Re/genT Note[1]: 18103 / CE27 / V3	Technical Note
Project	Ecodesign & Labelling Review Household Refrigeration, review study
Subject	Estimate of manufacturer workload related to the introduction of a new energy label, efficiency and performance test standard.
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To	CECED WG Cold

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1. Introduction

1.1. Document revision history

Release date	*Author*	*Version*	*Remark / document change*
8/1/2018	MJ	V1	First version for internal WG Cold discussion
19/1/2018	MJ	V2	After comments received during WG Cold Phone Conf 18+19/1/2018.
22/1/2018	MJ	V3	Comments received and integrated. Confidentiality removed.

1.2. General

The EU commission, DG Energy, has presented a working document on energy label (EL) and eco-design (ED) for cold appliances on 13/11/2017. This has been discussed in a consultation forum on 6/12/2017.

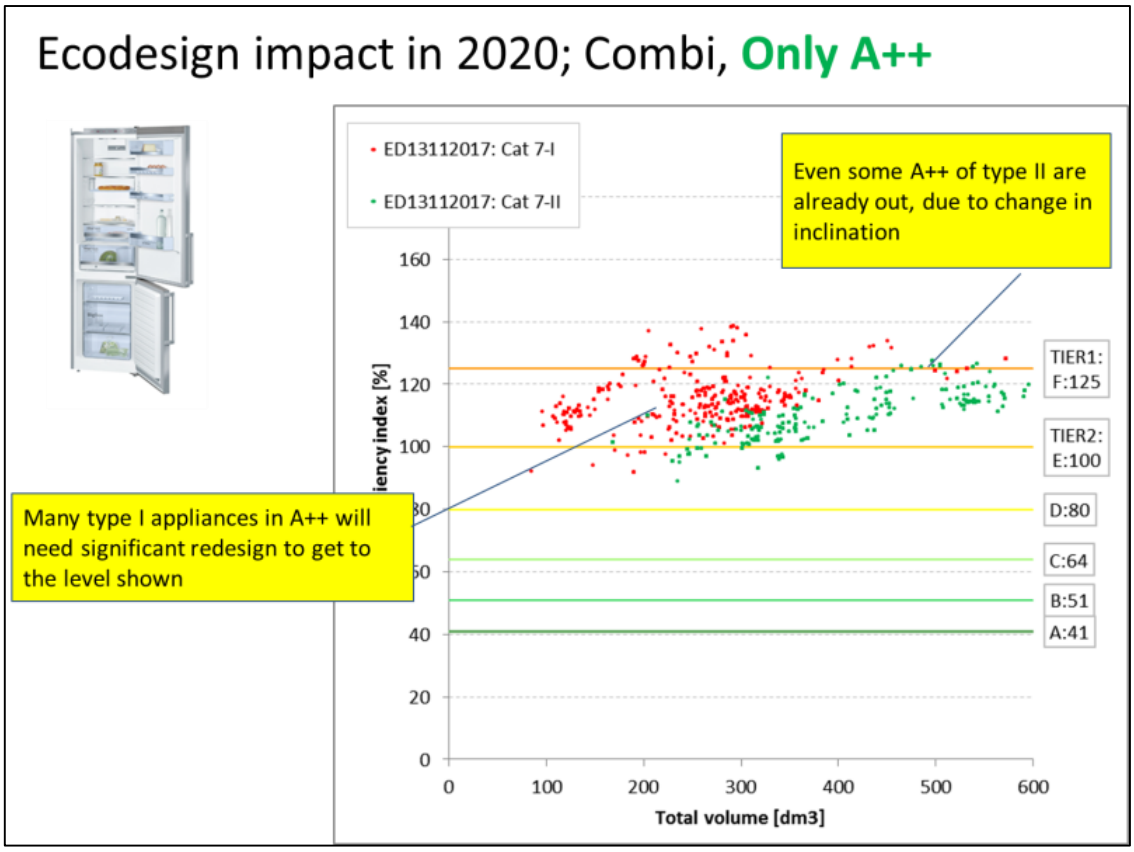
[1] *The last digits refer to the version number of this note*

The commission has proposed a TIER1 at 125 (1 April 2020) and TIER2 at 100 (1 April 2023). CECED has commented that these proposed new TIERs have a too strict timeline and has proposed a time shift to these two TIERs and a TIER0 upfront (140 at 1 April 2020).
CECED has mentioned that setting a new TIER is now entirely different than removing an efficiency class as has been done in the past. This is due to the simultaneous introduction of:

1. a new eco-design
2. a new energy label
3. a new calculation metrics
4. a new test standard

Obviously, introducing all these aspects simultaneously is essential and also desired by industry. It does however require a very high effort from manufacturers as 100% of the existing products are affected. Minimally a retest is needed, but in very many cases also product adaptations.

As an illustration of the complexity, the next figure shows combi appliances today rated as A++. This shows that even A++ appliances are already affected by TIER1. It must also be noted that all the diagrams and database analysis presented by the commission consultant and by CECED are based on an estimation of the impact of the change to the new standard. This estimation is based on an average value for each category of products; for each individual product the impact can be very different. In addition, for combi type I appliances, the estimations have been based not on typical type I designs but on improved ones. This means that already an improvement is needed to reach the values used in the presentations. This is by design of the new standard and it is known as one of its larger benefits, however this effect has not been valued properly yet. In praxis this means that even for many of the current A++ combi appliances presented below TIER1, not only a retest is required, but also a redesign in order to stay below TIER1.



In this study only the workload on the climate room capacity is considered. Of course, an increased workload on development teams raises also concern with respect to human resources, but climate room availability will also certainly be a limiting factor.

The workload estimation concentrates on the tests required to relabel products and perform those redesigns required to meet the new eco-design criteria. This workload is incremental to the daily business. Of course, due to the revision of the energy label, there will also be a pull effect and manufacturers will not only develop to meet eco-design limits but will also attempt to produce the best energy labelled products. However, this workload is excluded from the analysis as this cannot be seen as incremental.

The workload estimation concentrates on the effort involved for achieving TIER1 as proposed by the commission, as this is the most urgent and time critical phase.

2. Time line

The ED and EL working documents presume the following dates:

a) Entry into force, 20th day following publication in the official Journal of the European Union. (Presumable 1 April 2019)
b) Implementation date, 1 April 2020 (TIER1 and EL, labels have to be in place 4 months earlier, so as of 1 December 2019).
c) TIER2, 1 April 2023

This study follows this estimated time line. This means that formally industry has only 8 months for conversion (from 1 April 2019 for official publication to 1 December 2019 where new labels have to be in place for those appliances which continue to be produced after 1/ April 2020).

As it can be expected that the contents of the final regulation will be clear prior to 1 April 2019, this study contains 3 scenarios:

S8: 8 months (as of publication date 1 April 2019)
S11: 11 months (as of 1 January 2019)
S14: 14 months (as of 1 October 2018)

3. Data base analysis

For studying the workload involved, the CECED model database of 2016 has been used. This data base contains 13528 entries split over 10 different categories.

For the analysis, data has been split over 5 groups:

a) *Refrigerator*: Category 1 and 3, these can be fresh food only models or can include a chill, a wine or cellar compartment, effectively also forming a combi (this was the case for 286 models out of app. 1946 models).
b) *Combi (refrigerator-freezers):* Category 7 for combi's. In principle also category 10 is of interest, but the data base has only a small amount of such models registered (184 compared to almost 10000 models in category 7) so these models have not been considered. This category is split in type I appliances (having a single control) and type II appliances (having a separate control of frozen and fresh food compartment). Between these two types, the impact of the new standard is very different.
c) *Freezer:* This category is split into category 8, upright freezers (cat 8) and chest freezers (cat 9) as the proposed TIER1 and TIER2 work out differently for the existing products.

Wine storage appliances and some other appliances were eliminated from the study leading to in total 13129 products.

Presuming a TIER1 level of 125 the following table gives an overview of the models eliminated[2]:

		Actual situation		With MEPS = 125			
	Total models	Average EEI	Average Consumption [kWh/y]	Models < Limit	Average EEI of Models < Limit	Models > limit	Percentage Models > limit
Cat 1, 3	1946	122.2	136.7	1207	108.2	739	38.0%
Cat 7 type I	5516	125.0	259.7	2685	108.2	2831	51.3%
Cat 7 type II	4347	108.3	276.5	3171	96.1	1176	27.1%
Cat 8	975	118.9	245.4	541	105.1	434	44.5%
Cat9	345	106.8	211.0	298	103.5	47	13.6%
Average total	**13129**	**118.1**	**244.7**	**7902**	**103.0**	**5227**	**39.8%**

For more details behind this calculation and the estimated energy consumption according the new test standard, please see note 17420/CE25/V5 "EU commission proposal for cold appliance efficiency limits and efficiency classes of 13/11/2017".

Looking at this table one could simply conclude that 40 % of the models above the limit would not have to be addressed by the manufacturers as these would have to be eliminated from the market, leaving app. 60 % of 13129 models to be studied,

[2] *For more details behind this calculation and the estimated energy consumption according the new test standard, please see note 17420/CE25/V5 "EU commission proposal for cold appliance efficiency limits and efficiency classes of 13/11/2017".*

making a total of close to 8000 appliance. For this 60 % only a few tests would be needed in order to relabel these. However, this is very far from reality due to the following factors:

a) The data base contains a lot of equivalent models which are generally treated as one group during the development[3]. Therefore the database must be filtered to show only unique products, which highly reduces the number of models to investigate.

b) Models ending theoretically just above the limit will also be interesting to evaluate as the individual model may perform better than expected, or because the modifications in order to achieve TIER1 may me reasonable. A further driving factor is that an average elimination of 40 % of the models is so large, that this would lead to a too limited range of designs available in the market. Therefore evaluating models theoretically above TIER1, cannot be avoided by manufacturers, despite that such model could only be made available up to TIER2. In this study it is assumed that all models less than 10 % above TIER1 will be subject to investigation.

c) Individual products can have quite a different impact. This is for a large part due to the new test standard, but also to the change in metrics (e.g. built-in and frost free factors change, elimination of climate class). This means that products ending below TIER1 according the estimation, may well end up above.

The next table gives the amount of models to be assessed in each group as an average for industry. Note that the figures may differ substantially between manufacturers, depending on the product range produced, efficiency level, etc.

	Total models in the database	Total unique models	Ratio models versus unique models	Percentage of models > limit+10%	Total products to assess
Cat 1, 3	1946	263	7.4	35.0%	171
Cat 7 type I	5516	735	7.5	30.5%	510
Cat 7 type II	4347	548	7.9	15.9%	461
Cat 8	975	213	4.6	16.5%	178
Cat9	345	96	3.6	0.0%	96
Total	**13129**	**1855**	**7.1**	**24.5%**	**1416**

[3] *It is well known that manufacturers have models in the data base which are equivalent in terms of performance but may differ in other properties such as colour, finishing etc. Equivalent models are defined as having:*
a) The same compartment types and volumes
b) The same climate class
c) The same defrost system
d) The same characteristic of use: built-in or free standing
e) The same rated energy consumption

So in total 1416 models would need to be evaluated.

4. Typical test time required

To estimate the total workload for climate room testing, a typical test time has been established. It must be realised that this is just an average figure. The test time assumes that:

a) Energy consumption testing is needed, always at two ambient temperatures, some products will need only two tests with different thermostat positions (at each ambient), others may need more than 4.
b) Storage temperature testing is needed, as due to other loading schemes, it is not guaranteed any more that temperatures are maintained at maximum and minimum ambient temperature according the climate class. For empty products this will go rather fast, for freezers with load it takes relative long for taking the load to the correct temperature.
c) Freezing capacity is needed due to the change is test procedure and rating.
d) Temperature rise test is required according the product information sheet
e) 1 day is presumed for preparation and placing of the sample in the test room, loading and unloading related to storage and freezing tests and disassembling at the end of the test.

The table below gives an estimate of the test time required for testing a single sample. The test time is only defined as the time needed inside a climate room in order to establish the tests according IEC62552-1,-2 and -3:2015.

	Days inside test room					
	Sample handling (set up, loading, removal, etc.)	Energy consumption test (2 ambients)	Storage temperatures	Freezing capacity	Rising time	Total test days (per sample)
Cat 1, 3	1	8	3	0	0	12
Cat 7 type I	1	12	5	4	1	23
Cat 7 type II	1	10	5	4	1	21
Cat 8	1	6	6	5	1	19
Cat9	1	6	6	5	1	19

5. Activity per model to be assessed

The number of activities to be performed per model will be very different, ranging from a simple retest to a full redevelopment trajectory. It should be noted that not only the eco-design limits drive the redesign but also other changes in eco-design criteria, some examples:

- Change in gaskets.
- Limitations of electromechanical control in relation to winter switches and freezing modes.
- Additional criteria for chill compartments

Additionally the new standard drives redesigns, a few examples only:

- Already noted are the adaptations needed for combi type I (adjustments of heaters and controls, redesign evaporator balance between compartment)
- Freezing capacity testing protocol adjustment

To simplify this study, only 3 types of activities are defined (n is the number of test series[4]):

a) Only retest and relabel. Here it is presumed that three samples are always verified (n=3) as this this is the minimum number of samples manufacturers would use for performance verification as it is specified in the regulation. This activity will typically be done only for the most efficient appliances.

b) Retest followed by small redesign (e.g. compressor change), followed by release test. Here it is assumed that the retest is done on one sample first, followed by a release test on 3 samples (n=4).

c) Retest followed by significant redesign (e.g. compressor change plus heat exchanger change, requires refrigerant charge optimisation, etc.) Requires intermediate test plus final release testing. Here it is assumed that the retest is done on one sample, the intermediate tests are done three times on two samples and the final release test on 3 samples (n=10). Note that this is a gross simplification. In reality, one may study one sample quite long and very detailed and one may not repeat all tests on all samples.

[4] *n=3 can be read as 3 samples with 1 test series on each sample or read as 3 test series on one sample (each time varying an aspect, e.g. compressor).*

6. Total test room workload estimation

In the next table a distribution of the activities is made per category of product. For each category it is estimated which fraction of products require only a simple retest (activity A), limited change (activity B) and a full redesign of the refrigeration system (activity C).

Some examples:

a) for Cat7, type I practically all products require significant redesign due to the new test standard. Only for very efficient products activity A will be sufficient
b) For Cat9, the chest freezers, for most products only a test and relabel is needed for TIER1 as the new metrics works out advantageous for this group compared to upright freezers[5] (to date the current metrics in fact disadvantages chest freezers, setting tougher limits at equal volumes)
c)

	Total models	Activity A (n=3)	Activity B (n=4)	Activity C (n=10)	Total test days
Cat 1, 3	171	40%	30%	30%	11081
Cat 7 type I	510	10%	40%	50%	80937
Cat 7 type II	461	40%	30%	30%	52277
Cat 8	178	50%	30%	20%	15895
Cat9	96	80%	20%	0%	5837
Totals	**1416**	**470**	**466**	**480**	**166027**

In principle these figures apply to the manufacturers organised within CECED (as the data base is derived from the data of these manufacturers). To understand the impact on the current test room capacity it has been estimated that the CECED manufacturers have in total 500 test places available for developing, testing and releasing products in terms of energy efficiency for the EU market. Note that this is not the complete reserve of test places by manufacturers, as a number of activities require test facilities which need to continue, this includes (but is not limited to):

a) Product development for non-EU market
b) Quality testing[6]
c) Product development for non-energy related topics, such as product features and product cost reduction.

If it is further assumed that each climate room is in operation 24 days per month[7], then the total workload amounts to app 14 months.

[5] *The current metrics disadvantages chest freezers, it sets lower limits at equal volumes compared to upright freezers.*
[6] *This includes the periodic testing of products by sampling these from the production line*
[7] *This equates to a high test room availability of 79 % (all year around). The remaining 21% relates to weekend days (only Sundays), holidays, calibrations, etc.*

Total test days	166027
Amount of test positions available for relabelling, redesigns in relation to energy	500
Lab days / month	24
Workload (months)	13.8

This would have the following impact depending on the scenario:

S8	Workload is 173 % of available capacity
S11	Workload is 126 % of available capacity
S14	Workload is 100 % of available capacity

This would mean that even if the full conversion project would be started half a year before the official release of the regulation (S14), the test room capacity would still be just sufficient.

7. Calculations using the CECED proposed TIER0 (140)

CECED has proposed a TIER0 (at index 140) upfront of the commission proposed TIER1=125 value. The calculations presented in the previous chapters have been repeated using this scenario.

		Actual situation		With MEPS = 140			
	Total models	Average EEI	Average Consumption [kWh/y]	Models < Limit	Average EEI of Models < Limit	Models > limit	Percentage Models > limit
Cat 1, 2, 3	1946	122.2	136.7	1270	109.2	676	34.7%
Cat 7 type I	5516	125.0	259.7	4088	116.5	1428	25.9%
Cat 7 type II	4347	108.3	276.5	3775	102.1	572	13.2%
Cat 8	975	118.9	245.4	858	115.7	117	12.0%
Cat9	345	106.8	211.0	345	106.8	0	0.0%
Average total	**13129**	**118.1**	**244.7**	**10336**	**110.0**	**2793**	**21.3%**

In this scenario, 21.3 % of the models will be above the limit.

To estimate the amount of models to be evaluated the following is assumed:

a) The number of products is reduced by searching for the equivalent products (same figures as in chapter 3).
b) It is estimated that no products estimated to be above the limit will be included in the investigation. This results in the following table:

	Total models in the database	Total unique models	Ratio models versus unique models	Percentage of models > limit	Total products to assess
Cat 1, 3	1946	263	7.4	34.7%	172
Cat 7 type I	5516	735	7.5	25.9%	545
Cat 7 type II	4347	548	7.9	13.2%	476
Cat 8	975	213	4.6	12.0%	187
Cat9	345	96	3.6	0.0%	96
Total	**13129**	**1855**	**7.1**	**24.5%**	**1476**

As there are fewer products eliminated, the total amount of products to deal with has increased compared to the previous case (from 1416 to 1476).

The distribution of activities needed to meet the eco-design limits changes significantly. There will be more products which will meet the limit, so less need for complete redesigns. Further for those products close or just above the limit, it is suspected that the simpler redesign (activity B) is sufficient.

	Total models	Activity A (n=3)	Activity B (n=4)	Activity C (n=10)	Total test days
Cat 1, 3	172	70%	30%	0%	6797
Cat 7 type I	545	60%	30%	10%	50114
Cat 7 type II	476	70%	20%	10%	38976
Cat 8	187	80%	20%	0%	11396
Cat9	96	90%	10%	0%	5654
Totals	**1476**	**977**	**342**	**97**	**112937**

With this amount of test days and following the same estimates for availability of test rooms as before, a workload of 9.4 months results. Following the three time scenario's next table results:

S8	Workload is 118 % of available capacity
S11	Workload is 86 % of available capacity
S14	Workload is 67 % of available capacity

8. Conclusions

A workload estimate related to the introduction of a new energy label, new eco-design and a new test standard has been made looking at test room requirements only. In its most strict form this would mean that during the implementation time frame from official publication to products needed to be labelled on the market (8 months) the current test room capacity is far from sufficient. App. 75 % more capacity would be needed.

If conversion is started earlier this becomes slightly more relaxed but still results in an overload on the test capacity, which, given the current time schedule, cannot be increased significantly.

With an initial TIER0 at an index of 140 as proposed by CECED, the conversion process would be much less disruptive as also the time just after 1 December 2019 (date that labels have to be present) could be used for energy improvements of the products. The load on test room capacity before TIER0 would still be very high (for the most tight time scenario of 8 months, still 18 % more capacity is needed than available), but the pressure is significantly less as a much higher share of the current models would only require a retesting action.

It needs to be mentioning that this study only attempts to give a best estimate of the real workload. There are many factors not taken into account, such as:

a) During the time frame between the data used for the study (2016 data) and the implementation date (2020) a gradual improvement of models would have taken place, also in the absence of new TIERs.
b) Products which will be redesigned to meet the eco-design criteria will have to be tested also with the current standard, this is due to the double labelling requirement. Especially with the TIER1 level at 125 this adds quite a significant extra load.
c) Redesign of products will also lead to additional testing requirements related to other factors than energy, e.g. durability, but in particular also safety.
d) The pull effect of the new label compared to the existing one will be quite significant.
e) The updated eco-design does not pose only new energy limits, but also includes new and/or changed other product requirements.

This study only presents the incremental workload on test rooms. There are obviously also other factors limiting the conversion process which needs to be considered, such as:

a) Human resources
b) Capital investments. Though the higher efficient products meeting TIER1 are already produced today, production increase on such lines does mean significant investments also requiring time to implement.