European Commission

Preparatory study for Kettles implementing the Ecodesign Working Plan 2016-2019

Task 7: Policies and scenarios (draft)

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ABOUT THIS DOCUMENT

23.12.2020 - Draft: Task 7 draft for stakeholder consultation based on a consultation document with data and assumptions presented and commented by stakeholders (THIS DOCUMENT)

Please be aware that this draft consultation document is only published for receiving stakeholder comments to the Ecodesign Process. It may still undergo substantial revisions prior to being released as a final report of this study.

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LIST OF ABBREVIATIONS AND ACRONYMS

BAT	Best Available Technology
BAU	Business-as-Usual
BoM	Bill of Materials
DO	Design Option
EC	European Commission
EEI	Energy Efficiency Index
EU	European Union
GHG	Greenhouse Gases
IEC	International Electrotechnical Commission
LLCC	Least Life Cycle Cost
MEErP	Methodology for Ecodesign of Energy-related Products
MEPS	Minimum Energy Performance Standards
PCR	Post-Consumer Recycled Materials
R_{cyc}	Recyclability rate
R_{post}	Post-consumer materials content
UK	United Kingdom

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7. TASK 7 – POLICIES AND SCENARIOS

The purpose of this task is to provide an understanding of the impacts of future scenarios in line with policy measures that could be introduced at EU-level. This is a key task as it requires the combination of the results of all previous tasks. Its purpose is to derive estimates of the impacts of different Ecodesign policy measures and design options. Thereby, it is aimed at providing an analytical basis in support of the Ecodesign decision-making process. It contains a set of quantitative scenarios for the market penetration levels of various kettle technologies and the consequences for the environment, users and industry. To this end, a stock model has been developed to estimate future sales and stocks of kettles under different policy scenarios. The outcomes are then compared with the Business-as-Usual situation.

> Please note that the conclusions drawn here are preliminary and solely represent the view of the consortium. They do not necessarily reflect the opinion of the European Commission. Tasks 1 to 6 provide the baseline data for future work conducted by the European Commission (impact assessment, further discussions in the Consultation Forum and the development of implementing measures, if any). Unlike the previous tasks, Task 7 serves to provide a summary of policy implications as seen by the consortium. Furthermore, elements of this task may be analyzed further in greater depth during the impact assessment.

SUMMARY OF TASK 7
Will be provided later

7.1. Analysis of policies

Based on the review of the existing policies and standards (see Task 1), the feedback of the stakeholders and the cost-optimized technical improvement potential of the technologies (see Task 6), this task identifies and discusses policy options aimed at fostering the energy efficiency of kettles and reducing their impacts on the environment.

The following policy options are discussed later:

- minimum energy performance standards (MEPS)
- policy actions related to requirements regarding keep-warm
- energy labelling
- information requirements on the performance of the kettles
- policy actions related to behaviour
- policy actions related to circular economy
- policy actions related to materials

Furthermore, this task will include aspects related to measurements.

7.1.1. Scoping of possible policy requirements and key definitions

Objective:

This section describes the prospective boundaries and "electric water kettle" definitions to address the Ecodesign performance improvement from this study. The proposed policy measures themselves and potential legislative instruments to be used are discussed in subsequent sections.

In line with Task 1 and the work carried out during the study, the following product definition is suggested for the scope of this analysis of policies and scenarios:

> *"Electric kettles" are stand-alone, unpressurized, electrically powered kitchen appliances primarily intended for boiling a batch of up to 10 litres of drinking water, potentially also including the possibility to heat water below boiling temperature and/or a warm-keeping function after heating.*

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7.1.2. Proposed requirements to consider in policy measures

7.1.2.1. Specific ecodesign requirements

Based on the work carried out in Task 4 (Technologies) and Task 6 (Design Options), there is room for improving the energy efficiency of kettles for the boiling phase and for the keeping-warm phase (for kettles with this feature).

7.1.2.1.1. Specific energy efficiency requirement for boiling

Minimum energy performance standards (MEPS) is the main policy option to transform the appliance market towards higher energy efficiency. A precondition for establishing and implementing MEPS is the availability of test procedure.

Test procedure

A main challenge for electric water kettles is the lack of test standards. Task 1 reviewed existing regulations and voluntary labels around the world. Based on this review, Table 7-1 provides an overview of the related test conditions and energy efficiency metrics applied for kettles.

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Table 7-1: Overview of the test procedures and energy efficiency metrics related to electric kettles (source: Fraunhofer ISI)

Name / Reference	Country	Volume [l]	Start temperature of the water [°C]	End temperature of the water [°C]	Energy efficiency metric	Detail
IEC 60530:1975		1	15	95	None (focus on boiling time)	
Blue Angel / RAL-UZ 133[1]	Germany	1	20	100 (switch off)	Specific energy consumption [kWh/l] W20 = WM * 80 / TM	• WM: power consumption until automatic switch-off of the kettle • Temperature difference compared to the boiling temperature of 100°C
TopTen[2]	Switzerland	1	15	100 (switch off)	Yearly energy consumption [kWh/a] $E_{kettle} = E_{boil} + E_{keep\ warm} + E_{stand\text{-}by}$	• E_{boil} = 365 * $E_{consumption}$ to heat 1 litre if T-setting feature is available: -10% • $E_{keep\ warm} = P_{keep\ warm}$ x 0.5 x (max time keep-warm) x 365 if no measurement possible: 15 W x 1h x 365 • $E_{stand\text{-}by}$: $P_{stand\text{-}by}$ x 8760 h
ESR003	UK				not specified	
Eco-Label Standard[3] (EL408:2013)	South Korea	1	15	99	Specific energy consumption [kWh/l]	
GB/T 22089-2008	China	Rated volume	20[4]	80	$\eta = \frac{C*M*(80-T1)}{E}*100\%$	T1: start temperature
Greenmark N126[5]	Taiwan	1	15	99	Specific energy consumption [kWh/l]	
Energy Efficiency Label[6]	Thailand		30	90	η=ϱ*(90-30)/(0,24 P*t)*100	
ISIRI 7875[7]	Iran	1	20	90	Specific energy consumption [kWh/l]	
Manufacturer			20	98	Efficiency: η = Q / Energy Consumption	With: Q=(98-20)x4186xVolume

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1 https://www.blauer-engel.de/en/products/electric-devices/water-boilers-electric-kettles

2 https://storage.topten.ch/source/files/Technische-Kriterien-Wasserkocher-2017.pdf

3 http://el.keiti.re.kr/enservice/enpage.do?mMenu=2&sMenu=1

4 not clearly specified, but the thermal efficiency test requires to "make the initial water temperature as consistent with the ambient temperature as possible", ambient temperature is 20 +/- 5 °C.

5 http://greenliving.epa.gov.tw/GreenLife/uploadfiles/Criteria/126/7ab784a7-239c-4e83-86c5-ca7331a47b72.pdf

6 http://labelno5.egat.co.th/new58/wp-content/uploads/2016/form/mn/ele_kettle.pdf

7 http://www.behsa.ir/index.php/booklibrary/standards/20-isiri-7875/file

Key findings:

- most of the regulations focus on boiling water and are based on the specific energy consumption to heat 1 litre of water, but the scope of the regulations was rather small kettles (volume < 2.5 litres)
- most of the standards assume that the kettles are tested with a volume of 1 litre. Therefore, they cannot deal with kettles with less than 1 litre of capacity, although such kettles are theoretically within the scope of the standards
- the definition of "boiling water" is not harmonized
- only in few cases (China, Thailand or manufacturers) energy efficiency is considered and it is defined as ratio between the measured energy and the theoretical energy to warm up water
- only the TopTen approach takes the "keep warm performance" into account

To regulate the energy efficiency of kettles, an appropriate methodology to assess the energy consumption and/or the energy efficiency has to be elaborated.

Test procedure for electric kettles

A test procedure could be elaborated based on the experience from IEC 60530:1975 to assess the energy efficiency of kettles, for which the Technical Committee TC 59[8] "Performance of household and similar electrical appliances" and especially SC 59L "Performance measurement of small household appliances and similar electrical appliances except for surface cleaning appliances" are responsible.

According to IEC 60530-1975, "the time to boil 1 l of water is the time taken to raise the temperature of the water 80°C above its initial value" (which is 15°C). While this temperature level is used for determining boiling time, the standard does not take into account the real duration until the kettle will stop heating water. Therefore, it does not reflect the real use situation: neither the real energy consumption nor the real boiling time. Compared to IEC 60530:1975, the following changes are suggested:

1. The test procedure should describe how to measure energy consumption (in addition to the boiling time).
2. The values should be based on heating water from 15°C until shut off with the requirement to increase temperature by at least 80°C, i.e. attaining at least 95°C.

While the elaboration and the adoption of a test procedure from scratch usually takes a long time, drafting a test procedure for kettles is relatively straightforward. At the end of this report, "Annex A – Test procedure for electric kettles" provides the main elements of the suggested test procedure.

A rationale behind suggesting the proposed test procedure is to minimize over-heating. **Over-heating** is defined here as heating water too long or at an excessive temperature, which leads to a waste of energy and thus lower environmental performance[9]. As long as there is no requirements regarding the energy consumption of kettles and no information to be provided on the boiling time, manufacturers might have a tendency to design and produce over-heating kettles. However:

- IEC 60530:1975 implicitly defines boiling temperature as 95°C, since the "boiling time" is defined as the time required to heat up 1 litre of cold water (15 °C) by 80°C (see Task 1).

[8] https://www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID,FSP_LANG_ID:1275,25

[9] not to be confused with "over-boiling", which is defined as boiling too much water

- water kettles are used to prepare beverages, whose temperature do not exceed 95°C. Solely the preparation of distilled water[10] requires boiling water.[11]
- limescale is formed during the transition phase from water to steam. Avoiding over-heating contributes to addressing the limescale issue (see also 7.1.2.5)

Thus, the proposed test procedure used for an Ecodesign regulation is expected to give an incentive to avoid or at least reduce overheating.

Table 7-2 provides an overview of the regulations and voluntary standards identified in Task 1. The specific energy consumptions to heat 1 litre of water was estimated for a temperature increase of 80°C.

Furthermore, it is suggested to assess the energy efficiency (Energy Efficiency Index) as a ratio of the heat - theoretically needed to bring a certain amount of water to the target temperature - and the electricity consumed to heat the same amount of water under the same real conditions (when the kettle shuts off). EEI is defined as follows:

$$EEI = Q / E_{Tboil}$$

With:

$$Q = Cp \cdot M_{rated} \cdot (T_{boil} - 15)/3{,}600 \text{ [Wh]}$$

Cp = 4,186 J/kg/K as specific heat capacity of water at 15°C and 101 kPa

M_{rated}: rated water capacity of the kettle [kg]

T_{boil}: boiling temperature [°C]. In the context of this test procedure, T_{boil} corresponds to a water temperature of 95°C, at ambient pressure.

E_{Tboil}: electricity consumed to heat the rated water capacity from 15°C to boiling temperature. <u>It is measured until the kettle shuts off</u>.

<u>Overview of regulations/voluntary schemes</u>

Few regulations and voluntary schemes for kettles have been identified in Task 1. Table 7-2 shows the requirements and formulates them according to the test method and the EEI suggested by the project team.

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[10] for ironing or filling an aquarium

[11] please note, that the boiling point depends on the surrounding environmental pressure: water boils at 100°C at sea level but at a lower temperature at a higher altitude (e.g. 93.4°C at 1,905 m). Accordingly, the boiling temperature is usually lower than 100°C.

Table 7-2: Requirements for identified regulations, indicated for 80°C temperature increase (Fraunhofer ISI)

Name	Country	Temperature increase [°C]	Specific energy consumption [Wh/l] to heat 1 litre of water	Specific energy consumption[12] [Wh/l] to heat 1 litre of water	EEI[13] [%]
		a	b	c	d
		Conditions of the specific test procedure		*Calculated for 80°C increase*	
Blue Angel / RAL-UZ 133	Germany	80	115	115	81%
TopTen	Switzerland	85	123[14]	116	80%
GB/T 22089-2008	China	60	-	116	80%
Eco-Label Standard	South Korea	84	120	114	81%
Greenmark N126	Taiwan	84	117	111	83%
ISIRI 7875	Iran	70	125	143	65%

While the ISIRI 7875 standard (Iran) sets a rather low performance requirement, the five other standards listed in Table 7-2 have more stringent boiling requirements ranging between 111 and 116 Wh/l, and 115 Wh/l on average (for 80°C increase). This corresponds to an EEI range of 83% to 80%, with an average EEI of 81%.

<u>Specific energy consumption and filling level of the container</u>

The specific energy consumption (Wh/l) decreases with the increase of the volume of water to be heated. This could be observed by analysing data collected through measurements carried out by Fraunhofer ISI and the Swedish Energy Agency (see Figure 7-1), where the measurements for each kettle were repeated for different levels of water to be heated until the kettle shuts off. One of the reasons for the higher specific consumption at lower water levels might be, that the thermal mass of the kettle – which impacts the energy efficiency of the kettle - is always constant, no matter how full the kettle is. Moreover, for kettles with a controller which is based on the steam detection, a larger volume of steam has to be generated if the kettle is only partly filled compared to a fully filled kettle. This leads to an extended shut-off time and higher electricity consumption.

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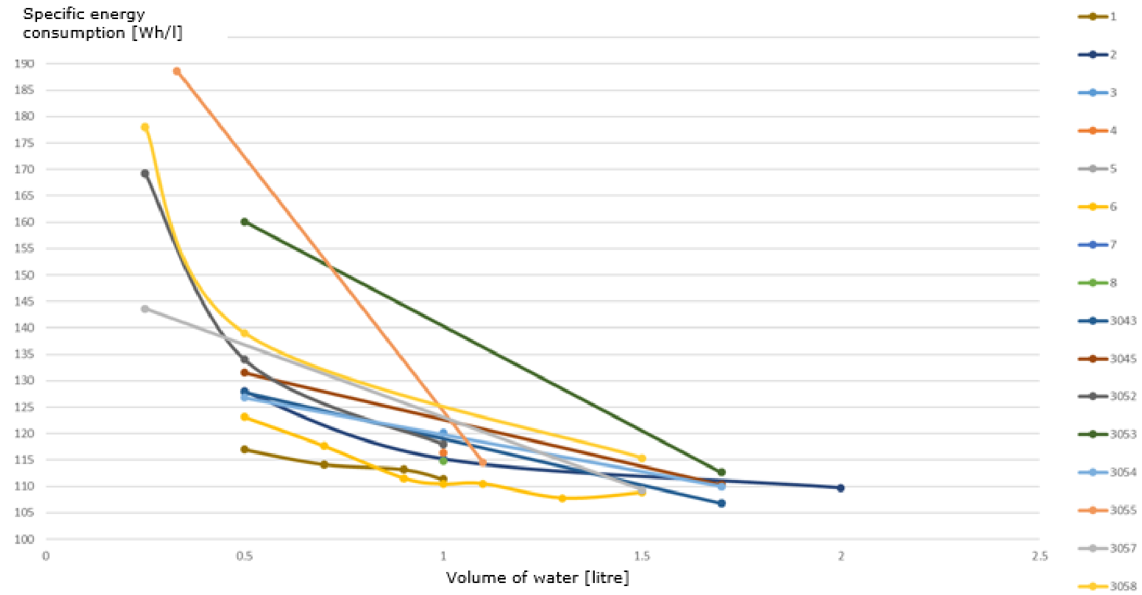
[12] where: c = b x 80 / a

[13] where: d = 4,186 x (80)/3,600) / c

[14] estimated for a basic kettle (without keep warm), with: 45 x 1,000 /365 = 123 Wh for 1 litre

Figure 7-1: Specific energy consumption at maximum temperature (shut-off) according to the volume boiled (Source: Fraunhofer ISI and Swedish Energy Agency)[15]



Many regulations focus on the energy consumption measured with 1 litre of water. However, for kettles with a rated capacity below 1 litre such a test is not applicable. Furthermore, large kettles will be filled with far more than 1 litre (up to 10 litres) and therefore 1 litre will not correspond to a realistic usage. Hence, it seems reasonable to focus on the energy consumption of kettles measured at rated capacity when defining the EEI requirement.[16]

Specific energy consumption at rated volume

Looking at the specific energy consumption of kettles, Fraunhofer ISI and Stiftung Warentest carried out tests on a sample of 26 kettles[17] in total, of which 16 were measured at rated volume.[18] The results are presented in Table 7-3. Hereby, the energy consumption of the kettle was measured until shut-off. In addition, the energy consumption for an 80°C temperature increase was measured during the same test. This allowed the calculation of the specific energy consumption for raising the water temperature by 80°C[19] and specific energy consumption until shut-off [Wh/l][20]. The energy efficiency was calculated as the ratio of the heat required to heat the water by a certain level divided by the electricity consumed. The column (F) of Table 7-3 shows the EEI of the kettles according to the proposed test procedure. The column (E) shows the EEI of the kettles, if they would have really shut off at 95°C, which is the minimum boiling temperature of the proposed test procedure.

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[15] Even if the specific energy consumption is higher for a small filling volume than for the rated volume, heating the right amount of water is always the best way to save energy.

[16] as done in the Chinese standard GB/T 22089-2008

[17] 8 for Fraunhofer ISI and 18 for Stiftung Warentest

[18] n=1 for 1.0 litre, n=5 for 1.5 litres, n=9 for 1.7 litres and n=1 for 2 litres

[19] see (A) in Table 7-3

[20] see (B) in Table 7-3

Table 7-3: Specific energy consumption and energy efficiency of kettles, measured at the rated capacity

	Size of the sample	Specific energy consumption to raise T by 80°C [Wh/l]	Specific energy consumption until shut-off [Wh/l]	Saving potential [%] 80°C increase vs. shut-off	Thermal efficiency measured at shut-off [%][21]	EEI [%] (theoretical) [22]	EEI [%] (practical)[23]
		(A)	**(B)**	**(C)**	**(D)**	**(E)**	**(F)**
1.0 l	1	107.2	111.4	-3.7%	86.8%	86.1%	83.5%
1.5 l	5	102.2	111.6	-8.3%	91.1%	88.2%	83.4%
1.7 l	9	102.3	109.5	-6.6%	91.0%	90.3%	85.0%
2.0 l	1	107.9	109.7	-1.6%	86.2%	86.8%	84.8%
Min		96.7	107.1	-17.1%	86.2%	84.7%	79.7%
Max		107.9	116.7	-1.6%	96.2%	92.3%	86.9%
Quartile 1		**101.6**	**108.7**	**-7.4%**	**89.3%**	**87.7%**	**83.6%**
Quartile 2	16	102.6	110.0	-6.5%	90.6%	89.4%	84.6%
Quartile 3		104.2	111.2	-5.2%	91.5%	90.9%	85.6%
Quartile 4		107.9	116.7	-1.6%	96.2%	92.3%	86.9%
Average		102.9	110.3	-6.6%	90.4%	89.2%	84.4%

Based on the figures in Table 7-3, the first quartile of the sample has an EEI of 87.7% (see E). This is still theoretical, since the controller of the kettles does not shut off at 95°C, leading, in practice, to higher electricity consumption. Considering this, the first quartile of the sample has a tested EEI of 83.6% (see F) and may be used as MEPS.

Due to the current situation and based on the available data (Table 7-2 and Table 7-3), it is assumed that a moderate MEPS with EEI >= 81% could be set already in 2023, giving enough time to the European Commission to go through the Ecodesign legislative process and to give manufacturers room to test their products and if necessary, adapt them to fulfil requirements on energy consumption. Based on a larger set of data,[25] the MEPS could be re-assessed 2 years later:

- they could be tightened (e.g. EEI >= 84%, based Table 7-3)
- and/or be based on a characteristic line depending on the rated volume

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[21] defined as: $Q_{shut\text{-}off}/E_{shut\text{-}off}$

[22] defined as: $Q_{95°C}/E_{95°C}$

[23] defined as: $Q_{95°C}/E_{shut\text{-}off}$

[25] currently, there is still a lack of data for kettles below 1.2 litre as well as over 2.0 litres

7.1.2.1.2. Specific requirement for keep-warm

As detailed in the previous tasks, a few measures can contribute to reducing the keep-warm energy consumption.

- **Maximum keep-warm time**

Until now, there is no limitation of the keep-warm time. Some kettles available on the market offer a time limit of 2 hours for keep-warm. Many stakeholders supported the idea of limiting the maximum keep-warm time. It is therefore suggested to **limit the keep-warm time to a maximum of 30 minutes**. Since such a requirement is easy to implement, the project team assumes that it can be implemented in the first stage of an Ecodesign regulation.

The results of Task 6 show that reducing the keep-warm time from 60 to 30 minutes would reduce the yearly energy consumption of Base Case 3 by 16.5%.[27]

- **Default setting** regarding keep warm function

Due to the considerable influence of the keep-warm function on energy demand, it should only be consciously activated by the user. In other words, the function should be off by default when a user switches on the kettle.

- **Specific energy efficiency requirements for keep-warm**

There is very little data regarding the real-world use of the keep-warm functions, partly since it is currently only available for a smaller market share. The project team carried out keep-warm and cool-down measurements on a very limited sample of four kettles with different types of container (see Figure 7-2):

- plastic (single wall)
- glass (single wall)
- stainless steel (single wall)
- plastic (insulated)

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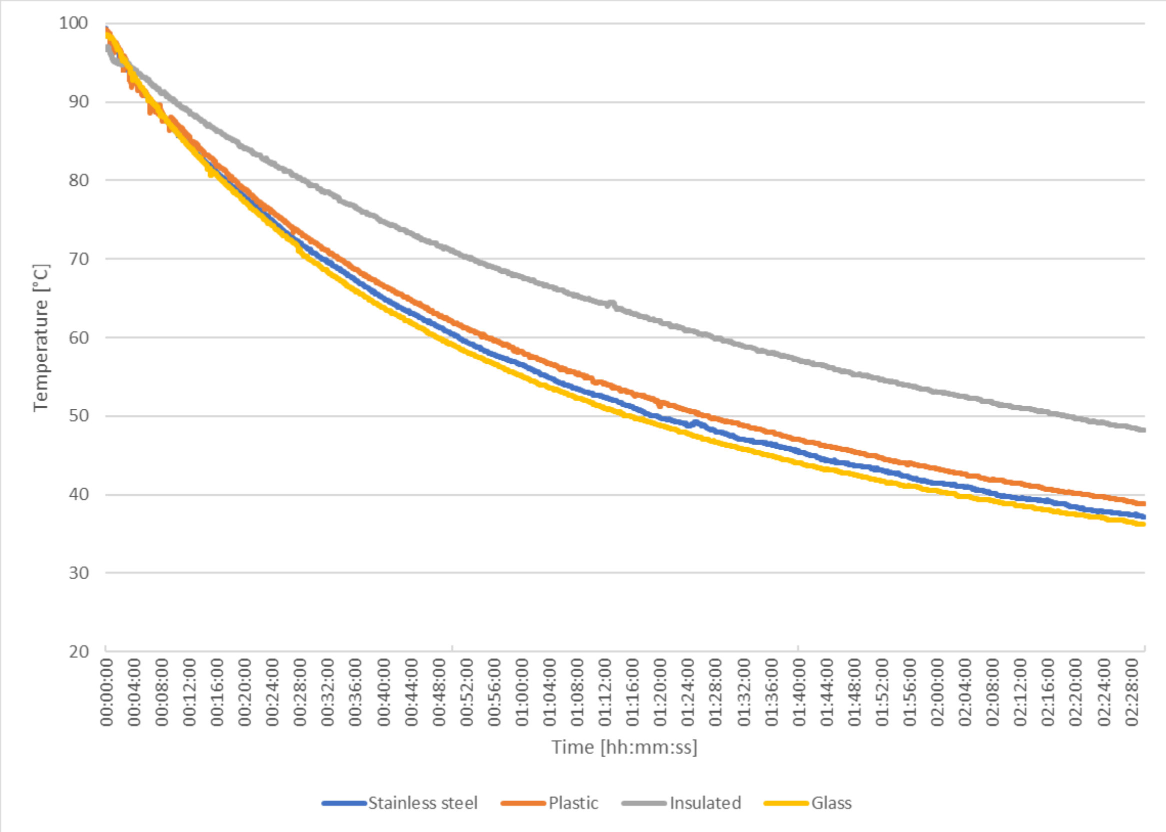
[27] See Task 5 for more detailed regarding the way to calculate the yearly energy consumption.

Figure 7-2: Cool down measurement of kettles with different containers (Source: Fraunhofer ISI, with 1 l of water heated at maximum temperature)



The tests presented in Figure 7-2 indicate that all single wall kettles had similar heat losses during the cool-down phase[28], while the insulated container had a much better performance.[29] Based on these measurements, Table 7-4 shows the temperature drop after 15, 30 and 60 min for single wall kettles and for the insulated kettle.

Table 7-4: Temperature drop during the cool-down test (Source: Fraunhofer ISI, with 1 l of water heated at maximum temperature)

Time after shut-off	Single wall[30]	Insulated	Insulated vs. single wall
15 min	-16.5 °C	-9.6 °C	-42%
30 min	-27.8 °C	-17.3 °C	-38%
60 min	-42.0 °C	-28.8 °C	-31%

Furthermore, the type of container had an important impact on the average power required to keep 1 litre of water warm. Figures in Table 7-5 show that the average keep-warm power for an

28 42°C water temperature decrease within 1 hour

29 only 29°C water temperature decrease during the first hour. However, more detailed analysis and larger sample of kettles tested would be required to quantify the impact of other factors (e.g. geometry, opening for spout...) on the cool down.

30 average of the 3 single wall kettles: 1 x glass, 1 x stainless steel and 1 x plastic

insulated kettle was roughly half of the power required for a single-wall kettle. According to Task 5, the energy required to boil 1 litre of water is typically 115 Wh.

Table 7-5: Impact of the container on the keep-warm power (Fraunhofer ISI, with 1 l of water at maximum temperature)

Kettle	Unit	Single wall[31]	Insulated
Average power [1l @ Tmax]	[W/l]	120	56

According to the figures in Task 6, insulating the container (see Design Option 4) is a cost effective measure only for Base Case 3, i.e. the base case that includes a keep-warm function. An insulated container does not have a great impact on the boiling consumption. However, for kettles without keep-warm function (Base Case 1 and 2), the Design Option 4 was not cost effective since the heat losses through the container are low during the relatively short time required to boil the water.

Consequently, it would be reasonable to require a minimum level of insulation for kettles with a keep-warm function. As the repeatability and accuracy in measuring heat transfer coefficient [W/m2/K] is challenging,[32] it is suggested to define a requirement based on the temperature drop after 30 min, e.g.: max 20°C temperature drop allowed for kettles with keep-warm function.[33]

> **Keep-warm or re-boil?**
>
> The higher the temperature difference between the water in the kettle and the ambient temperature, the greater the heat loss through the container and the kettle lid. Consequently, **keeping-warm the water at the target temperature will consume more energy than re-heating the water up to the same target temperature**, when the water will be needed. However, the keep-warm function delivers a different service than the solely boil function and might be useful, for users who need to have a certain volume of hot water ready anytime over a limited time period.

7.1.2.2. Specific requirement for "lift-off / switch-off"

The "lift-off / switch-off" function switches off a kettle when the container is lifted from the base. This function improves the safety but also can save energy, since the kettle will remain "switched off" when the container is placed back on the base. As mentioned by some stakeholders, the function is common on the EU market but still not standard. The project team suggests including this feature in the mandatory requirements.

7.1.2.3. Generic Ecodesign requirement

Currently, customers only have access to some technical data when purchasing a water kettle:

- rated capacity of the container (V_{rated})
- rated input power (P_{rated}), which shall be an indirect indicator on how fast the kettle can boil water
- availability of some features (keep warm, temperature pre-setting,...)

However, there is no information regarding the performance of a kettle thus consumers do not have the possibility to choose a product according to performance or energy efficiency criteria. In

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[31] average of the 3 single wall kettles: 1 x glass, 1 x stainless steel and 1 x plastic

[32] stakeholders' comments

[33] see "cool-down test" in the Annex A

order to improve this situation, a generic ecodesign requirement would cover the mandatory provision of the following additional technical data[35]:

- energy consumption $E_{Tboil,Vmin}$ [Wh] and time required $t_{Tboil,Vmin}$ [s] for heating the minimum volume of the container (V_{min}) by an 80°C water temperature increase – measured until the kettle shuts off;
- energy consumption $E_{Tboil,1}$ [Wh] and time required $t_{Tboil,1}$ [s] for heating 1 litre of water by an 80°C water temperature increase – measured until the kettle shuts off;
- energy consumption $E_{Tboil,Vrated}$ [Wh] and time required $t_{Tboil,Vrated}$ [s] for heating the maximum volume of the container (V_{rated}) by an 80°C water temperature increase – measured until the kettle shuts off;
- $E_{70°C,Vrated}$ [Wh] and $t_{70°C,Vrated}$ [s] for the performance at 70°C pre-set temperature (or the nearest pre-set temperature above 70°C) and V_{rated} – measured until the kettle shuts off;
- $E_{70°C,Vmin}$ [Wh] and $t_{70°C,Vmin}$ [s] for the performance at 70°C pre-set temperature (or the nearest pre-set temperature above 70°C) and V_{min} – measured until the kettle shuts off;
- information regarding a standardised energy consumption (SEC) [kWh] for heating 100 litres of water as follows:

$$SEC = \frac{100}{1000} \cdot \frac{\left(30\% \cdot E_{Tboil,Vmin} + 50\% \cdot E_{Tboil,Vrated} + 20\% \cdot E_{70°C,Vrated}\right)}{30\% \cdot V_{min} + 70\% \cdot V_{reated}} + P_{standby} \cdot \frac{8760}{1000} \cdot \frac{1}{8}$$

- specific input power $p_{kw,Vrated}$ [W/l] to keep warm the rated water capacity when the highest keep-warm temperature is selected; ;
- maximum keep-warm time t_{KWmax} [min];
- power consumption in standby mode $P_{standby}$ [W];
- power consumption in off mode $P_{off\text{-}mode}$ [W];
- water temperature drop measured during the cool-down test T_{drop} [°C].

7.1.2.4. Proposed policy actions related to behaviour

The energy consumption of an electric kettle is directly related to the amount of water heated. Therefore, **over-boiling** – defined as boiling a larger water volume than required – is one of the major issues to be addressed. The following requirements may have an impact for the users:

7.1.2.4.1. Minimum water capacity (V_{min})

Some kettles either have no clear indication regarding a minimum water level or indicate an unnecessary high volume (e.g. 0.7 litre). Still, it is difficult to set a direct requirement on the minimum capacity, especially for kettles with immersed heating elements, since the heating element has to be surrounded by enough water.

To incentivise manufacturers to minimise V_{min}, it is suggested to:

- set a requirement regarding a **mandatory indication of the minimum capacity of water** (V_{min});
- take into account the performance of kettle at V_{min} in the calculation of the SEC.

7.1.2.4.2. Indication of the water volume

According to Task 2 figures, 90% of the kettles have an outside water level indication.[38] It is unclear whether the indication is in litre or cup (e.g. with 1 cup = 0.125 litre)[39], yet, both indicators are helpful for the user in order to fill the right amount of water required for the usage. A survey from Philips confirmed also that dual water level indication contributes to reducing over-boiling (see Task 3). Consequently, the project team suggests including a **requirement regarding a mandatory dual water level indication**.

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[35] see Annex A for more details regarding the testing procedure and the definitions

[38] 4% have an inside indication and 6% do not have any

[39] see EN 60661:2015 "Methods for measuring the performance of electric household coffee makers"

7.1.2.4.3. Information requirements regarding over-boiling

Information regarding over boiling should be included in the instruction manual. It should be explicitly mentioned in the instruction manual that:

> **"The energy consumption of the kettle can be optimised by ensuring that only required amount of water is heated".**

In addition, a table showing the energy consumption for heating different volumes of water (V_{min}, 1 litre[40] and V_{rated}) at different temperatures shall be included in the instruction manual. As the pre-set temperatures are not harmonised and in order to limit the administrative burden for manufacturers, information should be provided at boiling temperature and at 70°C.

Furthermore, the project team highly supports the idea of indicating on the container[41] the "standard boiling time [s]" required to boil following volumes of water: V_{min}, 1 litre and V_{rated}. Such information might be an additional incentive for the users to avoid over-boiling as they might pay more attention to the boiling time than to the relative low energy consumption per use. However, it should be clearly mentioned that the figures have been measured with the same model, but under test conditions, and might be subject to deviations.[42]

7.1.2.5. Proposed policy actions related to limescale

Many regions in the EU have access to "hard" - i.e. calciferous - tap water. When hard water is used in a kettle, limescale deposits are formed. When the temperature rises, the concentration of carbonic acid decreases, the so-called lime-carbonic acid balance shifts and the water becomes increasingly supersaturated with calcium carbonate. In practice, the precipitated lime tends to settle at the hottest points (e.g. the immersed heating element, see Figure 7-3).

Figure 7-3: Limescale deposit in kettles: immersed (left) and concealed (right) (Fraunhofer ISI)

The poor thermal conductivity of lime has the consequence that a supposedly layer of lime of 2 mm already reduces the heat transfer by about 15% and affects the energy efficiency of kettles accordingly.[43] The calcification process accelerates with the temperature, meaning that heating

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[40] if applicable

[41] e.g. as a separate piece of paper inserted in the container, providing the information about boiling time and emphasising that the indicated figures have been measured under standard test conditions.

[42] e.g. depending on water temperature or power supply

[43] see: https://www.sbz-online.de/sbz-schwerpunkt/chemiefreie-wasserbehandlung-energiesparer

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water to 95°C instead of the physical boiling point will significantly reduce the formation of limescale deposit. In addition, limescale deposit has a negative impact on the kettle technical lifetime. For all these reasons, **mandatory information in the instruction manual regarding the need to descale and how to proceed** shall be provided. Many manufacturers already provide clear instructions, but not all.

7.1.2.6. Proposed policy actions related to circular economy

The Circular Economy Action Plan[44] of the European Commission lists some sustainable principles. Among them, some would be particularly relevant for kettles:

- improving product durability, reusability, upgradability and reparability, addressing the presence of hazardous chemicals in products, and increasing their energy and resource efficiency;
- increasing recycled content in products, while ensuring their performance and safety;
- enabling remanufacturing and high-quality recycling;
- reducing carbon and environmental footprints;
- restricting single-use and countering premature obsolescence.

7.1.2.6.1. Recycling

Based on the figures of the Bill-of-Materials (BoM) and EcoReport in Task 5 over 90% (in weight[45]) of a kettle consists of materials which can be recycled. This would be higher than the WEEE requirement for this product group.[46]

EN 45555:2019 "General methods for assessing the recyclability and recoverability of energy-related products" provides a general method for assessing the recyclability and recoverability of energy-related products. As base of discussion, the project team suggests following threshold on the recyclability rate (R_{cyc}):

$$R_{cyc} \geq 75\%$$

In addition, an information requirement should include the recyclability rate (R_{cyc}) of the kettle to be provided on the packaging, in the instruction manual and online.

7.1.2.6.2. Post-consumer recycled materials

Post-consumer recycled (PCR) materials could be easily used for parts[47] that are not in contact with water, i.e. for all parts except for the container[48], the lid and the filter. Based on the figures of BoM and EcoReport in Task 5, the weight of recyclable parts, which are not in contact with water, was in a range between 30% and 42% of the total weight of a kettle. At this stage, no requirement on a minimum PCR content can be set. Nevertheless, an information requirement should include the

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[44] https://ec.europa.eu/environment/circular-economy/pdf/new_circular_economy_action_plan.pdf

[45] without packaging and instruction manual

[46] 75 % shall be recovered, and 55 % shall be prepared for re-use and recycled, see DIRECTIVE 2012/19/EU on Waste Electrical and Electronic Equipment in Task 1

[47] similar appliances are already producing a noticeable portion of recycled plastics, see: https://www.philips.com/a-w/about/sustainability/sustainable-planet/circular-economy/senseo.html

[48] the inner part of the container, which is directly in contact with water.

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post-consumer materials content (R_{post}) of the kettle to be provided on the packaging, in the instruction manual and online.

EN 45557:2020 "General method for assessing the proportion of recycled material content in energy-related products" provides a general method for assessing the proportion of recycled material content in energy-related products.

7.1.2.6.3. Further requirements related to circular economy

- Information requirement regarding:
  - the **provision of the BoM**;
  - the **material of the parts of the container** which are in contact with water shall be indicated in the instruction manual as well as on the packaging, in the instruction manual and online.
- Requirement for **marking plastic components** heavier than 25 g
- Requirements for **dismantling, material recovery and recycling**:
  - appliances shall be designed in such a way that the materials and components referred to in Annex VII to Directive 2012/19/EU can be removed with the use of commonly available tools;
  - obligations laid down in Point 1 of Article 15 of Directive 2012/19/EU shall be fulfilled.
- Proposed policy actions related to reparability and durability:

  Kettles are relatively simple appliances and have a typical lifetime of 6 years (see Task 3). Improving the durability and the reparability would contribute to extending the lifetime and decreasing the environmental impact for the energy service delivered.

  For this purpose, the following sub-actions are suggested:

  - **minimum number of cycles**: 10,000 (boiling 1 litre of water). The Ecodesign Working Plan study stated that the industry runs over 10,000 test cycles on the kettles.[49] Assuming that a cycle test would take 5 min,[50] such a test routine will need in average 35 days. Furthermore, an information requirement would include the number of cycles, in case a kettle could perform successfully more than 10,000 boiling cycles;
  - **possibility to repair some components**: According to Which?,[51] faulty lids and broken limescale filters are the two major faults. As these components are rather simple and cheap, manufacturers shall be required to make at least these two components repairable;[52]
  - **availability of spare parts for a minimum period** of six years after placing the last unit of the model on the market. In addition, requirement on maximum delivery time of spare parts should be set. This requirement is applied for recent Ecodesign regulations;

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[49] For comparison: GB/ 22089-2008 in China requires more than 8,000 cycles for Grad A level. Also, some suppliers manufacture controllers that consistently exceed 12,000 cycles of normal operation (see e.g. https://strix.com/de/safety/)

[50] the heating time for 1 litre of water ranged between 189 seconds and 390 seconds according to the Base Cases (see Task 5)

[51] see Task 2 and https://www.which.co.uk/reviews/kettles/article/top-kettle-brands-aKCUC9s1znQZ

[52] removable limescale filter

- **affordability of spare parts**: figures regarding spare parts prices and shipping costs should be provided, in order to improve the information transparency;
- **access to repair and maintenance information** in the instruction manual and on the website of the manufacturer.

The last four sub-actions go hand in hand.

7.1.2.7. Proposed policy actions related to materials

Several requirements regarding materials are suggested by the study team in order to reduce the toxicity of the materials used. They are mainly based on the Blue Angel scheme.[53]

- Plastic parts intended to be touched in normal use (e.g. handles and controls) shall contain less than 10 mg/kg of polycyclic aromatic hydrocarbons (PAHs) and less than 1 mg/kg benzo[a]pyrene

- Plastics in the container and base plate:

  No substances may be added to the plastics as constituent parts, which are classified as:

  a) carcinogenic of category 1 or 2 according to Table 3.2 or category 1A or 1B according to Table 3.1 of Annex VI to Regulation (EC) No 1272/2008[54]

  b) mutagenic of category 1 or 2 according to Table 3.2 or category 1A or 1B according to Table 3.1 of Annex VI to Regulation (EC) No 1272/2008

  c) toxic to reproduction of category 1 or 2 according to Table 3.2 or category 1A or 1B according to Table 3.1 of Annex VI to Regulation (EC) No 1272/2008

  d) being of very high concern for other reasons according to the criteria of Annex XIII to the REACH Regulation, provided that they have been included in the List (so-called "Candidate List"[55]) set up in accordance with REACH, Article 59, paragraph 1.

  Halogenated polymers shall not be permitted.[56] Nor may halogenated organic compounds be added as flame retardants as they represent a major issue in the recycling of plastics[57]. Moreover, no flame retardants may be added that are classified pursuant to Table 3.1 or 3.2 in Annex VI to Regulation (EC) 1272/2008 as very toxic to aquatic organisms with

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[53] see https://produktinfo.blauer-engel.de/uploads/criteriafile/en/DE-UZ%20133-201309-en%20Criteria-2020-01-07.pdf

[54] Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006, Annex VI Harmonized classification and labelling for certain hazardous substances, Part 3: Harmonized classification and labelling – Tables, Table 3.2, – List of harmonized classification and labelling of dangerous substances from Annex I to Directive 67/548/EEC.

[55] link to the Candidate List in Regulation (EC) No. 1907/2006 concerning the Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH): https://echa.europa.eu/web/guest/candidate-list-table

[56] see A.P. Mouritz (2007): Durability of composites exposed to elevated temperature and fire. Woodhead Publishing Series in Civil and Structural Engineering.

[57] as mentioned in the preamble of the Ecodesign regulation on TV (EU) 2019/2021: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R2021&from=EN. See also Jandric, Aleksander & Part, Florian & Fink, N & Cocco, V & Mouillard, F & Huber-Humer, M & Salhofer, Stefan & Zafiu, Christian. (2019). Investigation of the heterogeneity of bromine in plastic components as an indicator for brominated flame retardants in waste electrical and electronic equipment with regard to recyclability. Journal of hazardous materials. 390. 121899. 10.1016/j.jhazmat.2019.121899.

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long-term adverse effects and assigned the Hazard Statement H410 or Risk Statement R50/53.

The following shall be exempt from this rule:

- process-related, technically unavoidable impurities;
- fluoroorganic additives (as, for example, anti-dripping agents) used to improve the physical properties of plastics, provided that they do not exceed 0.5 weight percent;
- plastic parts, less than 25 grams in mass.

Some stakeholders stressed that during the first cycles of use, chemical substances (especially at the seals) of a new kettle may dissolve in the water. It is therefore recommended not to consume the water boiled during the first use cycles of a new kettle.

Accordingly, the project team recommends setting a mandatory information requirement such as:

> **"Important recommendation before preparing the first beverage with a brand new kettle: boil the maximum volume of water and remove the water. Repeat this procedure 5 times".**

Ideally, this requirement shall be complemented by a removable sticker on the kettle or an instruction printed on paper in the container.

7.1.3. Policy measures excluded for further analysis

7.1.3.1. Energy label

MEPS and energy labels are the basic pillars of the market regulation for products. However, an energy label makes sense only for products, where a wide range of performances could be observed and the differences need to be shown to the customers in a clear way, so that they can make the right purchasing decision.

The study team had access to several test datasets of around 35 kettles. The energy efficiency of the kettles did not cover a wide range of performance.

In addition, the work carried out in Task 6 showed a fair potential for improvement: between 16% and 45% depending on the base case· However, some of the Design Options – like DO 1 "water level indicator"[59] – will impact the behaviour and indirectly the yearly energy consumption of the kettle, but not the energy efficiency of the product itself.

Accordingly, the relevance of elaborating an energy label for electric kettles is not guaranteed at this stage of the study. Even among many of the stakeholders (including NGOs), there was uncertainty about the usefulness of an energy label. Consequently, it is suggested to investigate the pertinence of an energy label only after enough market data has been collected (see 7.1.2.1.1).

In any case, the mandatory provision of information regarding the energy efficiency of kettles will be an incentive for manufacturers to invest in technical innovations and place better performing products on the market. In the medium term, this might broaden the range of energy efficiency performance of products on the market and make an energy label more justifiable.

7.1.3.2. Airborne noise

Some Consumer Organisations[62] assess – quantitatively or qualitatively – the noise level when testing and comparing products. However, according to a consumer survey in the UK, the noise

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[59] assuming to lead to energy savings between 5% and 10% of energy depending on the base case

[62] Which? (UK) or Stiftung Warentest (DE)

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level is not a relevant criterion when buying a kettle. Therefore, we do not support any requirement (maximum level or information requirement) regarding noise level in this study.

There is no kettle specific standard to measure the airborne noise level, nevertheless IEC 60704-3:2019 "Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 3: Procedure for determining and verifying declared noise emission values" would be suitable for kettles.

7.1.3.3. Mandatory limescale protection

Based on the information provided in 7.1.2.5, technical requirements regarding limescale protection might be meaningful, such as:

- mandatory built-in water filter OR
- mandatory limescale filter (removable or not)

However, the impact of such requirements on the yearly energy consumption of a kettle is difficult to estimate. Moreover, using hard tap water does not concern all EU-users and/or the ones who are concerned might already fill their kettles with filtered tap water. Therefore, this policy option is not further considered. Furthermore, the measure targeting over-heating will have a positive impact on the limescale issue.[63]

7.1.4. Summary of the stakeholders' positions

Apart from the bilateral exchanges with several stakeholders along the process, registered stakeholders were invited to two meetings (see Annex B – Meetings with stakeholders):

- a formal stakeholder meeting on 15.07.2020. This meeting was dedicated to commenting on draft reports for the Task 1, 2, 3 and 4. Also, first assumptions regarding Base Cases and Design Options as well as possible policy options were shortly presented and discussed.
- an exchange with stakeholders took place on 21.10.2020 to discuss the main comments on Tasks 1,2,3 and 4 and to review a document summarizing the assumptions for Task 5 and 6 reports as well as the first policy options.

Due to the COVID-19 crisis, both meetings took place online instead of physically.[64] The main comments regarding policy options are summarized here and classified by topic.

7.1.4.1. Scope

APPLiA supported the proposed scope and suggested to make clear, what is excluded (e.g. coffee machines). However, some stakeholders (Danish Energy Agency, BAM and ECOS) discussed the opportunity to have a larger scope, including for example boiling water heaters, coffee machines or urns up to 26 litres.

7.1.4.2. Usage

Due to the lack of data / surveys, the average usage of a kettles (including the yearly amount of water boiled[65]) was a controversial topic. A formula to calculate the average energy consumption of a kettle will remain a critical issue. However, ANEC-BEUC supported the pragmatic approach of Top10 Switzerland[66] regarding the calculation of the yearly energy consumption.

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[63] See 7.1.2.5: The calcification process is not linear, so that heating water to 95°C instead of the physical boiling point will significantly reduce the formation of limescale deposit.

[64] Thanks to the stakeholders, the quality of the exchanges was at least as good as in a physical meeting. In addition, it offered probably the chance to have more participants and to get more feedback.

[65] 1,000 litres per year in the first draft report for Task 3

[66] see Task 1 report

7.1.4.3. Standardisations

It was recognised by all actors, that there is a lack of standards to address energy efficiency or energy consumption for kettles, which is an issue for a regulation. In addition, the only standard dealing with the boiling times of kettles (IEC 60530:1975) is not often applied when testing kettles. Therefore, not only is there a lack of data but also the available test data[67] have not been always measured in a harmonized way.

The project team elaborated a test procedure. The stakeholders commented on the first draft and suggested using kg instead of litre to make the test easier to carry out.

Industry suggested measuring the efficiency of kettles at the rated volume, UBA/BAM and ECOS supported testing a standard volume of 1 litre in order to make the comparison between products easier.

UBA/BAM suggested testing for 15°C-95°C, 15°C-shutoff and keep-warm function. When applicable, test should cover different (target) water temperatures. Furthermore, the agency suggested checking if the measurement of the accuracy of the temperature settings is possible - in case different temperatures are indicated.

APPLiA explained that the testing procedure shall require reaching the boiling point and measuring the energy consumption until the controls automatically switch-off the kettle. 95 °C shall not be used as reference temperature.

ECOS stressed on (if temperature settings are possible) measuring at different temperatures as it is done at maximum temperature (heat up 1 litre from cold to each set temperature individually) and including this in the calculation of the yearly energy consumption.

UBA/BAM mentioned, that for hygienic reasons it has to be assured that water in a kettle can reach 100 degrees.

According to APPLiA, measurement of the heat transfer coefficient [W/m2/K] of the container would be difficult and therefore repeatability and accuracy would not be ensured.

7.1.4.4. Energy efficiency metric

For stakeholders like APPLiA, UBA/BAM or Danish Energy Agency, energy efficiency should be defined as the ratio between the theoretical value needed to boil a discrete amount of water and the measured energy consumption.

According to ANEC-BEUC, the calculation of the yearly energy consumption with the following components seems reasonable and feasible: $AEc = AEc\ boiling + AEc\ keep{-}warm + AEc\ standby$. In order to keep it simple and feasible AEc boiling and AEc keep-warm should not be considered separately.

7.1.4.5. Energy labelling

APPLiA recommended avoiding energy labelling for this category due to the very small range of the EEI values.

UBA/BAM stressed that an energy label only makes sense if the products on the market show sufficiently large differences in energy consumption to allow a spread of energy efficiency classes. NEA had a similar position and the Danish Energy Agency does not consider energy labelling being an appropriate measure for electric kettles.

ECOS expressed its support of assessing the possibility of an energy label for electric kettles. The NGO mentioned also that this is important to be able to award bonuses to kettles with specific environmental-friendly features. Finally, it stressed, that the benefits of different temperature settings can be best accounted for with an energy label.

ANEC/BEUC would also welcome the introduction of the energy label for electric kettles.

UBA/BAM supported information requirement on rated input power, boiling time (1l and V_{rated}) and some specific performance data (e.g. $EC_{boiling}$ and $P_{keep\text{-}warm}$).

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[67] gathered by the industry, consumer organisations or the Swedish Energy Agency

7.1.4.6. Over-boiling

Many stakeholders supported the idea of improving information regarding the water level as well as providing better guidance on how to use a kettle in order to reduce the energy consumption.

UBA/BAM supported 0.3 l as minimum volume, and providing boiling time for V_{min}, 1 l and V_{rated}. The Danish Energy Agency was in favour of measuring the energy efficiency of kettles when boiling only a small amount of water (for instance 0.2-0.3 litre corresponding to a cup of water).

APPLiA stressed, that a minimum level of 0.2 l is not realistic for all kettles and provided explanations. The association disagrees with a mandatory water level indicator and would prefer a requirement formulated in a way that the solution is not predefined.

7.1.4.7. Keep warm

Many stakeholders (e.g. ECOS, ANEC-BEUC, APPLiA) support the idea that keep-warm function should always be off by default and the maximum keep-warm time should be limited. For kettles with a keep-warm function, ANEC-BEUC and UBA/BAM suggested also setting heat transfer coefficient requirements for the container or requiring a double wall container.

7.1.4.8. Material

UBA/BAM suggested checking the possibility of the requirement on PCR content.

ECOS strongly suggested assessing the setting of a minimum mandatory requirement in new kettles for the recycled content from PCR. The NGO supported also a requirement for the recyclability of at least 75% of the kettle weight (figure to be demonstrated based on recycling data).

APPLiA complained, that a common definition for “recyclable” is missing and thus a recyclability criterion without a further assessment seems premature at this stage of the study. The association did not support requirements on PAHs and benzopyrene.

ANEC and BEUC support the introduction of further chemical restrictions under the Ecodesign implementing instrument, which would ensure safer products to consumers.

7.1.4.9. Limescale protection

No stakeholder (including NGOs) supported the approach of a mandatory limescale protection (built-in filter or limescale filter) but most of them were in favour of requiring information on how to deal with limescale in the instruction manual.

7.1.4.10. Durability and spare parts

UBA/BAM agreed with the reparability and durability requirements suggested in October. As a minimum duration of the guarantee seems not to be adequate within ecodesign, UBA/BAM suggested sticking to the numbers of cycles and carefully checking the number given.

UBA supported the reparability and durability requirements presented in October 2020, however suggested checking the number of cycles.

APPLiA stressed that not all limescale filters are removable.

7.2. Scenario analysis

Subtask 7.2 establishes scenarios according to the policy measures described in subtask 7.1. To this end, the analyses on the previous tasks have been extended to the defined scenarios in comparison with the Business-as-Usual (BAU) scenario and the Best Available Technology (BAT) scenario.

7.2.1. Scenarios overview

Different scenarios have been drawn up to illustrate quantitatively the improvements that can be achieved at the EU level by 2040 with suitable Ecodesign policy actions against the BAU scenario. Taking into account the time needed to elaborate and implement any regulation, the regulatory provisions are assumed to enter into force in 2023 for each policy scenario.

The reference case and main technical improvement option scenarios based on the findings of Task 6 are defined as follows:

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- **BAU scenario**: the products placed on the EU market have the same level of performance as the Base Case defined in Task 5,
- **Ecodesign scenario:** from 2023, the products placed on the EU market have to fulfil the policy requirements mentioned in 7.1. The following main requirements could be directly taken into account in the scenario:
    - water level indicator improved and requirements on minimum volume[68]
    - for kettles with keep-warm function: keep-warm time is limited by 30 minutes and container has to be insulated[69]
    - EEI >= 81%[70], no energy label
- **LLCC (Least Life Cycle Cost) scenario**: from year 2023, all kettles placed on the market comply with the LLCC performance level as assessed in Task 6
- **Best Available Technology (BAT) scenario**: from year 2023, all kettles placed on the market comply with the BAT performance level as assessed in Task 6.

No Break-Even Point scenario will be considered.[71]

Table 7-6 provides an overview of the main assumptions of new products placed on the market from 2023 for each product Base Case and scenario. The figures are derived from the results of Tasks 4, 5 and 6.

Table 7-6: Overview of the parameters, for the kettles considered, according to the scenario and product Base Case

Base Case	Level of Performance / Scenario	Design options implemented	total year energy consumption	Purchase Cost	Maintenance	Maintenance yearly
			[kWh/a]	[Euro]	[Euro]	[Euro]
1	BAU	no	86.8	16.0	20.0	3.3
	Ecodesign	1	82.4	16.0	20.0	3.3
	LLCC	1, 2, 3	73.6	23.5	20.0	3.3
	BAT	all (1, 2, 3, 4)	72.5	25.5	20.0	3.3
2	BAU	no	92.2	26.0	24.0	4.0
	Ecodesign	1	82.1	26.0	24.0	4.0
	LLCC	1, 2, 3, 5	70.0	34.0	24.0	4.0
	BAT	all (1, 2, 3, 4, 5)	68.9	37.0	24.0	4.0
3	BAU	no	137.3	62.0	25.0	4.2
	Ecodesign	1, 4, 6	91.7	65.0	25.0	4.2
	LLCC	all (1, 2, 3, 4, 6)	75.0	67.0	25.0	4.2
	BAT	all (1, 2, 3, 4, 6)	75.0	67.0	25.0	4.2

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[68] see Design Option 1 in Task 6 report

[69] see Design Options 4 and 6 in Task 6 report

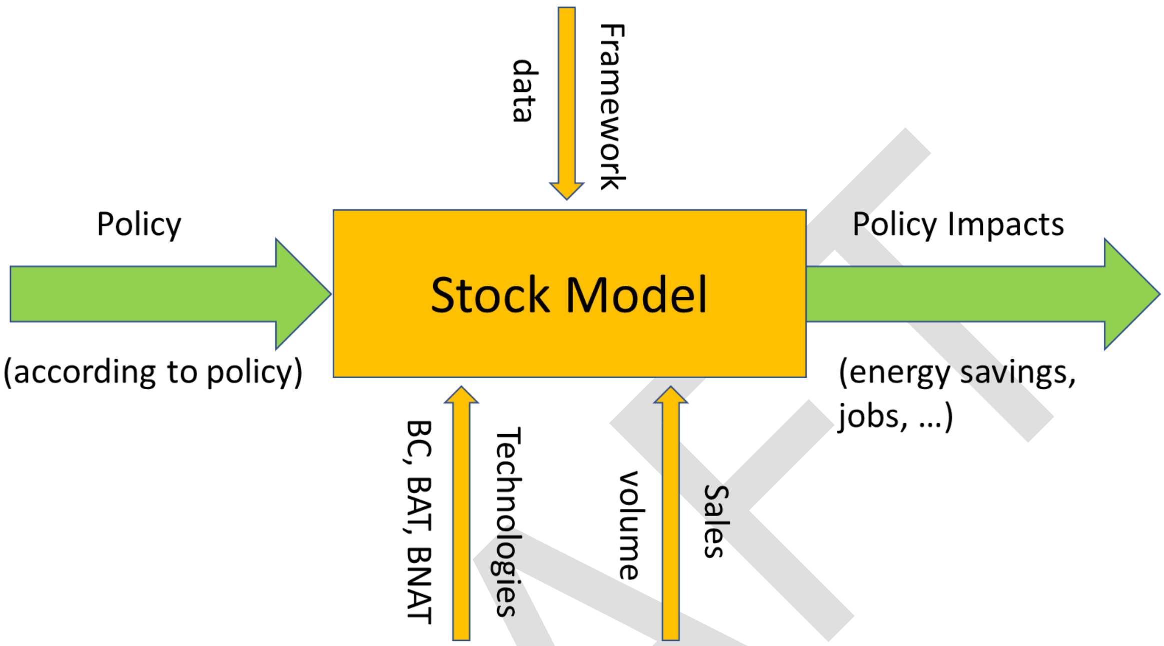
[70] This requirement is expected to have a limited effect on the energy efficiency of the Base Cases.

[71] The break-even point is defined in the MEErP methodology as the highest energy efficiency level for which the Life Cycle Costs (LCC) do not exceed those of the Base Case configuration. In this scenario, the energy savings are maximized without increasing the total costs.

7.2.2. Approach

For the purpose of producing the quantified scenario impact analyses under subtask 7.2, an Excel based stock-model was developed for this product group. The structure of the model is shown in Figure 7-4.

Figure 7-4: Simplified overview of the model (Source: Fraunhofer ISI)



With:

- Technologies and policies: an overview of the main data for each Base Case according to the level of technology considered was provided in Table 7-6
- Framework data: electricity (see Table 7-7) and socio-economic figures for typical market actors of the sector (see Table 7-8)

Table 7-7: Electricity prices and related GHG emissions (based on PRIMES)

Parameter	Unit	2020	2025	2030	2035	2040	2045
Electricity tariff (Households)	[€/kWh]	0.20	0.21	0.21	0.22	0.22	0.21
Electricity GHG emission	[kg CO2eq/kWh]	0.38	0.36	0.34	0.32	0.30	0.28

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Table 7-8: Framework data

Variable name and unit	Value	Source
ProductLife[72] [a]	6	based on sales & stock
WholeMargin [-]	5%	few manufacturers[73]
Jobs Industry ([1/mln euros revenue*]	4	APPLiA[74]
Jobs Install [1/mln euros revenue*]	n.a.	
Jobs Maint [1/mln euros revenue*]	n.a.	
Jobs Energy Companies [1/mln euros energy]	1	Impact Assessment Lot 15 (EC 2015)

*including EBIT

- Sales and stock:

The model used is a stock model, wherein:

$$stock_{BC_i,Y} = \sum_{j=Y-lifetime+1}^{Y} sales_{BC_i,j}$$

$$stock_{kettles,Y} = \sum_{i=1}^{3} stock_{BC_i,Y}$$

Where:

- *Y* = year
- *lifetime* = 6 years
- *BC* = Base Case
- *i* = index of the BC

Also, sales figures can be calculated based on stock figures:

$$sales_{BC_i,Y} = stock_{BC_i,Y} - stock_{BCi,Y-1} + sales_{BC_i,Y-lifetime+1}$$

The market volume is calculated based on the stock increase and the replacement of old appliances, which have reached the technical lifetime.

Task 2 provides sales and stock figures for the EU kettle market and the same data are used in the stock model.[75]

The stock figures are provided in Table 7-9 (based on the findings from the Task 2 report). For the period 2019-2040, the same equipment rate trend is assumed as the one calculated over 2013-2018.[76] Figure 7-5 provides an overview of the evolution of sales over time.

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[72] see Task 3

[73] based on the annual reports of Whirlpool, BSH, Arcelik, Electrolux, Philips, Groupe SEB, De'Longhi

[74] Statistical Report – 2018-2019, see https://www.applia-europe.eu/statistical-report-2018-2019/introduction/index.html (accessed: 05.11.2020)

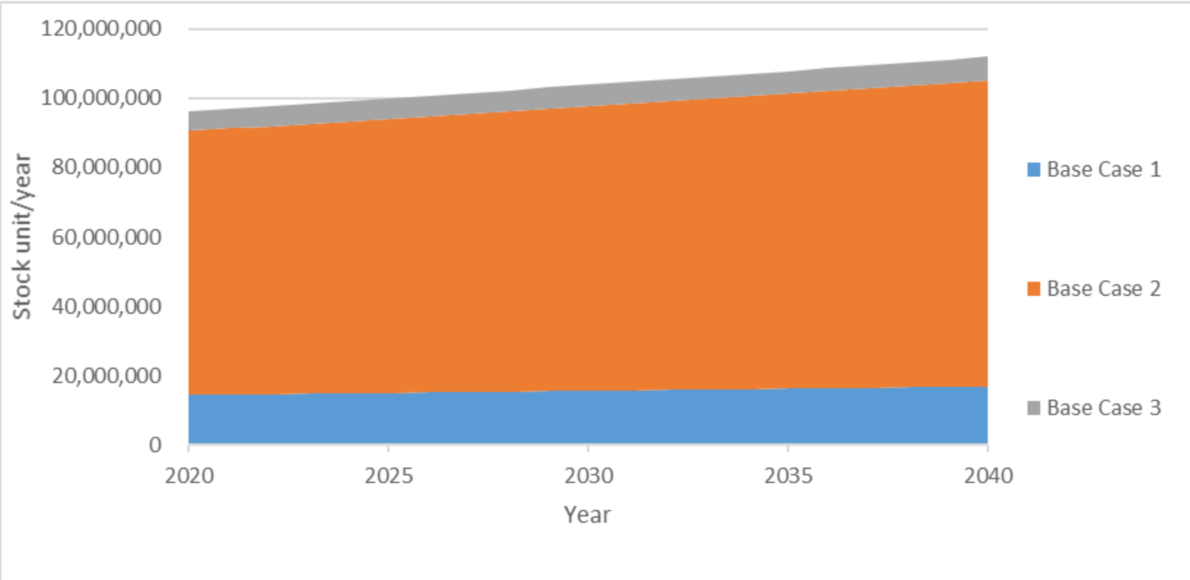
[75] Based on Task 2; however, due to the modelling approach in the Task 7 stock model, there might be a few deviations between the figures presented here and those reported in Task 2.

[76] +1.4% per year

Table 7-9: Evolution of the kettles stock per Base Case (EU-27)

	2020	2025	2030	2035	2040
BC1	14,452,687	15,006,447	15,581,425	16,178,433	16,798,316
BC2	76,117,487	79,033,956	82,062,172	85,206,414	88,471,129
BC3	5,781,075	6,002,579	6,232,570	6,471,373	6,719,326
Total water kettles	96,351,249	100,042,983	103,876,167	107,856,220	111,988,771

Figure 7-5: Evolution of the kettles stock per Base Case (EU-27)

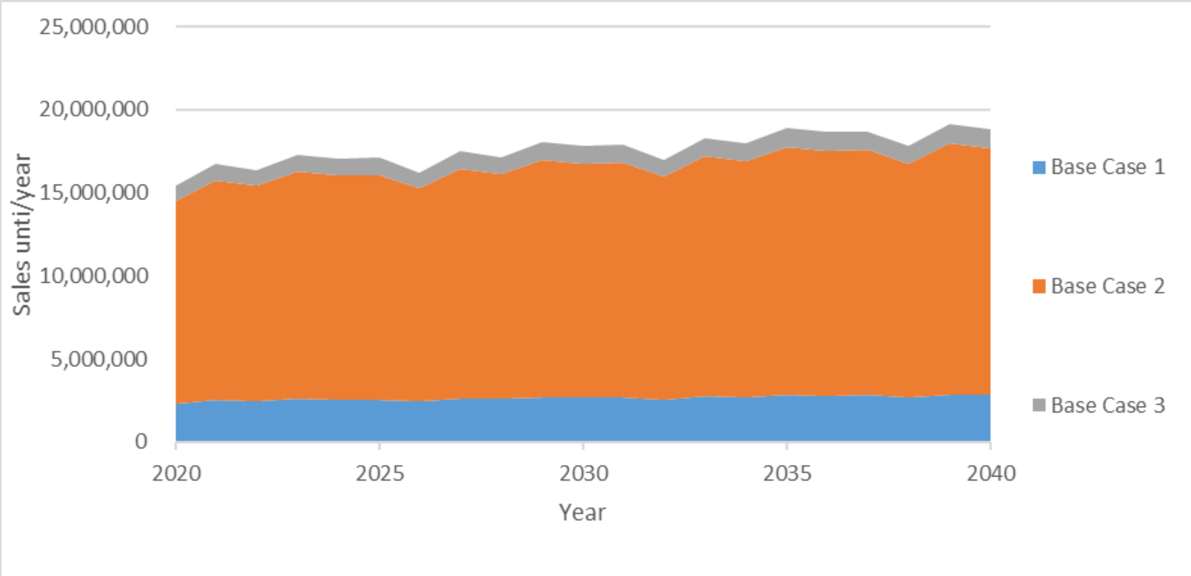


The sales figures are provided in Table 7-9 and Figure 7-6.

Table 7-10: Sales evolution of kettles per Base Case (EU-27)

	2020	2025	2030	2035	2040
BC1	2,319,837	2,565,311	2,677,327	2,831,771	2,818,878
BC2	12,217,808	13,510,639	14,100,588	14,913,991	14,846,090
BC3	927,935	1,026,124	1,070,931	1,132,708	1,127,551
Total water kettles	15,465,579	17,102,074	17,848,846	18,878,470	18,792,520

Figure 7-6: Sales evolution of kettles per Base Case (EU-27)



7.2.3. Environmental impacts

As Figure 7-7 and Table 7-11 show, there is an increase in the electricity consumption of the total electric kettle stock under the design option scenarios. Between 2020 and 2040, the energy demand slightly increases from 9.06 to approximately 10.54 TWh per year in the BAU scenario. Under the BAT and LLCC scenarios there is an absolute decrease in electric kettle energy demand, and the total energy consumption is projected to be 7.82 and 7.93 TWh respectively by 2040. The Ecodesign scenario is a moderate scenario (9.27 TWh per year in 2040), which achieves half the savings of the BAT scenario.

Figure 7-7: Electricity consumption in TWh/year (EU-27 stock)

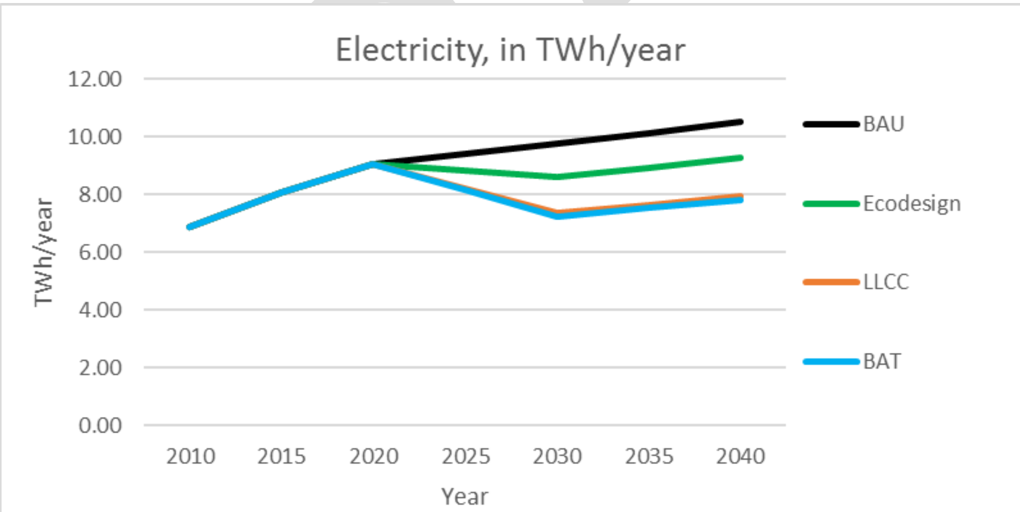


Table 7-11: Electricity consumption in TWh/year (EU-27 stock)

	2010	2015	2020	2025	2030	2035	2040
BAU	6.88	8.10	9.06	9.41	9.77	10.15	10.54
BAT	6.88	8.10	9.06	8.16	7.25	7.53	7.82
Ecodesign	6.88	8.10	9.06	8.83	8.60	8.93	9.27
LLCC	6.88	8.10	9.06	8.21	7.36	7.64	7.93
Absolute difference to BAU							
BAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAT	0.00	0.00	0.00	-1.25	-2.52	-2.62	-2.72
Ecodesign	0.00	0.00	0.00	-0.58	-1.18	-1.22	-1.27
LLCC	0.00	0.00	0.00	-1.20	-2.42	-2.51	-2.61
Relative difference to BAU							
BAU	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BAT	0.0%	0.0%	0.0%	-13.3%	-25.8%	-25.8%	-25.8%
Ecodesign	0.0%	0.0%	0.0%	-6.2%	-12.0%	-12.0%	-12.0%
LLCC	0.0%	0.0%	0.0%	-12.7%	-24.7%	-24.7%	-24.7%

Figure 7-8 and Table 7-12 present the GHG emissions according to the scenarios. Due to the decarbonisation of the electricity mix in the EU, the GHG emissions are expected to decrease in the BAU scenario from 3.44 $MtCO_2$ in 2020 to 3.16 $MtCO_2$ in 2040. Compared to the BAU scenario, the largest GHG reductions are achieved in the scenario BAT (-25.8%), followed by LLCC (-24.7%). Here again, the Ecodesign scenario achieves half the possible improvement observed in the BAT scenario.

Figure 7-8: GHG emissions in Mt CO2eq/year (EU-27 stock)

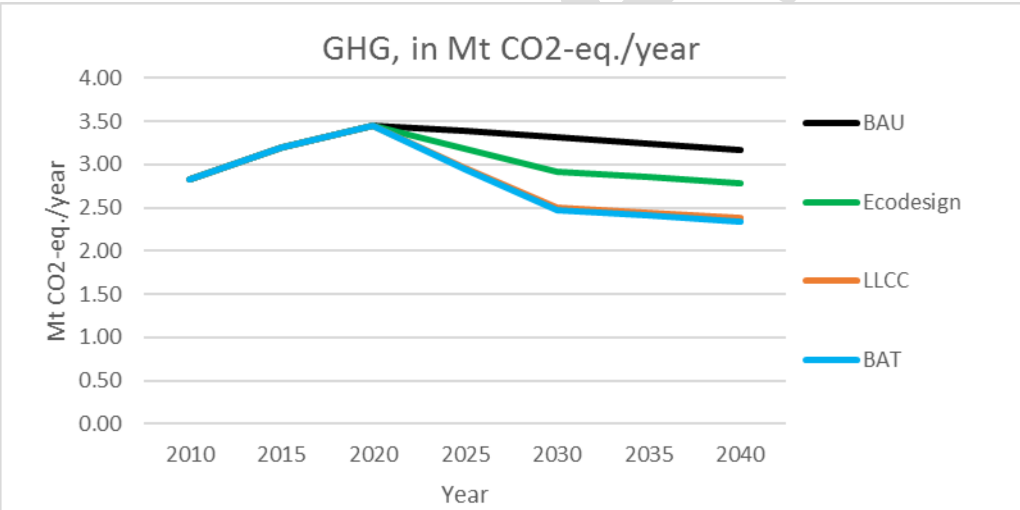


Table 7-12: GHG emissions in Mt CO2eq/year (EU-27 stock)

	2010	2015	2020	2025	2030	2035	2040
BAU	2.82	3.20	3.44	3.39	3.32	3.25	3.16
BAT	2.82	3.20	3.44	2.94	2.47	2.41	2.35
Ecodesign	2.82	3.20	3.44	3.18	2.92	2.86	2.78
LLCC	2.82	3.20	3.44	2.96	2.50	2.44	2.38
Absolute difference to BAU							
BAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAT	0.00	0.00	0.00	-0.45	-0.86	-0.84	-0.81
Ecodesign	0.00	0.00	0.00	-0.21	-0.40	-0.39	-0.38
LLCC	0.00	0.00	0.00	-0.43	-0.82	-0.80	-0.78
Relative difference to BAU							
BAU	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BAT	0.0%	0.0%	0.0%	-13.3%	-25.8%	-25.8%	-25.8%
Ecodesign	0.0%	0.0%	0.0%	-6.2%	-12.0%	-12.0%	-12.0%
LLCC	0.0%	0.0%	0.0%	-12.7%	-24.7%	-24.7%	-24.7%

7.3. Impact analysis industry and consumers

Impacts on consumers

Table 7-13 and Figure 7-9 show the purchase costs incurred by customers under the different scenarios. In the BAU scenario, total purchase costs increase from 0.41 bln.€ in 2020 to 0.50 bln.€ in 2040. The Ecodesign scenario is almost the same as the BAU scenario, +0.7% by 2040. One can observe a similar pattern in the BAT and LLCC scenarios: the total purchase costs increase by 39.1% and 29.1% respectively by 2040 due to the additional costs of the Design Options required.[77]

[77] see Task 6 report

Figure 7-9: Purchase costs in Bln. € (EU-27 market)

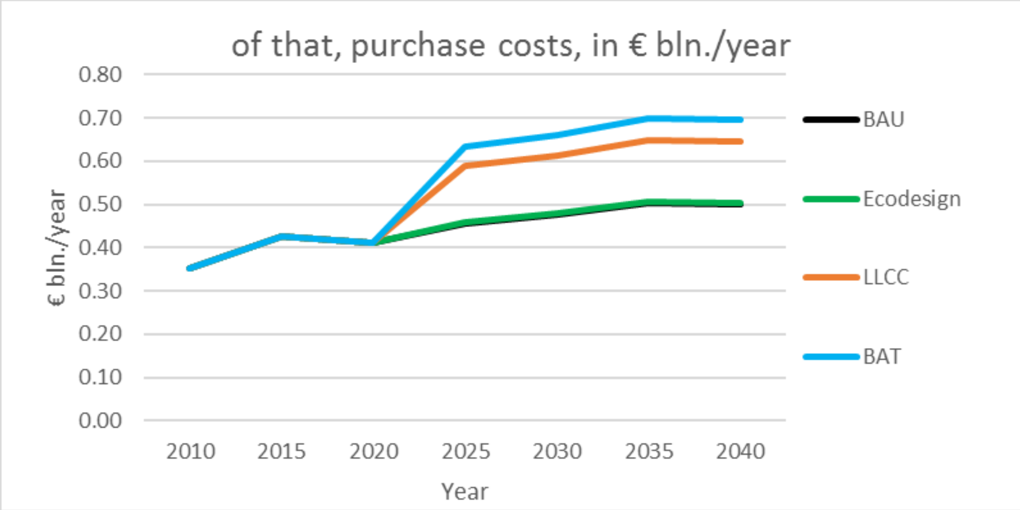


Table 7-13: Purchase costs in Bln. € (EU-27 market)

	2010	2015	2020	2025	2030	2035	2040
BAU	0.35	0.43	0.41	0.46	0.48	0.50	0.50
BAT	0.35	0.43	0.41	0.63	0.66	0.70	0.70
Ecodesign	0.35	0.43	0.41	0.46	0.48	0.51	0.50
LLCC	0.35	0.43	0.41	0.59	0.61	0.65	0.65
Absolute difference to BAU							
BAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAT	0.00	0.00	0.00	0.18	0.19	0.20	0.20
Ecodesign	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LLCC	0.00	0.00	0.00	0.13	0.14	0.15	0.15
Relative difference to BAU							
BAU	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BAT	0.0%	0.0%	0.0%	39.1%	39.1%	39.1%	39.1%
Ecodesign	0.0%	0.0%	0.0%	0.7%	0.7%	0.7%	0.7%
LLCC	0.0%	0.0%	0.0%	29.1%	29.1%	29.1%	29.1%

The energy costs (bills) are presented in Figure 7-10 and Table 7-14 for the whole EU electric kettle stock. While the BAU scenario shows an increase from 1.84 bln.€ in 2020 to 2.27 bln.€ in 2040, the BAT scenario shows a decrease from 1.84 bln.€ in 2020 to 1.68 bln.€ in 2040, which is around 26% below the BAU level. The LLCC scenario indicates the smaller decrease in energy costs: from 1.84 bln.€ in 2020 to 1.71 bln.€ in 2040. In the Ecodesign scenario, the energy costs can be reduced by 12% in 2040 compared to the BAU level.

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Figure 7-10: Energy costs in Bln. €/year (EU-27 stock)

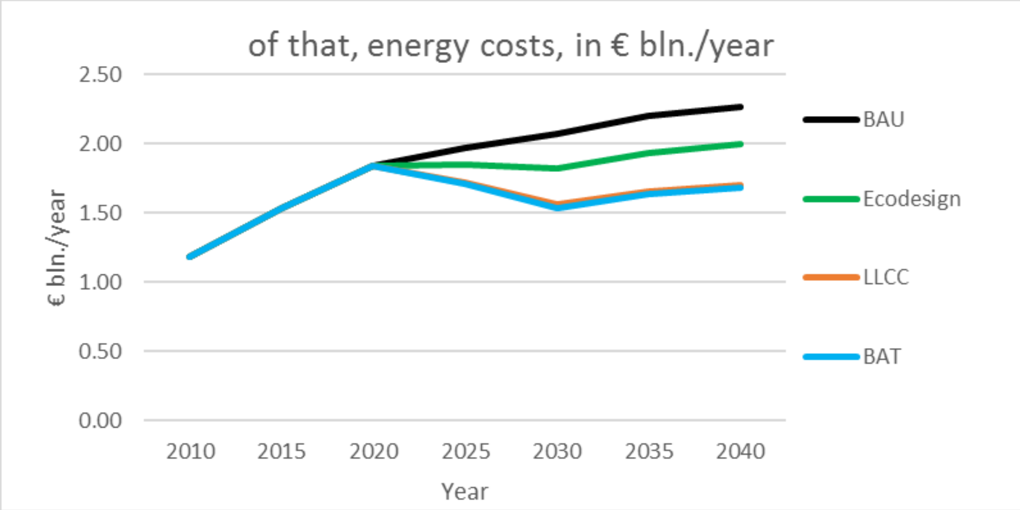

Table 7-14: Energy costs in Bln. €/year (EU-27 stock)

	2010	2015	2020	2025	2030	2035	2040
BAU	1.18	1.54	1.84	1.97	2.07	2.20	2.27
BAT	1.18	1.54	1.84	1.71	1.54	1.63	1.68
Ecodesign	1.18	1.54	1.84	1.85	1.82	1.94	1.99
LLCC	1.18	1.54	1.84	1.72	1.56	1.66	1.71
Absolute difference to BAU							
BAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAT	0.00	0.00	0.00	-0.26	-0.53	-0.57	-0.58
Ecodesign	0.00	0.00	0.00	-0.12	-0.25	-0.27	-0.27
LLCC	0.00	0.00	0.00	-0.25	-0.51	-0.54	-0.56
Relative difference to BAU							
BAU	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BAT	0.0%	0.0%	0.0%	-13.3%	-25.8%	-25.8%	-25.8%
Ecodesign	0.0%	0.0%	0.0%	-6.2%	-12.0%	-12.0%	-12.0%
LLCC	0.0%	0.0%	0.0%	-12.7%	-24.7%	-24.7%	-24.7%

Finally, the total expenditure is presented in Figure 7-11 and Table 7-15. The figures include: purchase costs (sales), O&M costs (stock) and energy costs (stock). In the BAU scenario, the expenditure is expected to increase from 2.63 bln. € in 2020 to 3.21 bln. € in 2040. In general, the impact of the choice of scenario on the total expenditure is limited with the greatest difference compared to the BAU being a 12.9% decrease by 2040 for the LLCC scenario. The BAT scenario leads to a decrease of 12.1% in expenditure by 2040. The Ecodesign scenario is an intermediate scenario, in which the total expenditure decreases 8.4% by 2040 compared to the BAU level.

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Figure 7-11: Expenditure in Bln. €/year (EU-27 stock)

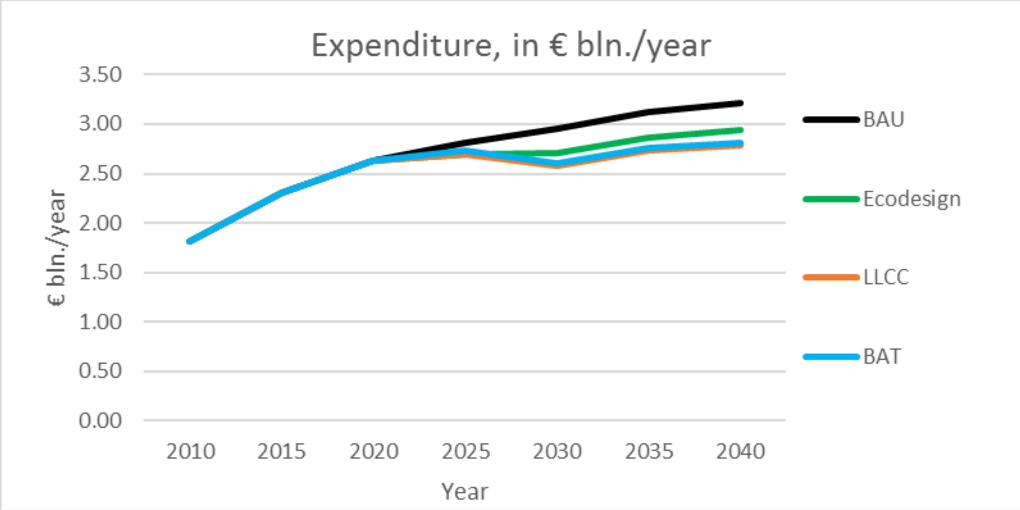

Table 7-15: Expenditure in Bln. €/year (EU-27 stock)

	2010	2015	2020	2025	2030	2035	2040
BAU	1.82	2.30	2.63	2.82	2.96	3.13	3.21
BAT	1.82	2.30	2.63	2.73	2.61	2.76	2.82
Ecodesign	1.82	2.30	2.63	2.70	2.71	2.87	2.94
LLCC	1.82	2.30	2.63	2.70	2.58	2.73	2.79
Absolute difference to BAU							
BAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAT	0.00	0.00	0.00	-0.08	-0.35	-0.37	-0.39
Ecodesign	0.00	0.00	0.00	-0.12	-0.25	-0.26	-0.27
LLCC	0.00	0.00	0.00	-0.12	-0.37	-0.40	-0.42
Relative difference to BAU							
BAU	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BAT	0.0%	0.0%	0.0%	-2.9%	-11.8%	-11.9%	-12.1%
Ecodesign	0.0%	0.0%	0.0%	-4.2%	-8.3%	-8.4%	-8.4%
LLCC	0.0%	0.0%	0.0%	-4.2%	-12.7%	-12.7%	-12.9%

Figure 7-12 shows the price of an average new kettle, placed on the EU market. It takes into account the purchase price of each Base Case and the market volume in each scenario. In the LLCC scenario, an average kettle costs 29% more than in the BAU scenario; in the BAT scenario, the marginal costs are even 39% higher. Details on the costs of the individual Design Options required for LLCC and BAT can be found in Task 6 report. The Ecodesign scenario does not require expensive Design Options, and only the purchase price for Base Case 3 is expected to increase by 3 € due to the insulation of the container. As the market share of this Base Case is low, the impact on the average kettle price in the Ecodesign scenario is negligible: +0.7% compared to the BAU level.

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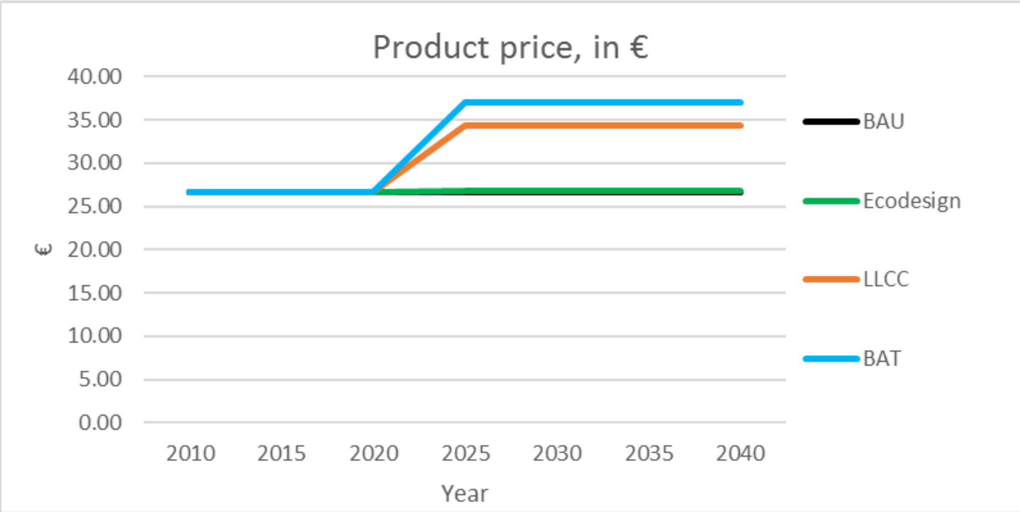
Figure 7-12: Average price of a new kettle placed on the EU-27 market



7.3.1. Impacts on business

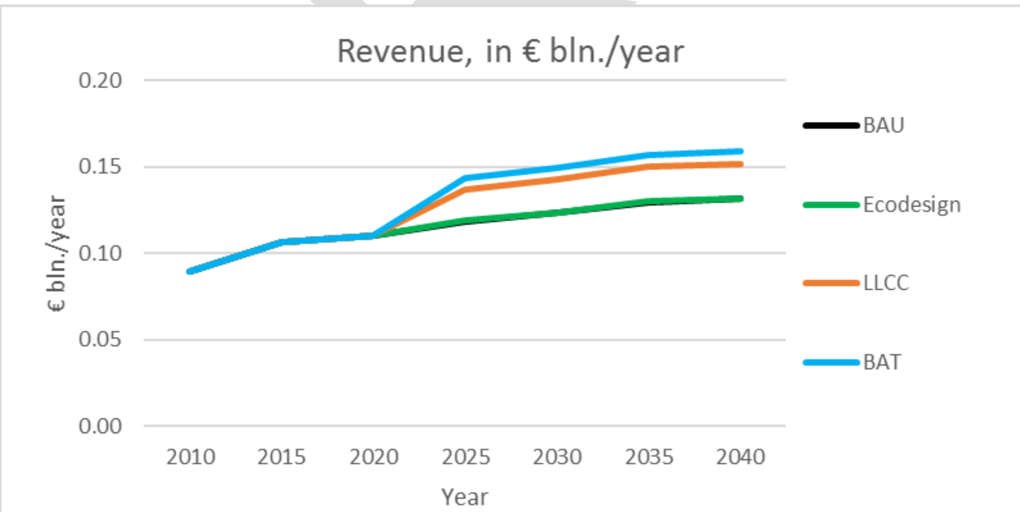
In this sub-section, the impact of the different policy scenarios on the business actors is presented.

In terms of turnover, it is assumed that:

- manufacturer turnover corresponds to the annual product purchase costs, i.e. it corresponds solely to the turnover due to the production and sale of kettles;
- the turnover of the maintenance companies corresponds to the maintenance costs (e.g.. spare parts);
- the turnover of the electricity companies corresponds to the electricity costs.

The revenue of the "kettles" sector is based on the turnover of the kettles manufacturers multiplied by their margins. Figure 7-13 shows the estimate of the revenue of the "kettles" sector according to the choice of scenario.

Figure 7-13: Revenue in Bln. € of kettles manufacturers (EU-27)



7.3.2. Impacts on employment

In this sub-section, the impact of the different policy scenarios on jobs is presented.

The number of jobs in the sector is estimated from the turnover figures and the ratio of jobs / turnover (see Table 7-16). Figure 7-14 and Figure 7-15 show the projected number of jobs according to the scenario and the job classification (manufacturers and energy companies).

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Figure 7-14: Manufacturing jobs (1,000s)

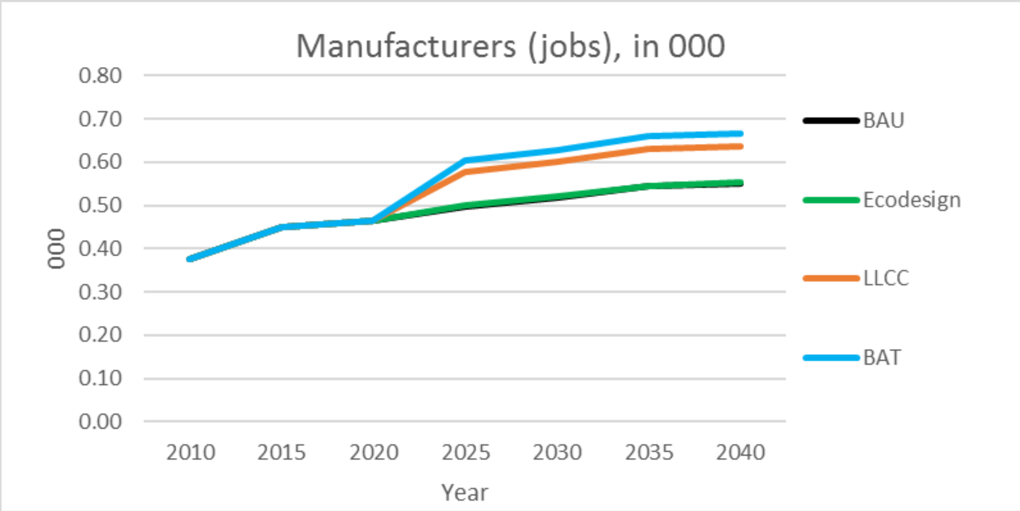
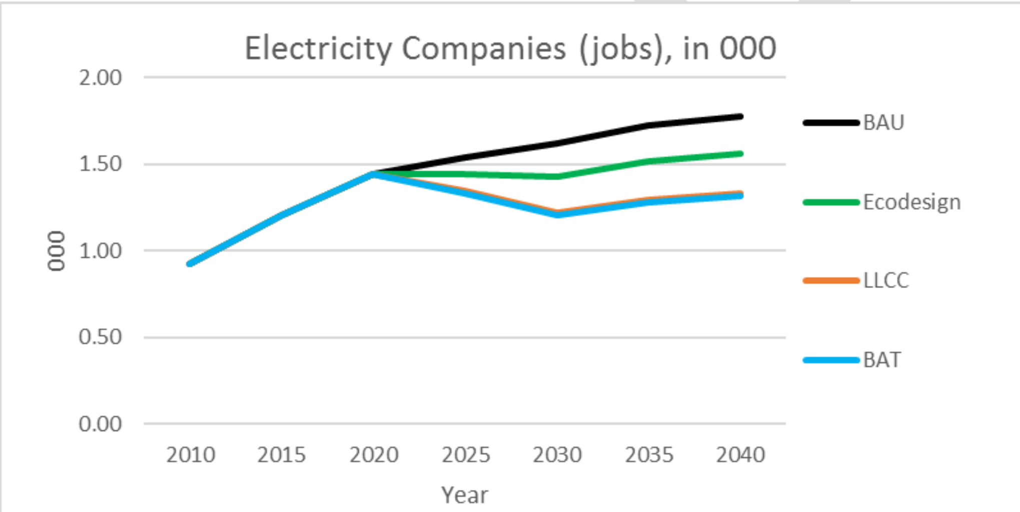


Figure 7-15: Number of jobs in electricity companies (1,000s)



7.4. Sensitivity analysis on the main parameters

7.4.1. High Sales projection

The Task 2 report reported between 96 and 165 million units in 2020. The baseline scenario corresponds to the lower figures. For the sensitivity analysis, we consider a "high sales scenario", whereby the sales volume is assumed to be 71%[78] higher than in the baseline scenario.

The main impacts in the case of the high sales projection for 2040 are provided in Table 7-16.

[78] 71% = (165/96 – 1)

Table 7-16: Main impacts of the scenarios by 2040 (high sales projection)

Criteria			MAIN IMPACTS IN YEAR 2040			
			1	2	3	4
			BAU	Ecodesign	LLCC	BAT
ENVIRONMENT						
	Electricity	TWh/year	18.04	15.87	13.58	13.39
	GHG	Mt CO2-eq./	5.41	4.76	4.07	4.02
CONSUMER						
EU totals	Expenditure	€ bln./year	5.49	5.03	4.78	4.82
	of that, purchase costs	€ bln./year	0.86	0.86	1.11	1.19
	of that, installation costs	€ bln./year	0.00	0.00	0.00	0.00
	of that, maintenance costs	€ bln./year	0.75	0.75	0.75	0.75
	of that, energy costs	€ bln./year	3.88	3.42	2.92	2.88
Per product sold	Sales (regulated)	000	32,181.89	32,181.89	32,181.89	32,181.89
	Product price	€	26.66	26.84	34.41	37.08
	Installation costs	€	0.00	0.00	0.00	0.00
	Energy costs	€/year	20.25	17.81	15.24	15.03
BUSINESS						
EU turnover	Manufacturers	€ bln./year	0.86	0.86	1.11	1.19
	Installers	€ bln./year	0.00	0.00	0.00	0.00
	Maintenance	€ bln./year	0.75	0.75	0.75	0.75
	Electricity Companies	€ bln./year	3.88	3.42	2.92	2.88
	Revenue	€ bln./year	0.23	0.23	0.26	0.27
EMPLOYMENT						
Employment (jobs)	Manufacturers	000	0.95	0.95	1.09	1.14
	Maintenance	000	3.87	3.87	3.87	3.87
	Installers	000	0.00	0.00	0.00	0.00
	Electricity Companies	000	3.04	2.67	2.29	2.25
	Indirect Employment	000	0.00	0.00	0.00	0.00
	TOTAL	000	7.85	7.49	7.25	7.27

7.4.2. Electricity prices

In line with the MEErP methodology, the scenarios have been recalculated with higher and lower (+/-50%) energy prices.

The overview of the scenarios in 2040 with energy prices 50% below the former assumptions (see Table 7-7) is presented in Table 7-17:[79]

[79] Same sales and stock assumption as in 7.2.2

961 **Table 7-17: Main impact of the scenarios by 2040 (low energy price scenario)**

Criteria			MAIN IMPACTS IN YEAR 2040			
			1	2	3	4
			BAU	Ecodesign	LLCC	BAT
ENVIRONMENT						
	Electricity	TWh/year	10.54	9.27	7.93	7.82
	GHG	Mt CO2-eq./	3.16	2.78	2.38	2.35
CONSUMER						
EU totals	Expenditure	€ bln./year	2.07	1.94	1.94	1.98
	of that, purchase costs	€ bln./year	0.50	0.50	0.65	0.70
	of that, installation costs	€ bln./year	0.00	0.00	0.00	0.00
	of that, maintenance costs	€ bln./year	0.44	0.44	0.44	0.44
	of that, energy costs	€ bln./year	1.13	1.00	0.85	0.84
Per product sold	Sales (regulated)	000	18,792.52	18,792.52	18,792.52	18,792.52
	Product price	€	26.66	26.84	34.41	37.08
	Installation costs	€	0.00	0.00	0.00	0.00
	Energy costs	€/year	10.12	8.90	7.62	7.51
BUSINESS						
EU turnover	Manufacturers	€ bln./year	0.50	0.50	0.65	0.70
	Installers	€ bln./year	0.00	0.00	0.00	0.00
	Maintenance	€ bln./year	0.44	0.44	0.44	0.44
	Electricity Companies	€ bln./year	1.13	1.00	0.85	0.84
	Revenue	€ bln./year	0.13	0.13	0.15	0.16
EMPLOYMENT						
Employment (jobs)	Manufacturers	000	0.55	0.55	0.64	0.67
	Maintenance	000	2.26	2.26	2.26	2.26
	Installers	000	0.00	0.00	0.00	0.00
	Electricity Companies	000	0.89	0.78	0.67	0.66
	Indirect Employment	000	0.00	0.00	0.00	0.00
	TOTAL	000	3.70	3.59	3.56	3.58

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964 The overview of the scenarios in 2040 with energy prices 50% above the former assumptions (see
965 Table 7-17) is presented in Table 7-18:[80]

966

[80] Same sales and stock assumption as in 7.2.2

Table 7-18: Main impact of the scenarios by 2040 (high energy price scenario)

Criteria			MAIN IMPACTS IN YEAR 2040			
			1	2	3	4
			BAU	Ecodesign	LLCC	BAT
ENVIRONMENT						
	Electricity	TWh/year	10.54	9.27	7.93	7.82
	GHG	Mt CO2-eq./	3.16	2.78	2.38	2.35
CONSUMER						
EU totals	Expenditure	€ bln./year	4.34	3.93	3.64	3.66
	of that, purchase costs	€ bln./year	0.50	0.50	0.65	0.70
	of that, installation costs	€ bln./year	0.00	0.00	0.00	0.00
	of that, maintenance costs	€ bln./year	0.44	0.44	0.44	0.44
	of that, energy costs	€ bln./year	3.40	2.99	2.56	2.52
Per product sold	Sales (regulated)	000	18,792.52	18,792.52	18,792.52	18,792.52
	Product price	€	26.66	26.84	34.41	37.08
	Installation costs	€	0.00	0.00	0.00	0.00
	Energy costs	€/year	30.37	26.71	22.86	22.54
BUSINESS						
EU turnover	Manufacturers	€ bln./year	0.50	0.50	0.65	0.70
	Installers	€ bln./year	0.00	0.00	0.00	0.00
	Maintenance	€ bln./year	0.44	0.44	0.44	0.44
	Electricity Companies	€ bln./year	3.40	2.99	2.56	2.52
	Revenue	€ bln./year	0.13	0.13	0.15	0.16
EMPLOYMENT						
Employment (jobs)	Manufacturers	000	0.55	0.55	0.64	0.67
	Maintenance	000	2.26	2.26	2.26	2.26
	Installers	000	0.00	0.00	0.00	0.00
	Electricity Companies	000	2.66	2.34	2.00	1.97
	Indirect Employment	000	0.00	0.00	0.00	0.00
	TOTAL	000	5.47	5.15	4.90	4.90

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7.5. Summary

This section provides a summary of the main outcomes of the previous analyses, looking at suitable policy options to achieve improvements in the environmental performance of kettles and in the light of the life cycle costs as determined in Task 6.

7.5.1. Main policy recommendation

The analyses provided in Task 6 as well as in sections 7.2 and 7.3 of this report show that there are substantial cost-effective energy saving potentials: up to 25%. Some of the Design Options do not improve the specific energy consumption of the kettles as such, but would rather reduce the yearly energy consumption, as they impact the way the kettles will be used: less water to be heated, slightly lower water temperature, shorter keep-warm time. For these measures, there are still some uncertainties on:

- how the impact of the requirement will be on the user. Even if the impact will be positive, the magnitude is difficult to quantify without any additional survey, and;
- how the impact on the average energy consumption over the period of one year will be.

Still, the measures could be easily addressed within the Ecodesign framework by setting information requirements (e.g. better water level indication) or technical requirements (e.g. max boiling keep-warm of 30 min).

By 2040, the BAT scenario saves 2.72 TWh/a electricity compared to the BAU scenario (10.54 TWh/a), the LLCC scenario is very close to the BAT with 2.61 TWh/a electricity savings. Even if both BAT and LLCC scenarios are cost efficient, they have a major impact on the purchase price of an average kettle, which would increase by 10.42€ (+39%) in the BAT scenario and by 7.75€ (+29%) in the LLC.

Fortunately, the Ecodesign scenario has almost no impact on the purchase costs of the products but is expected to tap half of the saving potentials shown in the BAT scenario, so that this policy option would be a very interesting compromise. In this scenario, the MEPS requirement would be set at EEI >= 81%.

A pre-condition for setting a MEPS would be the definition of a common test procedure, which would be mandatory. In order to limit over-heating, it is proposed to measure the energy consumption until shut off of the kettle, while boiling water would require heating up the water up to at least 95°C. More information on the testing procedure is provided in Annex A.

Introducing a test procedure and information requirements on the performance of kettles will make the competition among manufacturers stronger. Without any mandatory test procedure, manufacturers cannot really promote the advantage of the energy efficiency thick film kettles and will not convince many customers to buy energy efficient products. At the moment, the broad range of kettles, in terms of performance, is still too limited to justify an energy label.

In addition to energy efficiency requirements, several requirements on material would be meaningful in order to ensure that end-users will consume a proper hot water and that the environmental impacts will be reduced, by promoting circular economy.

7.5.2. Main outcomes of the scenarios

Based on the criteria mentioned in Art. 15 of 2009 /125/EC (Ecodesign Directive), the impacts of the scenarios have been assessed in this report.

The main figures are presented in 2030 (see Table 7-19) and 2040 (see Table 7-20).

Table 7-19: Main impacts of the scenarios in 2030 (normal sales and electricity prices)

Criteria			MAIN IMPACTS IN YEAR 2030			
			1	2	3	4
			BAU	Ecodesign	LLCC	BAT
ENVIRONMENT						
	Electricity	TWh/year	9.77	8.60	7.36	7.25
	GHG	Mt CO2-eq./	3.32	2.92	2.50	2.47
CONSUMER						
EU totals	Expenditure	€ bln./year	2.96	2.71	2.58	2.61
	of that, purchase costs	€ bln./year	0.48	0.48	0.61	0.66
	of that, installation costs	€ bln./year	0.00	0.00	0.00	0.00
	of that, maintenance costs	€ bln./year	0.41	0.41	0.41	0.41
	of that, energy costs	€ bln./year	2.07	1.82	1.56	1.54
Per product sold	Sales (regulated)	000	17,848.85	17,848.85	17,848.85	17,848.85
	Product price	€	26.66	26.84	34.41	37.08
	Installation costs	€	0.00	0.00	0.00	0.00
	Energy costs	€/year	19.97	17.57	15.03	14.82
BUSINESS						
EU turnover	Manufacturers	€ bln./year	0.48	0.48	0.61	0.66
	Installers	€ bln./year	0.00	0.00	0.00	0.00
	Maintenance	€ bln./year	0.41	0.41	0.41	0.41
	Electricity Companies	€ bln./year	2.07	1.82	1.56	1.54
	Revenue	€ bln./year	0.12	0.12	0.14	0.15
EMPLOYMENT						
Employment (jobs)	Manufacturers	000	0.52	0.52	0.60	0.63
	Maintenance	000	2.10	2.10	2.10	2.10
	Installers	000	0.00	0.00	0.00	0.00
	Electricity Companies	000	1.62	1.43	1.22	1.20
	Indirect Employment	000	0.00	0.00	0.00	0.00
	TOTAL	000	4.24	4.04	3.92	3.93

Table 7-20: Main impacts of the scenarios in 2030 (high sales, normal energy prices)

Criteria			MAIN IMPACTS IN YEAR 2030 1 BAU	2 Ecodesign	3 LLCC	4 BAT
ENVIRONMENT						
	Electricity	TWh/year	16.74	14.72	12.60	12.42
	GHG	Mt CO2-eq./	5.69	5.01	4.28	4.22
CONSUMER						
EU totals	Expenditure	€ bln./year	5.06	4.64	4.42	4.47
	of that, purchase costs	€ bln./year	0.81	0.82	1.05	1.13
	of that, installation costs	€ bln./year	0.00	0.00	0.00	0.00
	of that, maintenance costs	€ bln./year	0.70	0.70	0.70	0.70
	of that, energy costs	€ bln./year	3.55	3.12	2.67	2.64
Per product sold	Sales (regulated)	000	30,565.87	30,565.87	30,565.87	30,565.87
	Product price	€	26.66	26.84	34.41	37.08
	Installation costs	€	0.00	0.00	0.00	0.00
	Energy costs	€/year	19.97	17.57	15.03	14.82
BUSINESS						
EU turnover	Manufacturers	€ bln./year	0.81	0.82	1.05	1.13
	Installers	€ bln./year	0.00	0.00	0.00	0.00
	Maintenance	€ bln./year	0.70	0.70	0.70	0.70
	Electricity Companies	€ bln./year	3.55	3.12	2.67	2.64
	Revenue	€ bln./year	0.21	0.21	0.24	0.26
EMPLOYMENT						
Employment (jobs)	Manufacturers	000	0.89	0.89	1.03	1.08
	Maintenance	000	3.59	3.59	3.59	3.59
	Installers	000	0.00	0.00	0.00	0.00
	Electricity Companies	000	2.78	2.44	2.09	2.06
	Indirect Employment	000	0.00	0.00	0.00	0.00
	TOTAL	000	7.26	6.92	6.71	6.73

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References for Task 7

EC (2009): Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of Ecodesign requirements for energy-related products. Online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0125&from=EN. Accessed: 07/02/2019.

EC (2010): Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products. Online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0030&from=EN. Accessed: 07/02/2019.

EC (2015): COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Commission Regulation implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for solid fuel boilers. Online: http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/swd_2015_0092_en.pdf. Accessed: 10/10/2018.

EC (2016): COMMISSION RECOMMENDATION (EU) 2016/2125 of 30 November 2016 on guidelines for self-regulation measures concluded by industry under Directive 2009/125/EC of the European Parliament and of the Council. Online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016H2125&from=EN. Accessed: 07/02/2019.

EU (2017): Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017 setting a framework for energy labelling and repealing Directive 2010/30/EU. Online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R1369&from=EN. Accessed: 07/02/2019.

KU LEUVEN (2018) Repairability criteria for energy related products. Online: http://www.benelux.int/files/7915/2896/0920/FINAL_Report_Benelux.pdf. Accessed: 07/07/2019.

Norms and standards

EN 45555:2019: General methods for assessing the recyclability and recoverability of energy-related products

EN 45557:2020: General method for assessing the proportion of recycled material content in energy-related products

IEC 60530:1975: Methods for measuring the performance of electric kettles and jugs for household and similar use

IEC 60530:1975/AMD1:1992: Amendment 1 - Methods for measuring the performance of electric kettles and jugs for household and similar use

IEC 60530:1975/AMD2:2004: Amendment 2 - Methods for measuring the performance of electric kettles and jugs for household and similar use

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7.6. Annex A – Test procedure for electric kettles

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7.6.1. Definition

- V_{rated} [l]: rated water capacity of the kettle;
- V_{min} [l]: minimum water capacity of the kettle;
- E: electricity consumed until the kettle shuts off under the test condition;
- T_{boil} [°C]: boiling temperature. In the context of this test procedure, T_{boil} corresponds to a water temperature of 95°C at ambient pressure;
- Boiling: process of raising the water temperature in the vessel of the kettle from T_1 up to at least T_{boil};
- T_{kw} [°C]: average water temperature in keep-warm mode when the highest keep-warm temperature is selected;
- $E_{Tboil,Vrated}$ [Wh]: electricity consumed to heat the rated water capacity from T_1 to boiling temperature. It is measured until the kettle shuts off;
- $E_{Tboil,1}$ [Wh]: electricity consumed to heat 1 litre of water from T_1 to boiling temperature. It is measured until the kettle shuts off;
- $E_{Tboil,Vmin}$ [Wh]: electricity consumed to heat the minimum water capacity from T_1 to boiling temperature. It is measured until the kettle shuts off;
- $E_{70°C,Vrated}$ [Wh]: electricity consumed to heat the rated water capacity from T_1 until shut-off, when 70°C pre-set temperature (or the nearest pre-set temperature above 70°C) is selected. It is measured until the kettle shuts off;
- $E_{70°C,Vmin}$ [Wh]: electricity consumed to heat the minimum water capacity from T_1 until shut-off, when 70°C pre-set temperature (or the nearest pre-set temperature above 70°C) is selected. It is measured until the kettle shuts off;
- P_{rated} [W]: rated input power
- $P_{kw,Vrated}$ [W]: average input power to keep warm the rated water capacity when the highest keep-warm temperature is selected;
- $p_{kw,Vrated}$ [W/l]: specific input power to keep warm the rated water capacity when the highest keep-warm temperature is selected;
- C: specific heat capacity of water;
- $t_{Tboil,Vmin}$ [s]: time to boil the minimum water capacity. It is the time to raise the water temperature from T_1 until T_{boil} is reached and the kettle shuts off;
- $t_{Tboil,Vrated}$ [s]: time to boil the rated water capacity. It is the time to raise the temperature from T_1 until T_{boil} is reached and the kettle shuts off;
- $t_{Tboil,1}$ [s]: time to boil 1 litre of water. It is the time to raise the temperature from T_1 until T_{boil} is reached and the kettle shuts off;
- $t_{70°C,Vrated}$ [s]: time to heat the rated water capacity when 70°C pre-set temperature (or the nearest pre-set temperature above 70°C) is selected. It is the time to raise the temperature from T_1 until the kettle shuts off;
- $t_{70°C,Vmin}$ [s]: time to heat the minimum water capacity when 70°C pre-set temperature (or the nearest pre-set temperature above 70°C) is selected. It is the time to raise the temperature from T_1 until the kettle shuts off;
- t_{KWmax} [min]: maximum keep-warm time;
- keep-warm: function which keeps the water temperature in the range of a pre-set temperature.
- $P_{standby}$ [W]: power consumption in stand-by mode
- $P_{off-mode}$ [W]: power consumption in off-mode

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- T_{drop} [°C]: water temperature drop measured during the cool-down test
- N_{cyc} [-]: number of cycles carried out successfully with the same kettle during the durability test

7.6.2. General conditions for measurements

In this document, in order to facilitate the testing, **the quantity of cold-water indicated in litre is assumed to be the same in kg**.[82]

Testing conditions:

- ambient temperature and appliance preconditioned at a temperature: 20 +/- 3°C
- cold water temperature: 15 +/- 1°C
- the water temperature is measured by a watertight thermocouple situated 10 mm above the bottom centre of the water container or the highest end of the electric heating element[83]
- testing room: substantially draught free

7.6.3. Measuring methods

7.6.3.1. Definition of the energy efficiency

The energy efficiency is calculated as the ratio of the theoretical energy demand needed to bring a defined amount of cold water T_1 to the target temperature T_2 in relation to the measured electricity consumed until shut-off to heat the same amount of water under the same conditions:

$$\eta = \frac{C \cdot V \cdot (T_2 - T_1)}{E \cdot 3600}$$

Where:

- C: specific heat capacity of water, 4186 J/(kg.K), at 15°C and 101 kPa
- V: volume of water in l
- T_1: initial water temperature, expressed in °C; T_1 = 15°C in all tests performed according to this standard
- T_2: final water temperature, expressed in °C;
- E: electricity consumed until shut-off, expressed in Wh.

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[82] accordingly, in the sense of this document, V_x and M_x correspond to the same quantity of water (x kg or x litre)

[83] in case of kettles with immersed heating element

7.6.3.2. Definition of the standardised energy consumption

The standardised energy consumption (SEC) [kWh] for heating 100 litres of water is calculated as follows:

$$SEC = \frac{100}{1000} \cdot \frac{\left(30\% \cdot E_{Tboil,Vmin} + 50\% \cdot E_{Tboil,Vrated} + 20\% \cdot E_{70°C,Vrated}\right)}{30\% \cdot V_{min} + 70\% \cdot V_{rated}} + P_{standby} \cdot \frac{8760}{1000} \cdot \frac{1}{8}$$

Where,

- SEC: standardised energy consumption, expressed in kWh
- $E_{Tboil,Vmin}$: electricity consumed to heat the minimum water capacity from T_1 to boiling temperature, measured until the kettle shuts off, expressed in Wh
- $E_{Tboil,Vrated}$: electricity consumed to heat the rated water capacity from T_1 until shut-off, when 70°C pre-set temperature (or the nearest pre-set temperature above 70°C) is selected. It is measured until the kettle shuts off, expressed in Wh
- $E_{70ºC,Vrated}$: electricity consumed to heat the rated water capacity from T_1 until shut-off, when 70°C pre-set temperature (or the nearest pre-set temperature above 70°C) is selected. It is measured until the kettle shuts off, expressed in Wh;
- V_{min}: minimum water capacity of the kettle expressed in volume, expressed in litre;
- V_{rated}: rated water capacity of the kettle, expressed in litre;
- $P_{standby}$: power consumption in stand-by mode, expressed in W.

7.6.3.3. Tests procedures

7.6.3.3.1. Test 1: Energy consumption ($E_{Tboil,Vrated}$) and time measurement ($t_{Tboil,Vrated}$) for boiling until shut-off at rated water capacity to determine the energy efficiency (EEI)

Fill the kettle with cold water (15°C) to the rated water capacity level of the kettle. Start the boiling process and start timing ($t=t_s$). Measure the energy consumption $E_{Tboil,Vrated}$ until the kettle shuts-off ($t=t_e$). The water temperature has to be at least 95°C. The boiling time is measured as: $t_{Tboil,Vrated} = t_e - t_s$ at test conditions.

Calculate the energy efficiency index as follows:

$$EEI = \eta_{Tboil,Vrated} = \frac{C \cdot V_{rated} \cdot (T_{boil} - T_1)}{E_{Tboil,Vrated} \cdot 3600}$$

Where:

- $\eta_{Tboil,Vrated}$: is the energy efficiency of the kettle at rated water capacity and boiling temperature.
- C: specific heat capacity of water, 4,186 J/(kg.K) at 15°C and 101 kPa
- V_{rated}: rated water capacity of a kettle, expressed in litre;
- T_1: initial water temperature, expressed in °C; T_1 = 15°C in all tests performed according to this test procedure
- T_{boil}: boiling temperature, expressed in °C. In the context of this test procedure, T_{boil} corresponds to a water temperature of 95°C at ambient pressure;

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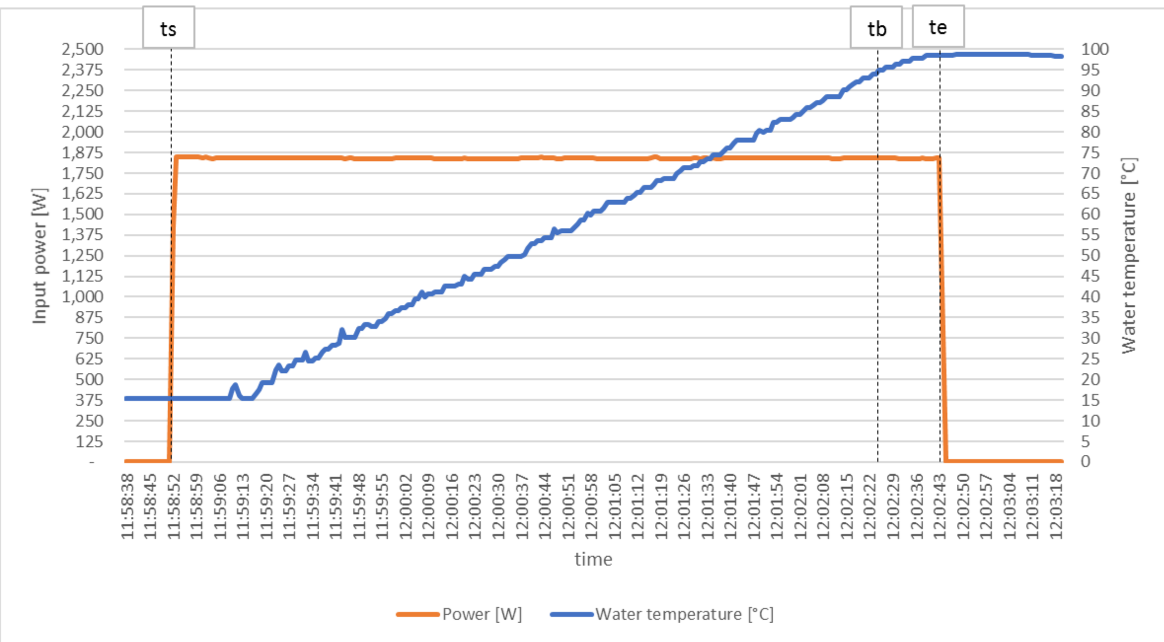
- $E_{Tboil,Vrated}$: electricity consumed to heat the rated water capacity from T_1 to boiling temperature, measured until the kettle shuts off, expressed in Wh.

Figure 7-16 shows a typical measurement for boiling test to have as an example, in order to calculate the energy efficiency and the EEI of a kettle.

Figure 7-16: Example of boiling test result measurements



7.6.3.3.2. Test 2: Energy consumption and time measurement for boiling until shut-off at minimum water capacity

Fill the kettle with cold water (15°C) to the minimum water capacity level of the kettle. Start the boiling process and start timing ($t=t_s$). Measure the energy consumption $E_{Tboil,Vmin}$ until the kettle shuts-off ($t=t_e$). The water temperature has to be at least 95°C. The boiling time is measured as: $t_{Tboil,Mmin} = t_e - t_s$ at test conditions.

7.6.3.3.3. Test 3: Energy consumption and time measurement for boiling tests until shut-off at volume = 1 litre.[84]

Fill the kettle with cold water (15°C) to 1 litre of water. Start the boiling process and start timing ($t=t_s$). Measure the energy consumption $E_{Tboil,1}$ until the kettle shuts-off ($t=t_e$). The water temperature has to be at least 95°C. The boiling time is measured as: $t_{Tboil,1} = t_e - t_s$ at test conditions.

7.6.3.3.4. Test 4: Energy consumption and time measurement for heating until shut-off at pre-set temperature of 70ºC (or the nearest pre-set temperature above 70ºC) at a rated water capacity

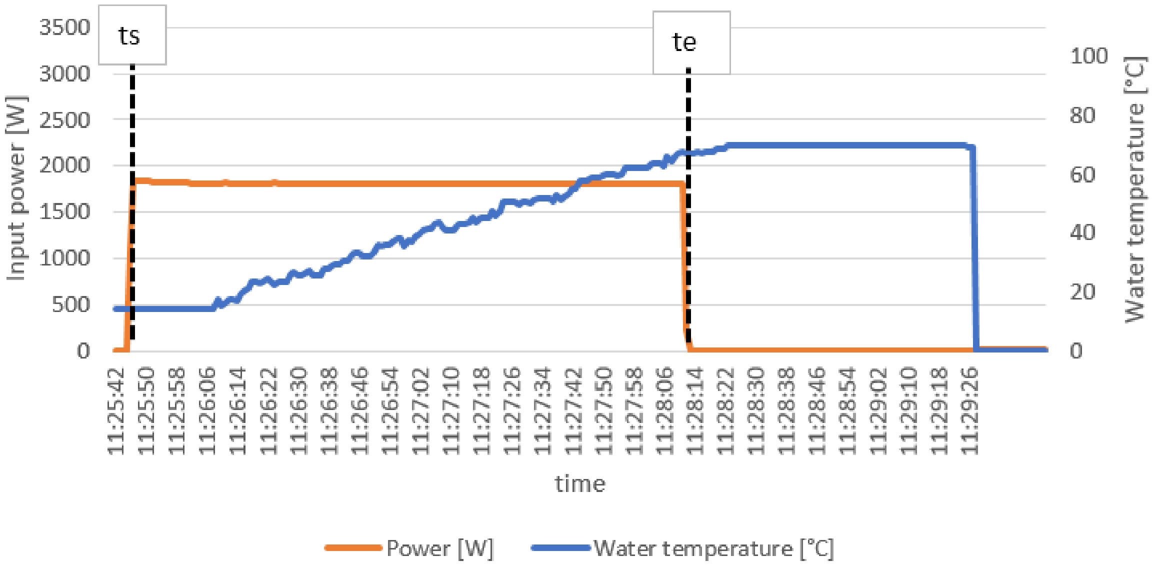
Fill the kettle with cold water (15°C) to the rated water capacity level of the kettle. Start the heating process ($t=t_s$). Measure the energy consumption $E_{70°C,Vrated}$ until the kettle shuts off ($t=t_e$).

[84] applicable if V_{rated}>1 litre

It shall be verified, that the water temperature is higher than 70°C when the kettle shuts off ($T_{t=te} \geq 70°C$). The heating time is measured as $t_{70°C,Vrated} = t_e - t_s$ at the condition of the test.

Figure 7-17 shows a typical energy efficiency measurement for heating test at pre-set temperature to have as an example.

Figure 7-17: Example of a heating test at pre-set temperature measurements



7.6.3.3.5. Test 5: Energy consumption and time measurement for heating until shut-off at pre-set temperature of 70ºC (or the nearest pre-set temperature above 70ºC) at minimum water capacity

Fill the kettle with cold water (15°C) to the minimum water capacity level of the kettle. Start the heating process ($t=t_s$). Measure the energy consumption $E_{70°C,Vmin}$ until the kettle shuts off ($t=t_e$). It shall be verified, that the water temperature is higher than 70°C when the kettle shuts off ($T_{t=te} \geq 70°C$). The heating time is measured as $t_{70°C,Vmin} = t_e - t_s$ at the condition of the test.

7.6.3.3.6. Test 6: Average input power, average water temperature and maximum keep warm time measurement for keep warm function at maximum keep warm temperature and maximum time setting at a rated water capacity

Fill the kettle with cold water (15°C) to the rated water capacity level of the kettle; select the highest pre-set temperature for keep-warm function and the longest possible keep-warm time and start. At the end of the heating process, the keep-warm phase starts ($t=t_{kw\text{-}s}$). Measure the average input power P_{kw} and the average water temperature T_{kw} during the keep-warm phase. Check that T_{kw} corresponds to the pre-set temperature +/- 3°C. The maximum keep-warm time t_{KWmax} is defined as $t_{kw\text{-}e} - t_{kw\text{-}s}$.

Calculate the specific average power input as follows:

$$p_{kw,Vrated} = \frac{P_{kw,Vrated}}{V_{rated}}$$

Where:

- $P_{kw,Vrated}$: average input power to keep warm the rated water capacity when the highest keep-warm temperature is selected, expressed in W;
- V_{rated}: rated water capacity of a kettle, expressed in litre;
- $p_{kw,Vrated}$: specific input power to keep warm the rated water capacity when the highest keep-warm temperature is selected, expressed in W/l.

Figure 7-18 shows a typical measurement of a keep-warm test.

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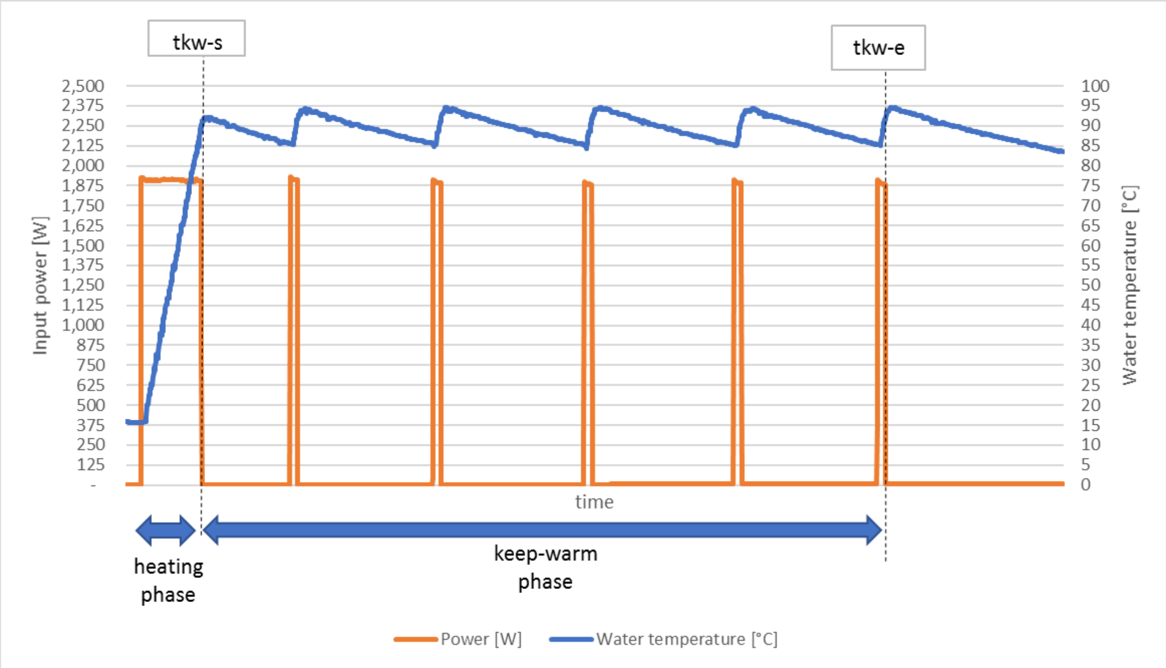
Figure 7-18: Example of keep-warm test measurements

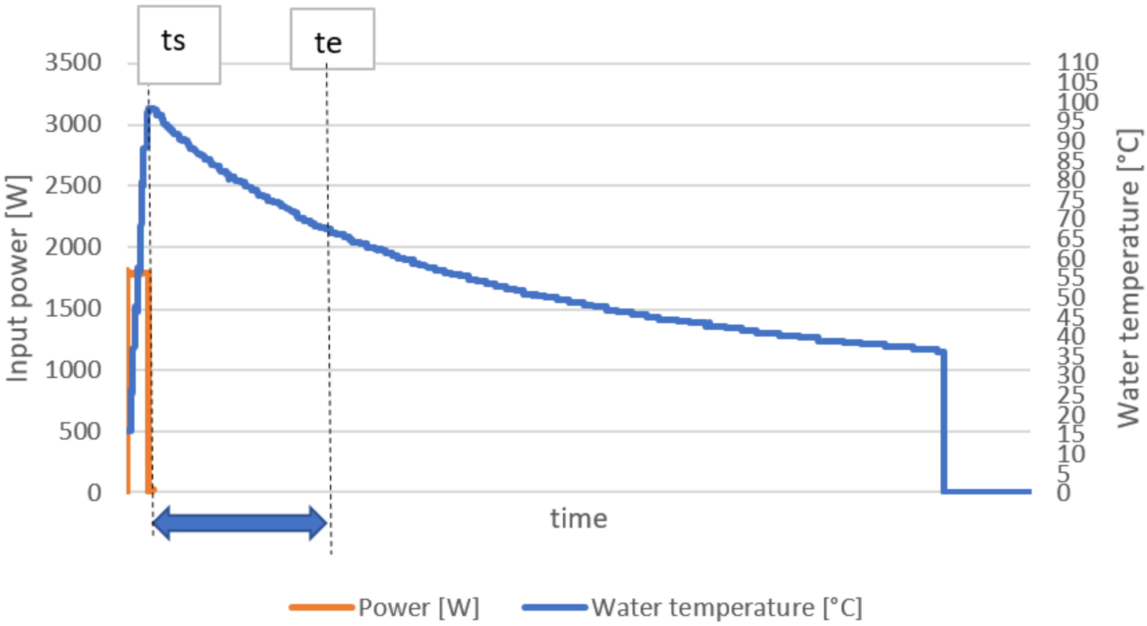


7.6.3.3.7. Test 7: Temperature drop for cool down 30 minutes after boiling at rated water capacity

Fill the kettle with cold water (15°C) to the rated water capacity level of the kettle. Start the boiling process. Measure the water temperature when the boiling process stops ($t=t_s$) and 30 minutes later. Report the temperature drop $T_{drop} = T_{(t=ts)} - T_{(t=te)}$.

Figure 7-19 shows typical measurements of a cool-down test to have as an example.

Figure 7-19: Example of cool-down test measurements



7.6.3.3.8. Test 8: Stand-by and off-mode tests

To be measured according to according to EN 50564:2011-12 (IEC 62301:2011, modified) "Household electrical appliances - Measurement of standby power".

7.6.3.3.9. Test 9: Durability test

Each cycle is defined as follows: fill in the container with 1 litre of cold water and boil the water, check that the water temperature could at least reach 95°C. After the kettle shuts off, pour the water out. The kettle shall work normally, meaning the power switch shall operate smoothly; the lid shall open and close smoothly, the container has no leak. Repeat the cycle and when required, descale the kettle.

The maximum number of cycles carried out successfully with the same kettles is N_{cyc}.

7.6.3.3.10. Overview of the tests measurements and calculations

Table 7-21 shows a summary of the required test measurements and calculations.

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Table 7-21: Overview of the test conditions and calculation of the results

Test number	Type of test	Quantity of water	Measurement	Parameters measured or calculated
Test 1	Boiling	Rated water capacity	Until shut-off (at least T_{boil})	$E_{Tboil,Vrated}$ $t_{Tboil,Vrated}$ EEI
Test 2	Boiling	Minimum water capacity	Until shut-off (at least T_{boil})	$E_{Tboil,Vmin}$ $t_{Tboil,Vmin}$
Test 3	Boiling	1 litre (*)	Until shut-off (at least T_{boil})	$E_{Tboil,1}$ $t_{Tboil,1}$
Test 4	Heating	Rated water capacity	Until shut-off, when 70°C pre-set temperature (or the nearest pre-set temperature above 70°C) is selected	$E_{70°C,Vrated}$ $t_{70°C,Vrated}$
Test 5	Heating	Minimum water capacity	Until shut-off, when 70°C pre-set temperature (or the nearest pre-set temperature above 70°C) is selected	$E_{70°C,Vmin}$ $t_{70°C,Vmin}$
Test 6	Keep-warm	Rated water capacity	Max keep-warm temperature selected Longest possible keep-warm time	t_{kwmax} T_{kw} $P_{kw,Vrated}$ $p_{kw,Vrated}$
Test 7	Cool down	Rated water capacity		T_{drop}
Test 8	Standby	0 litre		$P_{standby}$
Test 9	Durability	1 litre (or V_{rated} if V_{rated} > 1litre)	Until shut-off (at least T_{boil})	N_{cyc}

n.a.: not applicable
* applicable if V_{rated} > 1 litre

7.6.3.3.11. Definition of the recyclability rate

The recyclability rate R_{cyc} is assessed according to EN 45555:2019 "General methods for assessing the recyclability and recoverability of energy-related products".

7.6.3.3.12. Definition of the post-consumer materials content

The post-consumer materials content R_{post} is assessed according to EN 45557:2020 "General method for assessing the proportion of recycled material content in energy-related products".

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7.7. Annex B – Meetings with stakeholders

7.7.1. Stakeholder meeting on 15th July 2020: minutes

Distribution: General

vito vision on technology

Date :	15/07/2020	Ref.	ENER/C4/FV 2019-467/06/FWC 2015-619 LOT1/05
From :	Fraunhofer ISI	Annex(es):	**PowerPoint presentations of the meeting (here)**

Minutes of stakeholder Meeting for Ecodesign Preparatory Study on electric kettles - First Stakeholder meeting on 15/07/2020

Online event

Participants

Organization	Role
DG ENER	European Commission
Fraunhofer ISI	Project team
APPLiA Home Appliance Europe	Stakeholders
BSH Hausgeräte GmbH / APPLiA	
Danish Energy Agency	
De'Longhi Appliances / APPLiA	
ECOS	
EEB	
IEP	
Karlsuher Institute für Technologie	
Netherlands Enterprise Agency	
Öko-Institut	
Otter Controls Limited	
SEB / APPLiA	
Swedish Energy Agency	
Topten	
Umweltbundesamt	
Which?	

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Distribution: General

Objective of the meeting

The meeting was the stakeholder meeting for the Ecodesign preparatory study for electric kettles. The purpose of this meeting was to discuss with stakeholders the implementation of the stakeholder feedback on Tasks 1-4 and the outlook of Tasks 5-7. Stakeholders can provide comments on the draft reports of Tasks 1-4, which are available here. Documents related to the stakeholder meeting are available under the same link. Preliminary figures related to Task 5-6 have been sent per email to the stakeholders after the stakeholder meeting.

Agenda

12:45 – 13:10	Arrival of participants
13:10 – 13:20	**Welcome and presentation of the consortium** Fraunhofer ISI
13:20 – 13:25	**Methodology and context of the study** Fraunhofer ISI
13:25 – 13:50	**Presentation of Task 1: Scope** Fraunhofer ISI
13:50 – 14:35	**Presentation of Task 2: Markets** Fraunhofer ISI
14:35 – 14:40	Break
14:40 – 15:30	**Presentation of Task 3: Users** Fraunhofer ISI
15:30 – 16:20	**Presentation of Task 4: Technologies** Fraunhofer ISI
16:20 – 16:50	**Presentation of an insight in Tasks 5-6-7** Fraunhofer ISI
16:50	**Closing** Fraunhofer ISI

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Distribution: General

Minutes

Welcome and Short presentation of the consortium

Fraunhofer ISI opened the meeting. He welcomed the participants and explained the housekeeping rules for the online meeting. He presented the agenda for the meeting and shortly introduced the consortium. The study is carried out by the project team at Fraunhofer ISI and the project is managed by VITO. Although not a part of the call, an additional stakeholder meeting is likely to be held in Oct/Nov 2020. Stakeholders will have three weeks to comment on the draft reports and are requested to follow the provided template. The whole work (incl. working document for the Consultation Forum) has to be completed by end of January 2021.

ISI presented the background on methodology and context on the study followed by Task 1: Scope (see PowerPoint).

The presentation was followed by a discussion:

abbr.	Comment/answer
ECOS	Where does the 10 l limitation come from, it is not specified in the working plan 2015-17? ISI: The 10 l threshold is based on the safety standard *(20.7.2020: EN 60335–2–15:2002+A2:2008 "Household and similar electrical appliances — Safety — Part 2-15: Particular requirements for appliances for heating liquids", which covers "kettles and other appliances for boiling water, having a rated capacity not exceeding 10 l")*
ECOS	Are we certain that appliances with a larger capacity than 10 l don't have a significant environmental impact? ISI: For the market data in task 2 we didn't consider that limitation and these appliances are included but have a really low market share
Umweltbundesamt	Regarding the boiling water heaters: if you have your base case of 1000 l, how is the energy used compared to the kettles. ISI: More information is available in the VHK report[1].
APPLiA	Will you complete the list of excluded appliances, like coffee machines, urns and appliances producing directly hot drinks, tea makers? ISI: The list could indeed be more precise, we will to do it after the meeting.
APPLiA	The UK pattern of use is different from the UK 27. ISI: We excluded UK for all statistics and we try to look for data on the Member States but if there is no data from EU27, we will use the UK data.

ISI presented Task 2: markets (see PowerPoint).

Afterwards there was a discussion:

abbr.	Comment/answer
ECOS	Market figures: is it only household or restaurants and hotels are also included? ISI: B2B channels are not included in the GfK data, therefore we do not know to what extent the data from hotels and restaurants is included.

[1] see Energy analysis for Quooker (VHK 2010): https://www.vhk.nl/downloads/Reports/2010/Energy%20analysis%20Quooker.zip

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BSH	Lime scale filter: you should differentiate between the lime scale filter and consumable filter (cartridge) and on slide 59: it should be water filter instead of built-in lime filter ISI: built-in water filter use cartridge (e.g. Brita) and filter the water that will be boiled.
BSH	What is the definition of a re boil function ISI: category covered by GfK. We will clarify the definition in the report *(20.7.2020: Re-boil is a dynamic function. It ensures the water kettle to restart automatically each time when the temperature of the water in the kettle has cooled down below a certain temperature)*
Umweltbundesamt	Any data about Smart devices? ISI: the category is also covered by GfK but the share is very low, and we couldn't see any significant increasing trend. Data is already included in the report, market share: 0.5%.
Umweltbundesamt	Any data on energy consumption for heating up 1 litre of water? Data could be available from consumer organizations? ISI: Data will be provided in task 5. Since there is no regulation for energy consumption, GfK data doesn't cover data on that. Some consumer organizations like Which? or Stiftung Warentest have tested products and have data, but we can only access the report and not the raw data. The Swedish energy agency carried out a test on around 10 kettles. We received the valuable data of this test and the info is used for in task 5.
Otter	Boil dry protection as additional feature does not affect the energy consumption that much but is necessary for the safety. ISI: We will check and possibly correct this feature
Otter	We have some data on energy consumption of the kettles with different types of elements. I will send it to you after the meeting.
EEB	The table on slide 55 is misleading. There are many correlations among different features, if you do a multi regression analysis you will be able to get more targeted results for each of the features. But the table shown here will not be useful for calculation of the extra costs for a certain feature ISI: the additional price does not correspond to only one feature. The data provided by GfK are not covering all features at once, so we cannot do the multi parameter analysis. If the table is confusing, we will remove it.
Topten	You have no data from B2B, maybe manufactures could provide some data, are you looking into that? ISI: We had already talks with the some manufacturers but so far they could not provide any data. This was also the reason why we had to buy market data.
Which?	Energy consumption: we collect data on that and we can share it with you. Lime scale filter: we collect information on that but there is a correlation between descaling and consumers who throw away their kettles too early. The lime scale problems could have something to do with the owners not maintaining the kettles rather than the fault of the kettle. Smart appliances: we have similar data, so it is the niche market. But it could become a large portion of the market in a few years.

ISI presented Task 3: Users (see PowerPoint).
Afterwards a discussion took place:

abbr.	Comment/answer
De'Longhi	Regarding the 1000 litre per year as the average boiled amount for a kettle: - We still do not have this certainty that this figure is realistic and we believe that UK cannot be used as the use pattern for EU27, the intensity of usage of kettle in UK is much higher. - You refer to a study from TNO, but that one is not clear. The 1000 l is the overall usage in households; 650 l for hot drinks and 350 l for cooking, but I do not believe people use kettle for cooking.

	- I believe 1000 l is overestimating, so I suggest to check again and look for more sources. We also try to support. - Consider this input in sensitivity analysis. ISI: We also agree that UK might not be the closest-to-reality assumption, but we currently have no better data source. The 1000 l has been repeated in various publications. The project team will check the data again, but additional data from the stakeholders is welcome. In an energy-related methodology, the actual shut-off temperature should be used instead of a fixed temperature increase. ISI: The project team agrees.
Topten	How did you come to the 7 year life time, from the data set it seems that it could be lower, if there are studies about that, they should be included ISI: The project teams takes the remark into consideration and will check for additional sources/verification.
Otter	Any test for the energy consumption should have the lid on and the temperature should not be considered 100, because it varies with the pressure, ... So the tests should be lid on and when the kettle automatically turns off ISI: The project team agrees and will take consider this concerning the conclusions towards a potential methodology for measurement.

ISI presented Task 4: Technologies (see PowerPoint).

Afterwards a discussion took place:

abbr.	Comment/answer
EEB	Choice of materials: did you include the full container material perspective (environmental impact and health issues) ISI: such issues will be addressed and considered in Task 5
De'Longhi	We will provide answer to many questions mentioned in this task. Is there more information or drawings about double chamber feature available? ISI: the project team showed an additional slide showing how a double chamber product can look like and explained the working principle on base of a drawing (see back-up slide of the PowerPoint).
ECOS	Why was the digital display feature considered not useful and excluded ISI: Monitoring the temperature is a valuable feature, but it should not be limited on a digital display solely. It would be beneficial to provide a technology-open level playing field. Meaning, that it is up to the producer to find technical solutions to monitor the water temperature. The 3 base cases are out of plastic, isn't it useful to vary on that? ISI: we chose plastic because they are the most kettles sold. Amongst other measures, material substitution will be analysed from environment and energy perspectives in other upcoming tasks.
Netherlands Enterprise Agency	What is the contribution of these options/improvements in energy/material efficiency? ISI: Task 4 shall provide an overview and technical description of technological parameters. Other objectives of task 4 are the definition of Base Cases and the identification of potential measures for standard improvement of electric water kettles. More detailed questions of the named measures on energy/ material efficiency are addressed in task 6
De'Longhi	Over boiling cannot be completely avoided by double chamber ISI: we totally agree, over boiling is a user behaviour issue but certain constructions and control mechanism may lead to a higher sensitivity for the over boiling by users.
Otter	- BC 2 and 3: no or really low aluminium amount, you should check that

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	- Not all kettles with concealed element and dry boil protection do reset automatically and the user needs to reset them manually. - It is possible to do a lift up switch off function, it is already available in some kettles - It is difficult to know how each feature is going to improve energy efficiency. The best practice for the best kettle depends on how it is going to be used. - Thick film elements are more efficient, but the efficiency depends on how much water is boiled. So you need to set different tests for looking at the efficiency.

ISI presented the outlook of Tasks 5, 6 and 7:

ISI explained that the work presented in this part was the preliminary stage of the work and therefore still open to recommendations. He requested the stakeholders to provide their feedback on the indicators to be added or on available data sources that they might have access to.

Some general and specific questions were asked following the presentation:

abbr.	Comment/answer
De'Longhi	Will you also provide the Task 5 report? ISI: for Tasks 5-7, there are no reports (yet). We worked on data for Task 5-7 the last weeks and wanted to present the first assumptions, to get comments of the stakeholders. We'll upload a pdf of the presented slides and you can comment on that. Is it possible to extend the deadline? ISI: comments should be sent by 5th of August.
Topten	Suggests to include the information on boiling time in the list of indicators
Umweltbundesamt	Asks if circular economy means recycle material content and recyclability ISI: yes
ECOS	Can we extend the deadline to 21st of August? ISI: we need the feedback by 5th of August. But tell us by then if you will update the comments later. Basically, the schedule of the project is tight: the contract will expire beginning of February 2021 and can't be extended.

Wrap-up of meeting and closure of the meeting

ISI thanked the project team for the presentations and emphasised that carrying out an eco-design study in such a short time would be a novelty. He thanked also the stakeholders for their participation and the valuable contributions during the meeting and for providing further **comments by 5th of August.**

7.7.2. *Exchange with stakeholders on 21st October 2020: minutes*

Distribution: General

Date :	21/10/2020	Ref.	ENER/C4/FV 2019-467/06/FWC 2015-619 LOT1/05
From :	Fraunhofer ISI	Annex(es):	**PowerPoint presentations of the meeting**

Exchange with stakeholders on 21/10/2020 for Ecodesign Preparatory Study on electric kettles - Minutes of the meeting

Online event

Participants (30 registrants, 26 attendees)

Organization	Role
DG ENER	European Commission
Fraunhofer ISI	Project team
VITO	
AMDEA	Stakeholders
ANEC/BEUC	
APPLiA Home Appliance Europe	
BSH Hausgeräte GmbH / APPLiA	
BAM (Germany)	
Danish Energy Agency (Denmark)	
De'Longhi Appliances / APPLiA	
ECOS	
EURIC	
FPSE (Belgium)	
NEA (Netherlands Enterprise Agency)	
NVE (Norway)	
Öko-Institut e.V. on behalf of BEUC	
Otter Controls Limited	
Philips	
SMEG SpA	
SEB / APPLiA	
Swedish Energy Agency (Sweden)	
Topten Switzerland	
UBA (Umweltbundesamt, Germany)	
Which? (United Kingdom)	
ZVEI (Germany)	

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Distribution: General

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Objective of the meeting

A document "Key assumptions of the study and possible policy options" has been send to the stakeholders on 9th of October. Stakeholder were invited to provide comments on the assumptions before the meeting, comments regarding the policy options can be done until 28th of October. One objective of this meeting was to report on the stakeholders comments regarding the Base Case and Design Options assumptions, which are the key input data for Task 5 and Task 6. A second objective of the meeting was to report on comments regarding testing procedure, EE metrics and possible policy options, and to provide more explanation to the stakeholders regarding these points and to exchange with them.

Agenda

8:45 – 9:00	**Session opened (technical check)**
9:00 – 9:10	**Welcome and presentation of the consortium** Fraunhofer ISI
9:10 – 10:10	**Reporting on feedbacks regarding the assumptions (Base Cases & Design Options)** Fraunhofer ISI
10:10 – 10:40	**Testing procedure and Energy Efficiency metrics** Fraunhofer ISI
10:40 – 11:50	**Policy options** Fraunhofer ISI
11:50 – 12:00	**Further proceeding and schedule, other issues, closing** Fraunhofer ISI

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Distribution: General

Minutes

Welcome and Short presentation of the consortium

Fraunhofer ISI opened the meeting. The moderator welcomed the participants and explained the housekeeping rules for the online meeting. He presented the agenda for the meeting and shortly introduced the consortium. The whole work (incl. working document for the Consultation Forum) has to be completed by end of January 2021.

ISI presented the feedbacks regarding the Base Case assumptions

The presentation was followed by a discussion:

abbr.	Comment/answer
De Longhi	It is important to have a common testing method. Otherwise, it would be difficult to comment on the data. *ISI: We will have a section later dedicated to this topic (methods, volume of water, target temperature…).*
ANEC BEUC	Why are the water costs (for boiling) lower in BC1 than in BC2 and BC3? *ISI: For all base cases the water costs are indeed the same (2,39€).*
Otter Controls	Concerning minimum water levels: It is easier for concealed heating electric appliances to deal with lower minimum water levels (e.g. 0.2 litre). However, this would be more difficult for unconcealed heating elements.
Amdea	Regarding immersed heating elements: The data is from testing on new electric kettles, but the data does not show behaviour over the lifetime of an electric kettle. *ISI: You are right. The assumptions are made for "new kettles". We do not have data regarding the impact of lifetime on the EE performance of the products and would welcome any data regarding this aspect.*
Topten	"Keep warm function": It would be helpful to have a comparison of how much energy is used by boiling vs. keeping the water warm. Without the information / comparison of whether keep-warm function makes sense, we cannot assess whether it is better to re-boil or to keep warm. *ISI: It is difficult to assess whether the feature makes sense, but we will provide information for a comparison*

ISI presented the feedbacks regarding the Design Option assumptions

The presentation was followed by a discussion:

abbr.	Comment/answer
UBA	Regarding the recyclability of electric kettles: Is there a reason why there was no design option regarding PCR? Should be easy to provide information in this area. *ISI: A predominant share of energy consumption within the overall life cycle of a kettle can be assigned to the use phase. PCR or recyclability in general play a minor role.*
Topten	1) Regarding the water level Indicator (overboiling): It is not clear what the proposed change was. The impact should be higher than proposed with regards to the reduced water. *ISI: Figures are based on different studies and adapted to the individual Base Case that is the reason why the saving potential seems to be rather low.* 2) Regarding the Keep-Warm function: If this option is automatically set on, the energy used is higher than when one has to manually activate the option. This should be included in this section of the report.

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	ISI: This function is going to be addressed within Task 7 as a new policy option.
De Longhi	1) There are two different meanings of the word "boiling" at certain points in the report/presentation. One needs to be consistent with the meaning of "boiling". *ISI: we will correct. "over boiling" for boiling too much water and "over heating" for heating too long the water* 2) With regards to the minimum level of water – 0.2 litres, for example, are not feasible in some cases – if we look at large volume electric kettles for example. *ISI: Based on your expertise, please let us know what would be suitable minimum water level.* 3) Regarding the figures on Thick Film Heating Elements: It would be good to have more information and if ISI could share to all stakeholders the data. *ISI: We will ask the relevant stakeholder if the figures can be published.* 4) With reference to the 95°C boiling concept: Water boils at 100°C (boiling point) and customers want to hear the noise the electric kettle makes when temperature reaches 100°C. Hence, we do not agree with a temperature lower than 100 degrees. *ISI: We agree that water boils at 100°C at 1 atm. Considering a potential heating process stop at 95°C: we do believe -depending on measuring approach- that boiling noises are occurring at water temperatures of 95°C.*

ISI presented the Testing Procedure and Energy Efficiency Metrics

The presentation was followed by a discussion:

abbr.	Comment/answer
Topten	In the proposed procedure, it is not reflected if/when there are kettles with different pre-setting temperatures. This aspect should be reflected. *ISI: The pre-setting temperatures are not the same for the kettles, therefore it is problematic to include such a test in the procedure. We are open for suggestions to improve the current proposal regarding the test procedure. However, the regulation could take into account this EE feature.* However, it would be good to have some kind of measure anyways!
smeg	1) Proposal: It is easier to measure water by weight compared to volume. Water gets wasted by measuring its volume. Hence, it would be easier to measure the weight than the volume. 2) Regarding the definition of boiling: The reason as to why 100°C were not measured might be that it is quite difficult to measure when it reaches the boiling point in a lab. Furthermore, it depends on air pressure. 3) The regression between air pressure and boiling can be found in any handbook. The question is how to incorporate it into our method? It is not as easy as including a standard correction factor. I would suggest to keep it as described in the standard.
De Longhi	The indicated range of atmospheric pressure could be problematic: either you need an expensive pressure chamber in the test laboratory or it should be possible to apply a correction factor.
Otter	Instead of testing 1 litre only, it would be good to see test results for ½ litre as well and for large volume (when applicable). *ISI: Default is 1 litre. We would appreciate to receive comments on whether the stakeholders agree that other water volumes would be useful to test as well. Please note that the EE depends on the filled-in volume (the more water, the higher energy efficiency)*
ISI	What is the reason behind the approach of changing from degrees to Kelvin?

	Amdea: You were referring to a standard from 1975. Now, K is the SI unit for temperature. Shouldn't we use a new standard for going forward?
De Longhi	Regarding the preference of 1 SH (slide 33), we support the introduction of an eco-design measure. We also agree on the max. keep warm time (slide 35).

ISI presented the possible policy options

The presentation was followed by a discussion:

abbr.	Comment/answer
RVO	In our opinion, energy labelling is only useful if the variation of the range on the market and the theoretical improvement are given. There is a general issue without sufficient data on improvement potential (energy savings). Hence, more data on this is needed! *ISI: We agree. Regarding the lack of data: We were grateful to have received data from the Swedish Energy Agency as well as from one manufacturer (regarding the comparison of heating elements). We have also tested ourselves 8 kettles, in order to have more data for carrying out Task 5-7.*
Topten	If there is no data yet, it is difficult to say "We do not want a label". There is a need for more data.
De Longhi	We are against the indication of boiling time information on the kettle. The information might not be clear to users and an explanation would be needed.
UBA	Temperature display: What would a bonus look like if there are only ecodesign requirements and no label? *ISI: You are right, the bonus is generally used for labelling regulation. If we have only ecodesign requirements, we would have to consider whether a bonus could be included to take into account features that promote energy savings.*
De Longhi	Limescale: We support the information requirement. However, we do not agree to mandatory limescale protection. (The built-in-water filter and the limescale filter have two different functions.) *ISI: The user/customer wants to drink clean boiled water. Without technical measures for limescale, the user might boil a new batch of water and this wastes energy. The solution is therefore a built-in-water-filter or a limescale filter (which can be removable).*
UBA	It would be good to refer to standard EN 45555:2019 in terms of recyclability
RVO	The latest measures of eco-design would be helpful! However, the eco-design cannot influence recyclability of products. It only provides conditions so that product can be recycled.
RVO	Some of the latest ecodesign regulation require the marking of plastic in order to facilitate the recyclability of the materials
De Longhi	Concerning slide 42 (second row of the table): We should avoid different regulations for the same topics.

Wrap-up of meeting and closure of the meeting

The project team thanked the stakeholders for their participation and the valuable contributions during the meeting. Deadline to submit comments regarding the test procedure, the energy efficiency metrics and the possible policy options: **28th of October 2020**

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