

ENDS.

Contacts:

ECOS – European Environmental Citizens' Organisation for Standardisation
Chloé Fayole, chloe.fayole@ecostandard.org

Topten Europe
Anette Michel, anette.michel@topten.info



Policy scenario proposals on household refrigeration

January 2016

This document describes the policy scenarios that we wish to see covered in the final chapter of the preparatory study (for modelling and assessment).

We only include specific Ecodesign requirements and energy labelling classification here. We also have recommendations regarding generic Ecodesign and information requirements (notably on durability and resource efficiency). We are not mentioning them here because they cannot be easily quantified in a model, however **we expect the final chapter of the study on policy recommendations to also refer to such requirements.**

At this stage, it is difficult to express scenarios for specific Ecodesign requirements and Energy Labelling classes in a precise way, as the background formulas and levels of the energy efficiency index are meant to change in the new regulations, and the new formulas are not stabilised yet. The proposed new approach to the EEI would allocate the same reference line (SAEc) to different refrigerator categories, making them comparable. This is a simplification and a substantial improvement compared to today, but this alignment also means changes to the current situation, with a different impact from one category to another. So it is difficult to use the current EEI reference lines as a basis for future scenarios.

First and foremost, we consider that whatever the final EEI formula, **the Ecodesign requirement levels and label classification should still be the same throughout the whole product lot**, and not differentiated by categories. The only temporary exception could be wine cellar appliances, for which Ecodesign requirements could be more progressive (as they have not been covered by Ecodesign before).

▪ Specific Ecodesign requirements

The Ecodesign Directive specifies that the level of energy efficiency requirements must be set aiming at the least life-cycle cost to end-users for representative models. The preparatory study report (p. 146) reveals that the LLCC level (as calculated in 2015 based on the current EEI formula and not taking into account future learning effects) is between EEI of 20 and 31 (depending on the categories), that is mostly in class A++, or for some A+++.

A basic policy recommendation should be to set a specific requirement at (or close to) the LLCC point as quickly as possible. Expressed with the new EEI formula, it could be chosen at the bottom level of the range of LLCC points for the different product categories (excluding wine coolers, which are treated separately). It should be ensured that this level does not lead to any back sliding (i.e. allowing forbidden products back to the market in some categories).

We propose this tier (at LLCC) one year after entry into force of the Regulation (i.e. around 2019).

In order to provide long-term visibility to the industry, we also strongly support a second more forward looking tier. In line with past policy considerations and recommendations from evaluation studies on the Ecodesign policy, this tier should be set at the level of current BAT, to reflect future decreasing trends on efficiency progress costs that will drive the LLCC point even further.

We propose this second Ecodesign tier at the bottom level of the range of BAT points five years after entry into force of the Regulation (i.e. around 2023).

For **wine coolers** (sold for households or professionals), a more classical set of Ecodesign tiers could be set as for new products regulated, e.g. first tier quickly at the level of current A class (Switzerland has been implementing this level for wine coolers since January 2013), and a 2nd tier at the LLCC level after three years.

- **Energy Labelling classes**

In line with current policy discussions on the revision of the Energy Labelling framework, the label for refrigerating appliances should revert to an A to G scale, with the A and possibly B class empty at start.

We propose to set the F class threshold at the level of the first Ecodesign tier (i.e. current LLCC level), and the C class so that the current most efficient BAT model (irrespective of the category) just reaches this level.

The classes in between can be divided equally. The resulting average improvement step from one class to another can then be applied to set the B and A class levels accordingly.

ENDS.

Contacts:

ECOS – European Environmental Citizens’ Organisation for Standardisation
Chloé Fayole, chloe.fayole@ecostandard.org

Topten Europe
Anette Michel, anette.michel@topten.info

To: Rene Kemna, VHK
Cc: Andras Toth, DG Energy
CECED, WG Cold
Date: 22 January 22, 2016

Dometic comments on the draft report (tasks 1-6) Ecodesign & Labelling Review Household Refrigeration

In addition to our previous comments issues 2015-06-25 and 2015-08-31 we take the opportunity to again express our view on some important considerations. For your convenience we have also added our previous input as attachments.

On Absorption and Thermoelectric products

The draft report is primarily dealing with standard kitchen appliance, but the legislations will however also cover smaller product categories and products with other cooling technologies than compressor cooling. We lack a plan how this should be done, and we take note that products with other cooling technologies are only briefly mentioned in the study. It is important that these products are not (incidentally) disqualified from the market.

As we are the main producer and provider of some of these products (such as minibars and portable cooling boxes) we would like to be involved in these discussions. We are of course willing to share with you performance data that could be a base for discussions on upcoming requirements.

On the scope discussion

As we have mentioned in our previous papers we principally support the ambition to simplify the scope. More important however, is to have clear border lines between the three product categories household, commercial and professional refrigeration. A product type should be easy to categorize into one – but only one - of these categories.

We have several times raised the problematic situation on hotel minibars. For long we have argued that we would prefer to have them covered by the regulations for commercial refrigeration. If this could not be achieved, inclusion in the household legislations is a “second best”, but the scope must then be made robust and clear. It stands clear that minibars are not covered by today’s household regulations (despite the fact that the Commission updated FAQ consider them to be covered). We have a clear legal verdict that these products are not covered by ecodesign and energy labelling regulations for household refrigeration. Combining this fact with the exclusion of cooling technologies other than compressor from the scope in both the professional ecodesign regulation

and in the draft commercial ecodesign regulation, the result is that absorption and thermoelectric minibars will not be covered by any of the three ecodesign regulations.

On measurement in 32 °C

The issue on measuring thermoelectric and absorption products in high ambient conditions has been discussed at the first stakeholder meeting. We continue to argue that these products should be measured according to the draft standard prEN 62552-1:2014-A1 in 25 °C ambient temperature only. Measurement in 32 °C could cause a misleading energy value far away from the “real” energy consumption of the product in most applications. Indicative, the declarable energy figure would be more than doubled compared with today’s value with risk of being forced out of the market. We can support this view further with real measurements.

Attached: *Dometic input to the stakeholder meeting July 1st, 2015, regarding upcoming review on the ecodesign regulation on household refrigeration, 2015-06-25.*

Dometic 2nd input to the stakeholder consultation on the review on the ecodesign regulation on household refrigeration, 2015-08-31

For Dometic Group

A handwritten signature in black ink, appearing to read 'Bernt Andersson', with a long horizontal flourish extending to the right.

Bernt Andersson
Dometic Holding AB
Hemvärnsgatan 15, 6th floor
SE-171 54 Solna, Sweden

Phone: +46 70 789 4903

E-mail: bernt.andersson@dometic.com

Annex 1

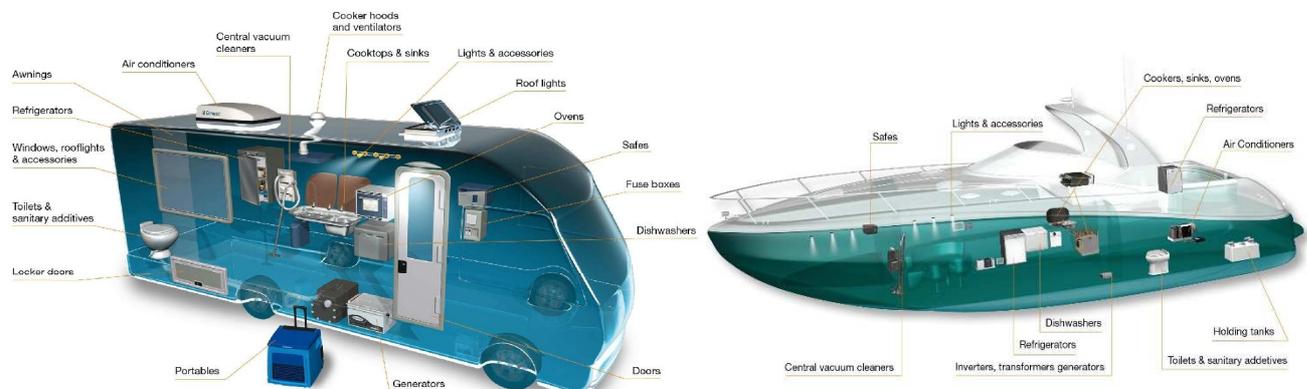
Solna, Sweden 2015-06-25

Dometic input to the stakeholder meeting July 1st, 2015, regarding upcoming review on the ecodesign regulation on household refrigeration

The comments in this paper refers basically to the interims report on the review of ecodesign and energy labelling requirements for household refrigeration¹. It has been prepared as input for the stakeholder meeting 1st of July 2015.

About Dometic

Dometic Group, with the brands Dometic, Waeco, Sealand, Mobicool and several others, is a customer-orientated, worldwide leading provider of innovative comfort products for the recreational vehicle (RV), automotive, marine, hotel, and special comfort markets. The pictures below with a selection of our products highlighted, illustrates our effort to be a complete supplier of products to the RV and marine sector.



Dometic is providing a number of refrigeration products – as indicated in the picture above - to RV, trucks and for marine application. Furthermore, we supply a range of wine cellars, and we are market leaders concerning hotel minibars. Some products for the retail market are complementing our range. Our refrigeration products are made with different cooling technologies; compressor cooling, absorption and thermoelectric, all depending on the customers need and preferences.

Dometic Group's total sales amount to about SEK 8 billion and the number of employees are about 6,200. For more details of our company and our products please visit our home page

www.dometicgroup.com

¹ Ecodesign & Labelling Review Household Refrigeration Preparatory/review study, Interims report, 1.6.2015

Dometic comments in short

1. Dometic supports the efforts to simplify the scope of the legislations and to focus on products used in homes. A clear and non-ambiguous scope is essential for us as we often have products in borderline applications. Furthermore, Dometic is supporting to use the definition of “household refrigeration appliance” from IEC 62552-1:2014. We also propose to define the word “Household”.
2. Dometic is proposing a clear approach for borderline products regarding ecodesign (and energy labelling) requirements. If products could be considered falling in the scope of more than one regulation (e.g. household and commercial) because of dual use, it should be clarified which regulation should apply.
3. To close potential loop holes we propose that the product category or the design temperature (for energy measurement) is indicated on the energy label.
4. Regarding our important product category hotel minibars, we propose them to be covered by the upcoming regulation for commercial refrigeration. We have previously submitted our comments on this during the development of the commercial regulation.
5. Regarding our important product category portable cooling boxes, that might fall out of the scope, we would work for establishing a voluntary agreement to ensure that products will continue to be labelled as today.
6. Regarding wine cellars we support the introduction of a separate product category. We understand the issue with glass door versus solid door, but we think that this could be tackled by a correction factor for door visibility.
7. Regarding the energy measurement in 16 and 32 °C ambient, we fully support the input from CECED. It is preferable to establish an average temperature of 25 °C to better compare with existing measurements. Furthermore we are emphasizing that some products with absorption cooling system or thermoelectric cooling could not be measured in 32 °C, and the energy consumption should therefore consequently continue to be tested in 25 °C ambient only. This is already expressed in the draft amendment of EN 62552-1:2014², and we would like this wording to be included also in the upcoming legislation.
8. Regarding the future measurement of energy performance with a reference temperature in the refrigerator of 4 °C, we have not assessed the impact on our products in detail. We will provide more information on this later in the process.

² prEN 62552-1:2014-A1, Annex A, A3.2.3. “for thermoelectric and absorption appliances the energy consumption test is to be done at 25 °C”

Detailed comments on specific topics

Scope and definitions

The Interims report suggest to simplify the scope and narrow it to products for household use. To our understanding household use should here reflect the usage “in the home”. Furthermore, definitions of the scope of regulations for the household, professional and commercial refrigeration appliances should be aligned.

We fully support this intention. Dometic products are often found in a grey zone between household, commercial and professional use, and any clarification on this is positive. We have unfortunately seen several examples of competitors taking advantage of loop holes in case of ambiguous scope. As all the three refrigeration regulations is now under work, it appears obvious that a holistic view should be taken.

We support the proposal from the interims report to use the definition of “household refrigeration appliance” from IEC 62552-1:2014. A further definition of “household” might however be needed. To us it is not clear if products for the garden, cottages or portable cooling boxes are considered falling under this definition. We also think an alignment with the product category “domestic refrigerators and freezers” from the F-gas regulation would be relevant.

With legal requirements in place for three applications of refrigeration – household, commercial and professional – products might be intended for multiple use, and covered by more than one legislation. It is therefore important to clarify the actual requirements for such cases. We take note that the working document regarding ecodesign requirements for commercial products introduces in Article 1.2(l) a hierarchy among the legal acts. We think this approach should be used also for the other regulations.

The Pantry category

The new product category “Pantry”, has introduced a potential loop hole regarding energy labelling. A more favorable energy index could be achieved by claiming that a product should be tested in Pantry category even if it is sold as a cellar or even a refrigerator. This could result in significantly better energy index for a product with higher actual energy consumption. As the design temperature or the product category is not posted on the energy label it would not be visible for the customer. Unfortunately we have seen examples of this. **We propose that the product category or the design temperature (for energy measurement) is indicated explicitly on the energy label.**

Furthermore, according to the upcoming revision of the standard IEC EN 62552 the energy consumption shall be measured at both 16 °C and 32 °C ambient temperature. A peculiar effect for a pantry product, without electronics, is that the energy consumption will in fact be 0,000 kWh/24h when measured in 16 °C. This would affect the declared energy consumption significantly. It appears that this effect has not been foreseen.

Hotel minibars

With the new proposed scope it stands clear that hotel minibars will not be covered by the legislation. Furthermore, we have noted that the definition of a “refrigerated commercial display cabinet” in the proposal for the commercial regulation is fully applicable on our hotel minibars. However, the commercial regulation is proposed not to apply any specific requirements on minibars nor on any products with absorption or thermoelectric technology (that both are common for minibars).

Dometic has previously submitted comments³ with the suggestion to clearly include hotel minibars in the upcoming legislation for commercial products. As beverage and other foodstuff is stored and displayed for sales in the minibars we believe they should be covered by this legislation.



Picture: Dometic minibar with transparent door

At time being we unfortunately face a very unpleasant market situation regarding the minibars. We as market leaders fully support the intension that hotel minibars should be a part of the ecodesign and energy labelling legislations. We have taken note that the Commission consider hotel minibars to be covered by the existing requirements for household refrigeration and has even added a question in the updated the FAQ document (2014)⁴. Unfortunately we have a verdict from a German court⁵ pointing in the complete opposite directions stating that hotel minibars are not covered by the ecodesign requirements or the energy labelling requirements for household refrigeration. The situation must therefore be clarified.

As we indicated above we support the intention to simplify the scope of the household legislation. Hotel minibars would then clearly fall outside the household legislations. **We continue to argue that these products should preferably be covered by the legislations for commercial products.** We would be glad to contribute further in this process.

Minibars for hotels are often using absorption cooling as this technology is totally noiseless. We would like to draw attention to the annual sales volumes indicated by the interims report (page 46): “Absorption refrigerators sales of 0.25-0.3 million units annually are still assumed to be correct”. We agree on this, but with a changed scope significantly fewer products will in fact be covered by the legislation.

Portable cooling boxes

Portable cooling boxes is an important product category for Dometic, and we are a major actor on the European market for cooling boxes. Cooling boxes use different cooling technology: compressor,

³ Dometic input on ecodesign and energy labelling requirements on hotel minibars, January 16th, 2014

⁴ Frequently Asked Questions (FAQ) on the Energy Labelling Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products and its Implementing Regulations, page 8-9, Last updated May 2015

⁵ Landgericht Düsseldorf, 37 O 58/13, 20th February 2014.

absorption or thermoelectric, depending on the application and customers need. The boxes are today clearly covered by ecodesign requirements and are energy labelled according to the household regulations. Energy measurements are carried out using the applicable household standards.

The cooling boxes might now fall outside the scope with the suggested changes proposed by the interims report. The boxes are by their nature mobile applications and the primary use is outside of the home.

We are in favor of keeping the ecodesign requirements and the energy labelling for these products although they are not clearly in any of the regulations. We would therefore work for a voluntary agreement among the major players.



Picture: Dometic CFX box with compressor technology

Wine coolers

Dometic is supporting the introduction of a new product category for wine storage appliances. We understand the challenge to compare products with glass door versus a solid door. We think however that this could be handled by introducing a door visibility factor. This factor could be scaled with the visible part of the door. We have previously submitted comment on this in relation to requirements for hotel minibars. We would be happy to share our thought more in detail.



Picture: Dometic wine cooler

Energy measurements

Dometic is backing the input from CECED on energy measurement, although the additional measurements required is putting a rather high (and maybe disproportionate) burden on us as a small supplier of rather few products.

Specifically for our absorption and thermoelectric products we would like to emphasize that some products could not be measured in 32 °C, and the energy consumption must therefore consequently continue to be tested in 25 °C ambient only. This fact is already expressed in the draft amendment of EN 62552-1:2014⁶, and we would like this wording to be included also in the upcoming legislation as clarification.

⁶ prEN 62552-1:2014-A1, Annex A, A3.2.3. "for thermoelectric and absorption appliances the energy consumption test is to be done at 25 °C"

Regarding the new design temperature for refrigerators, 4 °C, we need more time to evaluate how this impact our products. The effect on absorption and thermoelectric products, with a considerable lower cooling capacity, might not be comparable with how larger compressor products are affected.

For Dometic Group



Bernt Andersson
Dometic Holding AB
Hemvärnsgatan 15, 6th floor
SE-171 54 Solna, Sweden

Phone: +46 70 789 4903

E-mail: bernt.andersson@dometic.com

Annex 2

Solna, Sweden 2015-08-31

Dometic 2nd input to the stakeholder consultation on the review on the ecodesign regulation on household refrigeration

In addition to our input from 2015-06-25 we would like to give the following comments, focusing on the meeting minutes from the stakeholder meeting at July 1st 2015.

Discussion on scope

As already mentioned in our previous paper, we are principally in favour of simplifying the scope of the household legislation to cover only products used in homes. We however take note that during the stakeholder meeting some of our important product categories (hotel minibars and portable cooling boxes) were somewhat discussed, and that it appears to be an ambition of having these products covered by the new household legislation. Therefore it is important for us to share some more background information on these products. If you need any further information we would of course be happy to assist you.

Hotel Minibars

Hotel minibars are available on the market with three different cooling technologies: compressor cooling, absorption and thermoelectric. The three technologies have specific market advantages and must consequently exist in parallel. Dometic is providing all type of minibars. The ambient conditions during operation is rather well defined between 20 and 25 °C, and normally the products run with 6-9 °C internal temperature as this is the preferred beverage temperature. It is normally not required to reach fridge temperature. Some minibars are provided with transparent (partly or fully) doors. This is an important market feature, but also a way to save energy by avoiding unnecessary door openings. It is important that the legislation takes this aspect into consideration in a similar way as proposed for the wine products

The products are normally tested using the household standards. For energy measurement the design temperature of 12 °C is used (cellar compartment)⁷. Some products, mainly thermoelectric ones, will have significant difficulty to reach 12 °C internal temperature at 32 °C ambient.

It is not at all clear if hotel minibars are covered by the existing legislation for ecodesign and energy labelling. We have a legal verdict from a German court⁸ that hotel minibars are not covered by the ecodesign requirements or the energy labelling requirements for household refrigeration. On the

⁷ We have for long argued that a separate product category for hotel minibars would be preferable. The design temperature could then be set more close to the actual running condition, low cost versions with fixed thermostat setting can be made for the intended temperature and it would also be possible to handle transparent doors. We will continue arguing this towards the standard committees.

⁸ Landgericht Düsseldorf, 37 O 58/13, 20th February 2014.

other hand, the Commission FAQ consider them to be covered. In general products on the market are not labelled.

As we have highlighted in our previous paper, we would prefer hotel minibars to be covered by legislations for commercial refrigeration. If this could not be obtained, inclusion in the household legislation would be a second best option but would require;

- a) that hotel minibars are clearly included in the scope leaving no room for potential loop holes. The existing wording is not clear as been proven by reality.
- b) that a suitable definition of minibars is used in legislation. We would of course be happy to contribute to this.
- c) that the design temperature is defined on the energy label (+12 °C or as a separate category with e.g. 8 °C). This would eliminate the risk of using the pantry category to get a more favourable energy index.
- d) that products with absorption technology or thermoelectric technology would continue to be tested for energy consumption in 25 °C only (as indicated in prEN 62552-1:2014-A1). See also our specific comment on this below.
- e) that products with transparent door would not be disqualified by the legislation.

Portable cooling boxes

Similar to the minibars, cooling boxes are available with different cooling technology depending on the customer needs. The boxes are characterized by their limited volume and are therefore difficult to make energy effective (e.g. by increasing the insulation). There is a wide range of products in the market offering storage in different temperatures, from freezer temperatures up to 12 °C or even warmer. Thermoelectric boxes could also have the option of running at warm temperatures by reversing the polarity.

Many of our cooling boxes are designed for specific vehicles, e.g. with specific dimensions and fixation devices to fit between the seats of a car. These boxes are considered not falling under the scope of the ecodesign and energy labelling legislations. Portable electrical cooling boxes for the retail market are however within the scope of the legislation if not sold without a separate power supply. The exclusion of boxes sold without power supply is, as we see it, introducing an unnecessary loop hole and could be removed. Boxes sold without power supply are often specifically designed for vehicles and are anyhow excluded.

As the cooling boxes are designed for different internal temperatures it is difficult to compare energy performance between boxes. Unfortunately we often see competitors taking advantage of the pantry category (design temperature 17 °C) to achieve a better energy index. This loop hole could be eliminated by indicating the design temperature (or product category) on the energy label as we have suggested before.

Discussion on how to measure

Regarding the energy measurements of absorption and thermoelectric products we would again like to emphasize that some products with absorption cooling system or thermoelectric cooling could not reach the design temperature in 32 °C. This applies primary for some thermoelectric cooling boxes.

Consequently it would not be possible to introduce the new energy measurement method with measurement in 16 and 32 °C for these products. This issue have already been addressed during the development of the new standard. For thermoelectric and absorption products it is proposed to continue energy measurement in 25 °C ambient only⁹. This wording have been agreed among industry and we see no reason for a different approach in the legislation.

In the meeting minutes from the stakeholder meeting July 1st a different approach was suggested¹⁰ to measure cooling boxes as pantry (design temperature +17 °C) and measure in 16 and 32 °C. We are strongly against this proposal for two reasons: Primary, measuring energy in 16 °C ambient with 17 °C design temperature would obviously end up with a zero, or close to zero, energy consumption. The rated energy would then only be depending on the energy measured at 32 °C. Secondly, we believe it would be opening the Pandoras box to allow energy measurement in pantry condition when the actual temperature at normal operation is significantly lower. As we explained before, we see already now competitors taking advantage of the pantry category to achieve a better energy index for products designed for lower temperature. This hampers a fair competition and goes against the intention of the energy legislation.

If you have any further questions do not hesitate to take contact

Bernt Andersson

Dometic Product Compliance

bernt.andersson@dometic.com

Phone: +46 70 7894903

⁹ prEN 62552-1:2014-A1, Annex A, A3.2.3. "for thermoelectric and absorption appliances the energy consumption test is to be done at 25 °C"

¹⁰ Minutes of the 1st Stakeholder meeting Ecodesign & Labelling Review household refrigeration appliances, page 5, 1st section.