ANTI-Circumvention of Standards for better market Surveillance

ANTICSS

ANTICSS Project
Deliverable D19a (D4.6):
Impact Assessment of circumvention under EU Ecodesign and Energy labelling

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Abbreviations

CV	circumvention
EASME	Executive Agency for Small and Medium-sized Enterprises
ECO	ecological
EEC	Energy efficiency class
EEI	Energy efficiency index
EN	European norm
EU	European Union
GWh	gigawatt hour
IEC	International electrotechnical commission
kWh	kilowatt hour
MSA	Market surveillance agency
ps	place setting
TV	television
W	watt
WP	work package

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1 About the ANTICSS project

Objective of the research project 'Anti-Circumvention of Standards for better market Surveillance (ANTICSS)' is to assess and clearly define 'circumvention' in relation to EU Ecodesign and Energy labelling legislation and relevant harmonised standards.

The analysis of 'circumvention (CV)' was based on collecting and learning from cases of circumvention by literature research and dedicated expert interviews, as well as analysing existing EU Ecodesign and Energy labelling legislation and standardisation for possible loopholes. Also, the potential relation between CV and so called 'smart' products with specific embedded software was addressed by the project. Alternative test procedures to better detect CV by testing were developed and through testing a certain number of appliances within the ANTICSS project, the impacts 'if' and 'how much' energy consumption and/or functional performance modifications could be ascribed to CV were assessed.

Based on the results, ANTICSS will provide practical capacity building measures for key actors of market surveillance and test laboratories, support communication and collaboration platforms between major stakeholders and provide policy recommendations for policy makers and standardisation bodies to prevent future circumvention under EU Ecodesign and Energy labelling. ANTICSS project is also designed to provide reliability to manufacturers by specifying potentially vague legislation and standards which might be interpreted differently by market actors and some of them taking unfair advantages so far.

By overall awareness raising on the topic of circumvention among stakeholders, ANTICSS is supporting an effective EU legislation enforcement and thus increasing acceptance and trust of market actors and civil society into the Ecodesign and Energy labelling legislation. ANTICSS Work Packages (WPs) are summarised in Figure 1-1 as follows:

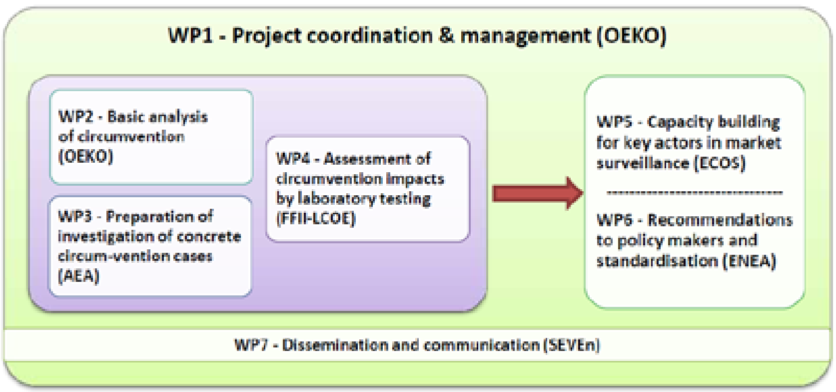

Figure 1: ANTICSS Work Packages

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2 Goal and approach (intervention logic) of the Impact Assessment

Amongst other impacts, such as increase of confidence among purchasers, manufacturers and retailers, and contribution to the enforcement of EU product legislation, the funded activities and outcomes of the ANTICSS project are expected to trigger also a certain amount of energy savings by reducing circumvention cases of the Ecodesign and Energy label regulations. In the case of circumvention, however, these 'energy savings' are already accounted for on paper, but they can only be achieved if the products in question achieve more favourable values in the standard test procedure due to applied circumvention acts. This means that in the case of circumvention the declared energy efficiency and savings of products will never be realised in everyday life; therefore, they are rather 'losses of declared energy savings' that the ANTICSS project aims to reduce with its outcomes and activities.

The report provides an estimation of the '*potential losses of energy savings through circumvention, that are supposed to be avoided by this project*', based on robust assumptions and a credible baseline. In addition, the impact assessment of water using products also includes the potential annual losses of water savings through circumvention.

The estimations follow the 'Guidelines for the Calculation of Project Performance Indicators' provided by EASME[1]. The following figure below shows the general elements of an intervention logic as outlined by EASME (i.e. the objectives, actions and resources, outputs, and outcomes). The elements are specified for the ANTICSS project in the subsequent sections.

In section 4, the potential losses of energy savings that occurred through circumvention confirmed by the ANTICSS laboratory testing in work package WP4 are calculated. For better understanding, section 3 introduces the ANTICSS understanding and definitions of circumvention and jeopardy effects and the categorisation of cases and tested models according to these definitions.

At the end of the project, the overall final report will provide an assumption about the percentage of the calculated potential losses of primary energy savings that are assumed to be avoided in the medium to long term through the various activities and outputs of the ANTICSS project.

1 European Commission. Executive Agency for Small and Medium-sized Enterprises (EASME): Guidelines for the Calculation of Project Performance Indicators. v2.0 05 December 2017. Applicable for energy efficiency projects funded under Societal Challenge III 'Secure, Clean and Efficient Energy' of the Horizon 2020 programme.

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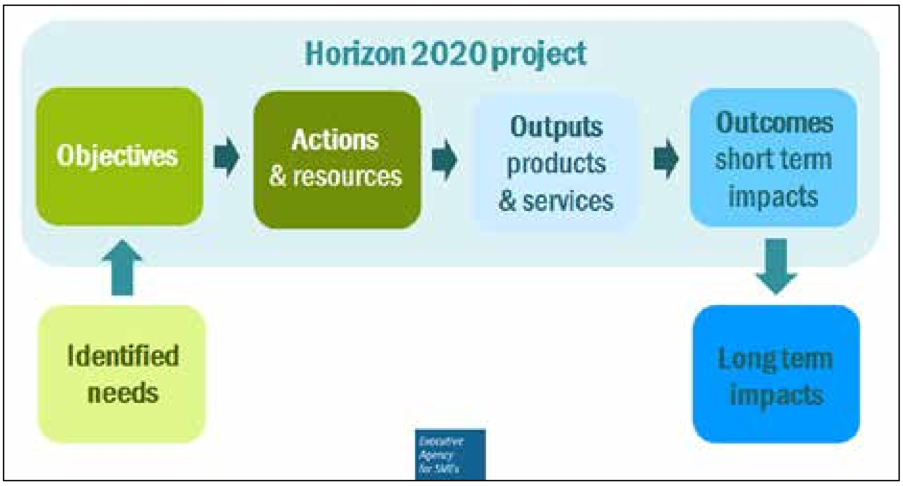

Figure 2: **EASME intervention logic (Source: European Commission, EASME)**

2.1 Objectives

The overall goal of ANTICSS is to assess the current and minimise the future risk of possible circumvention of the EU Ecodesign and Energy labelling regulations and harmonised standards. The corresponding main objectives of the project are:

- To detect and quantify the impact of the identified circumvention cases on the energy consumption of the regulated products in comparison to the energy consumption measured and declared under standard conditions (WP4: Assessment of circumvention impacts in laboratory testing).
- To enable MSAs to better detect circumvention (WP5: Capacity building for key actors in market surveillance).
- To enable policy makers and standardisation bodies to better design ecodesign and energy labelling regulations and measurement standards (WP6: Conclusions from circumvention investigation and policy recommendations).

2.2 Actions and resources

The following table lists the actions within the specific work packages that were or will be conducted to reach the objectives. Work package WP1 is mainly foreseen for the overall project management. The current report, presenting the assessment of savings of potential energy losses, is part of WP4.

Table 1: Actions of the ANTICSS project

Work package	Actions
WP1	· Development of a calculation scheme for the impact assessment related to circumvention (CV)
WP2	· Development of a decision matrix to define the scope of the project · Development of a clear definition of CV and differentiation to other effects · Collection of documented (potential) circumvention cases · Analysis of the relation between smart products and CV · Analysis of legislation and standards for selected product groups
WP3	· Conduction of interviews with different types of stakeholders (MSA/political stakeholders, industry stakeholders, consumer and environmental NGOs)
WP4	· Design of alternative test methods · Selection and purchasing of models of selected product groups · Testing of products according to harmonised standards and alternative methods · Assess and calculate the impact of the tested circumvention cases · Summary and results consolidation of tested circumvention cases
WP5	· Development of guidelines and tools for MSAs · Development of guidelines and tools for test laboratories · Implementation of a webinar for MSA · Implementation of a webinar for test laboratories · Support of the communication and collaboration between stakeholders
WP6	· Preparation of policy recommendations · Preparation of recommendations for standardisation bodies · Organisation of an expert workshop for policy makers · Organisation of an expert workshop for standardisation bodies
WP7	· Production and dissemination of communication materials (project leaflet, project level twitter and LinkedIn account, five newsletters, at least two articles, two press releases) · Design and regular update of public project website · Communication activities for dissemination (presentations, national events, etc.) · Production of a final publishable report · Organization of a final conference

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2.3 Outcomes

All actions and outputs shall result in certain outcomes to reach the goals of the project.

The main intended outcome of the project shall be fewer cases of circumvention of the Ecodesign and Energy label regulations. The above-mentioned actions and the resulting outputs contribute to this objective in several ways.

- First of all, circumvention cannot be avoided unless it is well defined and separated from other effects. The definition has to be included in regulations and then this has to be declared as not allowed. A first paragraph on circumvention was included in the Ecodesign regulations published in the so-called winter package 2019[2] defining and prohibiting circumvention. The definition included in these regulations is rather narrow however, only comprising circumvention by (hidden) software. The definition developed in the ANTICSS project builds upon this definition but broadens it to also include further possibilities of circumvention. ANTICSS thus contributes to a more comprehensive understanding of circumvention among relevant stakeholders that might be the basis for future regulations.
- It can be assumed that a certain way of circumvention is not used anymore by manufacturers when it is known by policy makers, standardization bodies and market surveillance authorities – policy makers and standardization bodies might change the regulations and standards in order to eliminate possible weaknesses, MSAs know what to look for and how to determine possible circumvention. This means the possibilities for circumvention are reduced and the risk of being caught rises. ANTICSS provides this knowledge amongst others through collecting suspect cases and through the development of alternative test methods to disclose the circumventing behaviour.
- If policy makers know where circumvention may happen, e.g., by automatic detection of products being in a test situation, they can decide that products using such a procedure are non-compliant; as done in the so called 'winter package' of regulations.
- The same holds for standardization bodies: if it is known what elements and properties of a standard make circumvention easier future measurement standards can be improved.

More concrete examples of how circumvention leads to a potential loss in resource savings, and how by fewer cases of circumvention the Ecodesign and Energy labelling regulations could fully spread their potentials are given in the following section 4.

[2] Ecodesign directives on motors, external power supplies, small, medium and large power transformers, welding equipment, refrigerating appliances, light sources, electronic displays, household dishwashers, household washing machines and washer-dryers and refrigerating appliances with a direct sales function.

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3 ANTICSS definitions of 'circumvention' and 'jeopardy effects'

The ANTICSS project team agreed on the following definitions for 'circumvention' and 'jeopardy effects' in relation to EU Ecodesign and Energy labelling legislation and related harmonised standards.[3] These definitions built the basis for the further research within the ANTICSS project, namely the categorisation of collected suspect behaviour cases and tested products. In this context it must be noted that parts b) and c) of the ANTICSS definition of 'circumvention' as well as the definition of 'jeopardy effects' so far are not included in the latest Ecodesign regulations.

3.1 Definition of 'circumvention'

„Circumvention is the act of designing a product or prescribing test instructions, leading to an alteration of the behaviour or the properties of the product, specifically in the test situation, in order to reach more favourable results for any of the parameters specified in the relevant delegated or implemented act, or included in any of the documentations provided for the product."

The act of circumvention is relevant only under test conditions and can be executed e.g.

a) by automatic detection of the test situation and alteration of the product performance and/or resource consumption during test, or
b) by pre-set or manual alteration of the product, affecting performance and/or resource consumption during test or
c) by pre-set alteration of the performance within a short period after putting the product into service.

3.2 Definition of 'jeopardy effects'

"Jeopardy effects encompass all aspects of products or test instructions, or interpretation of test results, which do not follow the goal of the EU ecodesign and/or energy labelling legislation of setting ecodesign requirements and providing reliable information about the resource consumption and/or performance of a product. These effects may not be classified as circumvention, but become possible due to loopholes or other weaknesses in standards or regulations."

[3] Further details and examples can be found in the ANTICSS Deliverable D8 "Definition of 'circumvention' and 'jeopardy effects' in relation to EU Ecodesign and Energy labelling legislation" https://www.anti-circumvention.eu/storage/app/media/uploaded-files/D08_ANTICSS_Final-definitions_circumvention.pdf

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3.3 ANTICSS categorisation of cases and tested models

The ANTICSS definitions of circumvention and jeopardy effects were also taken as basis to categorize the test results of selected products that were tested within WP4 of the ANTICSS project[4]. However, during interpretation and categorisation of the test results it became apparent that the category of 'jeopardy effects' is not sufficiently reflecting the results at product level in those cases where the test results revealed more favourable results *specifically* in the test situation but the ANTICSS definition of 'circumvention' could nevertheless not be applied as it was not only applied *exclusively* during testing, but was – even if extremely infrequent or only theoretically – also applicable during consumers' usage of the appliance.

Therefore, the ANTICSS project team decided to differentiate between the general level ('case') detected or reported, and the specific product level based on the test results of models tested within ANTICSS.

Figure 3 illustrates the underlying approach for the categorisation of reported cases and tested models within ANTICSS.

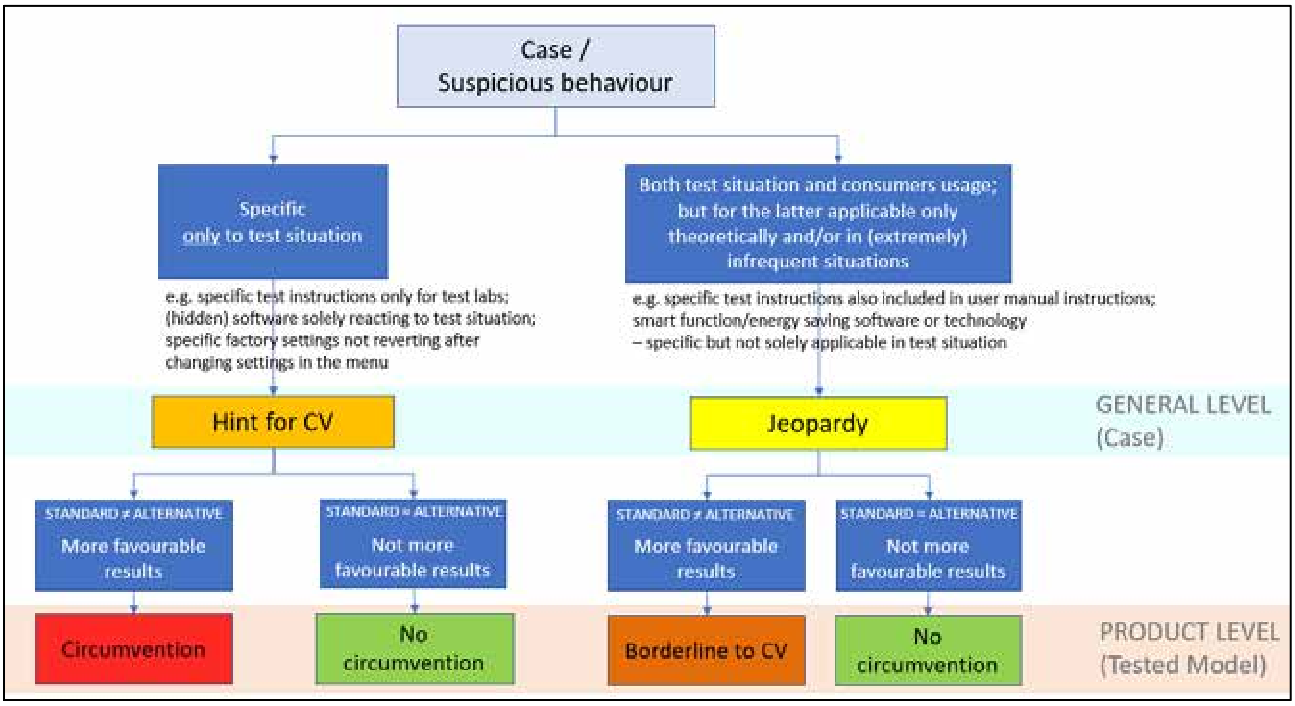

Figure 3: ANTICSS categorisation of cases and tested models to 'CV' and 'jeopardy effects'

[4] For more information see also: https://www.anti-circumvention.eu/storage/app/media/uploaded-files/D13_ANTICSS_List-of-product-categories-for-testing.pdf

4 Impact assessment: Calculation of losses of potential energy savings by circumvention

4.1 Cases selected for the impact assessment

Within ANTICSS work package WP4 ('Assessment of circumvention impacts in laboratory testing') several reported cases, being assigned by the ANTICSS project team as 'hints for circumvention' or 'jeopardy effects' in previous work packages, were tested by the ANTICSS test laboratory partners[5]. Aim of this testing was to analyse, whether circumvention can be confirmed in laboratory tests through application of alternative test methods, developed within the ANTICSS project. Table 2 presents those cases selected for the ANTICSS impact assessment in this report, i.e. which were considered for calculating the losses of potential energy and/or water savings. The products were included in the calculation of the impact assessment if the ANTICSS testing confirmed 'circumvention' or 'borderline to circumvention' for the tested model. In addition, although no circumvention was confirmed for the tested models, televisions are included in the impact assessment for the reasons given in the footnote.

Table 2: Tested cases considered in the ANTICSS impact assessment

Lot	Product category	Case	ANTICCS categorisation of the tested model
ENER 5	Televisions	TV2/3 – Test loop recognition	Jeopardy effect at case level[6]
ENER 13	Domestic freezers and refrigerators-freezers	COLD3 – Display is continuously activated	Borderline to circumvention at product level
ENER 14	Domestic dishwashers	DISH 3 – Removal / alteration of accessories	Circumvention at product level
ENER 22	Domestic ovens	OVEN 1 – Volume without shelf guides OVEN 3 – Electronic control	Borderline to circumvention at product level Borderline to circumvention at product level, however, impact not quantifiable

[5] Detailed test reports are online available under www.anti-circumvention.eu/about-project/documents-and-deliverables

[6] Case TV 2/3 has been included in the impact assessment as the measurements revealed that the tested model A indeed has a special function to detect fast moving images. The test results show that televisions might have a built-in function being able to recognize specific fast-moving sequences and reduce the energy consumption specifically under test; although not exploited by the tested model A, as the declared energy values were even higher than the values measured, it cannot be ruled out that other manufacturers or models might use such a technical feature under standard testing to reach more favourable values for the on-mode power consumption or the energy efficiency class on the label.

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4.2 Methodological approach for the impact assessment

The potential losses of energy and/or water savings through these cases are calculated as described in the following sections. For each case two impact scenarios are estimated, a *realistic scenario* that is based on a minimum and maximum estimation of models that show this type of circumvention, and an *extensive circumvention scenario* including all products which, by virtue of their design, have the technical condition for circumventing in this manner. These might be, for example, sensors that help to enhance the efficiency of the appliance but that might also be able to detect a test situation; a display that is switched on for most of the time during real use but, which is not active during testing; or accessories that need to be removed for the appliance test according to manufacturer instructions. The extensive scenario is based on the assumption that 'competitive advantages' through circumvention that are seen or realised in the market, will lead to the fact that this type of circumvention is copied by the competitors rather sooner than later.

- The ***realistic scenario*** aims to show the magnitude of the potential losses of energy savings through circumvention which are considered to be realistic by the project team. As the exact market share of models showing the circumvention behaviour that was confirmed for at least one tested model within ANTICSS is unknown, a range is derived that defines the currently likely minimum or maximum losses. The estimation of these shares is based on the knowledge about the market shares of relevant technical features of the appliances, and estimations of experts (e.g. experts from energy agencies, MSAs, testing institutes or standardisation bodies) about the market share of products showing this kind of behaviour. In case an educated guess based on expert information is not possible, a conservative market share of 5% is estimated for calculating the realistic minimum scenario.

- The ***extensive circumvention scenario*** shows the impact on the potential losses of energy savings, if all devices that have the technological capability, and are thus theoretically prone to this type of circumvention, are considered in the calculations. The estimation of these shares is based on the knowledge about the market shares of relevant technical features of the appliances, and estimations of experts (e.g. experts from energy agencies, MSAs, testing institutes or standardisation bodies) about the market share of products that might take up this kind of behaviour.

The potential losses of energy and/or water savings are then calculated taking into account the potential loss per product, the number of appliances expected to be sold in the year 2020 and the respective assumed market share.

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4.3 Calculation of impacts for selected cases

4.3.1 Televisions: Case TV2/3 – Test loop recognition

Short description of the case

According to standard IEC 62087-2:2015, the energy consumption of TVs is tested with default settings. According to the harmonised standard, the test movie, which is used for measuring the energy consumption, contains only fast-moving images. Prior to the start of the test movie, a countdown clip is shown. This countdown lasts for 10 seconds and does not contain any fast-moving images. After the 10 seconds, the movie content is played. In the reported case, an automatic brightness adjustment function was activated by default. This function analysed the broadcast program, and when fast moving images were detected, the brightness of the television was reduced automatically. As a result, the measured energy consumption of the television was significantly lower compared to a broadcast video without fast moving images (reduction of the input power of approximately 35 %).

Description of differences between harmonised and alternative test methods

The purpose of the alternative test methods for case TV2/3 was to evaluate if televisions have a function that detects fast moving images, when the appliance is tested according to standard IEC 62087-2:2015, and that consequently automatically adapts the brightness of the television. If the brightness is reduced, the power consumption of the TV decreases, which results in a lower energy consumption of the appliance.

Harmonised test method	Alternative test methods
The test is conducted following the prescribed standard test method A dynamic broadcast content as per IEC 62087-2:2015. The dynamic test sequence according to IEC 62087-2:2015 is used for measuring the average electricity consumption of the television over ten consecutive minutes. The brightness controls of the television are in the position adjusted by the manufacturer.	For this case two alternative test methods were conducted: For the alternative test method ‘50/50’, the dynamic broadcast content as per IEC 62087-2:2015 is used for measuring the average electricity consumption of the television. However, the ten-minute video sequence was divided in two parts. Measurement of power consumption was running first for the last 5 min and then the first 5 min. For the alternative test method ‘measurement starting after three minutes’, also the dynamic broadcast content as per IEC 62087-2:2015 was used. The measurement of the power consumption was started three minutes after the video has been started, i.e. three minutes later compared to the standard test. To ensure the ten-minute measurement, and to keep the average picture level (APL) at 34 %, the missing first three minutes are fit directly to the end of the video.

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Results of standard and alternative test method

For one of the tested TV models, the measurement revealed that the power consumption of the device decreases from 95 W to 85 W during the first 100 s of operation both in the standard test and under the alternative test method '50/50' (Figure 3). In alternative test method 'measurement starting after 3 minutes' the power consumption was already reduced before the measurement started (start of measurement delayed by 3 minutes).

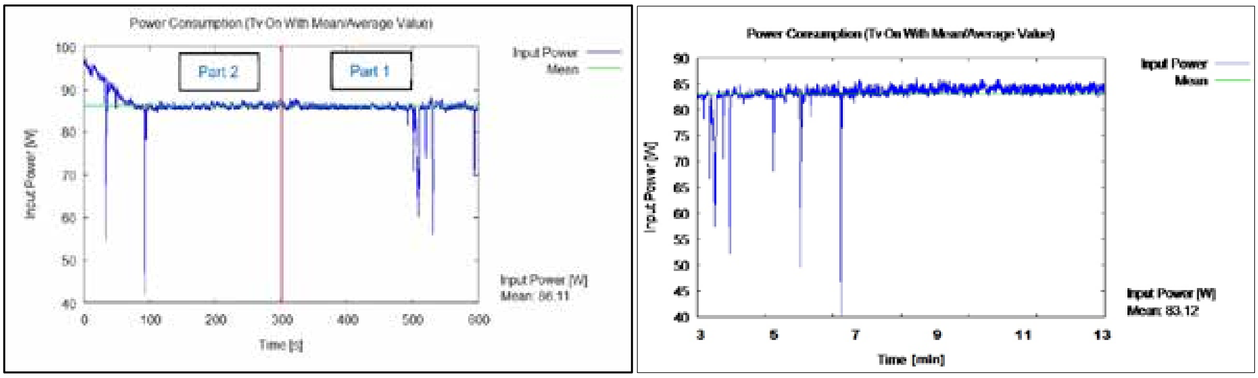

Figure 4: Results of television under alternative testing. On mode Power Consumption: '50/50' (left picture); 'measurement starting after 3 minutes' (right picture)

This decrease in power consumption can be ascribed to the detection of the fast-moving images of the standard test video. The alternative test methods confirmed that this model has a special function to detect fast-changing content. The results of the alternative test measures additionally revealed that not the specific start sequence of the standard test video triggered the backlight reduction but that the detection of the fast-moving pictures was independent from the initial sequence of the standard test video.

As the declared power consumption for this model is much higher than the measured values (both under standard and alternative test conditions) it was concluded that the manufacturer in this case did not use the backlight reducing function to reach more favourable results and therefore it was not rated as (borderline to) circumvention at product level. It cannot be ruled out however that other manufacturers or models might use such a technical feature to reach more favourable values under standard testing for the on-mode power consumption or the energy efficiency class on the label. Therefore, this case was included in the impact assessment even though the model was assigned formally as 'not circumventing' and, at case level, it was assigned to be (only) 'jeopardy effect' and not 'hint for circumvention' as it could not be excluded that this function also works in real life (and not specifically under standard test conditions).

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Calculation of losses of potential energy savings per appliance

In the tested case, the backlight reduction function was activated by default. In case this function is not triggered, the appliance will not reduce the power consumption. It will remain on the higher level of 95 W; thus the energy consumption of the TV is higher compared to the standardised test.
The measurement showed that the decrease of the power consumption by 10 W, from 95 W to 85 W in the first 100 s after starting the broadcast, is linear. Therefore, the average power consumption during the first 100 s is 90 W, and the average power consumption for the 10 minutes of the measurement during the test ($P_{av\ 600s}$) can be calculated according to the following function.

$$P_{av\ 600s} = \frac{90\ \text{W} * 100\ \text{s} + 85\ \text{W} * 500\ \text{s}}{600\ \text{s}} = 85.8\overline{3}\ \text{W}$$

In case the power consumption of the appliance is not adapted, the power consumption is $9.1\overline{6}$ W higher.

$$\text{D}P = 95\ \text{W} - 85{,}8\overline{3}\ \text{W} = 9.1\overline{6}\ \text{W}$$

The declaration of the annual electricity consumption of this TV on the energy label is based on a daily operation of 4 hours on 365 days/year. With this information, the additional electricity consumption (E) of the TV without adaption of the power consumption can be calculated[7]:

$$\text{E} = 9.1\overline{6} * \ 4\ \text{d/h} * 365\ \text{d/y}\ /1000 = 13.38\overline{3}\ \ \text{kWh/y}$$

Calculation of losses of potential energy savings on EU level

Table 3: Input parameters and results for case TV2/3

Input parameters	Calculation values of the input parameters and results		
Additional annual electricity consumption without triggered automatic brightness adjustment function of fast-moving images (per product)	13.38 kWh		
Forecast of annual sales of 'smart TVs' in 2020	39,000,000 units (Wierda and Kemna 2018)[8]		
Share of devices showing this behaviour (assumption)	**Realistic scenario** **min** 5 % *	**Realistic scenario** **max** 17.5 % **	**Extensive circumvention scenario** 100 % ***
Potential annual loss of electricity savings by all smart TV's sold in 2020	26.1 GWh	91.3 GWh	522.0 GWh

*as no specific expert information is available, a realistic minimum share of 5 % of the devices sold in 2020 is assumed, **experts from test houses assume a market share of 15 – 20 % of smart TV's being able to detect fast moving images; the medium is taken for the calculations, ***it is assumed that all smart TV's will adapt the technology in the future.

[7] See also EL Directive 1062/2010: "The annual on-mode energy consumption E in kWh is calculated as E = 1,46×P"
[8] Wierda, L.; Kemna, R. (2018): Ecodesign Impact Accounting, Status Report 2018. Annex A, pages 14/15.

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The calculated losses of potential energy savings in the realistic scenario vary between 26.1 GWh when a minimum marked share of 5 % is assumed, and 91.3 GWh, if a maximum market share of 17.5 % is considered. The realistic minimum scenario considers a share of 5 % of all smart TVs sold in the year 2020, as no specific expert information is available in terms of the minimum number of appliances with implemented automatic brightness adjustment function. Despite of this, the share of about 17.5 % is based on a much sounder assumption, made by experienced experts from test houses, who assume a market share of 15 to 20 % of all smart TVs sold in the year 2020, being able to adjust the brightness of the TV automatically.

The extensive scenario assumes that all manufacturers of smart TVs will adapt their products subsequently after the technology is seen in the market. Following this scenario, losses of 522 GWh of potential electricity savings might occur, if an automatic brightness adjustment function is triggered by fast moving images during the standard test situation in all smart TVs on the market.

4.3.2 Domestic freezers & refrigerator-freezers: Case COLD3 – Display continuously activated

Short description of the case

In the tested case, a controller display of the appliance is activated when the door is opened and remains switched on for 24 hours after the last door opening. If the door is not opened for at least 24 hours, the display is switched off automatically. The display cannot be switched off manually, and it is not possible to shorten the time of 24 hours in the settings. The consumer can only set if it will or will not turn off after 24 hours, whereas the user manual states not to change the default setting of the screen switch-off function, as then the energy consumption of the appliance would increase slightly. According to the current harmonised standard test method, no door openings are conducted. Thus, the additional energy consumption caused by the display is not considered in the overall energy consumption of the appliance as measured under standard conditions.

Description of differences between harmonised and alternative test methods

The purpose of the alternative test method was to determine the additional electricity consumption due to the rather continuous activity of the display during daily use.

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Harmonised test method	Alternative test method
The appliance was set up according to the harmonized standard and tested accordingly for the energy consumption. Following the harmonised standard EN IEC 62552:13, the appliance is installed inside a climate room which controls the environmental temperature of 25 °C. The temperature inside the appliance is measured with thermocouples inserted in a tylose package or a small cylinder. Loads used for compartments: - Fresh food: 3 small cylinders - Chill: loaded with a few tylose packages - Freezer: fully loaded with tylose packages The Energy consumption measurement is performed without door openings from defrost to defrost cycle, twice for one thermostat setting.	The power consumption of the display is measured during an off cycle of the cooling system by opening the door, and the increase in the power consumption is observed. The difference of the measured input power is accounted to the display. The increased annual energy consumption is determined by: $$AE_{increased} = AE_{conformity\ test} + \frac{E_{display} * 24\frac{h}{d} * Xd}{1000}$$ $AE_{increased}$ is the annual energy consumption considering the display input power [kWh/year] $AE_{conformity}$ test is the annual energy consumption measured during the conformity tests [kWh/year] $E_{display}$ is the input power of the display [W] *X* is the amount of days it is estimated that the display is activated $E_{display}$ is measured during an off cycle of the cooling system, while switching the display on and off.

Results of standard and alternative test methods

The power input measured under alternative test conditions that can be accounted to the display is 2.1 W[9]. It must be considered that the display is only on for 24 h, when the door of the refrigerator is opened due to normal use by the consumer, which does not happen when the user is absent, e.g. during holidays. Thus, 20 days per year without door openings are considered in the calculation.

Calculation of losses of potential energy savings per appliance

Assuming that the display is on for 24 hours/day during 345 days of the year (365 days/year minus 20 days of absence per year), the calculated energy consumption of the device caused by the display (*E*) amounts up to 17.39 kWh/year.

$$E = 2.1\ \mathrm{W} * 24\ \mathrm{h/d} * 345\ \mathrm{d/y} / 1000 = 17.39\ \mathrm{kWh/y}$$

[9] see also Deliverable D18: Test Reports – Part 4: Domestic freezers and refrigerators-freezers, p 38; online available at https://www.anti-circumvention.eu/about-project/documents-and-deliverables

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Calculation of losses of potential energy savings on EU level

According to market experts, the share of domestic stand-alone freezers and refrigerator-freezers is about 70 % of all domestic cooling appliances in the market. In addition, it is estimated that one third of these appliances have a display for different consumer information, e.g. time or internal temperature display. Those appliances are prone for this kind of circumvention. Thus, it seems reasonable to assume a market share of roughly 25 % of all domestic freezers and refrigerator-freezers being theoretically prone to the described case of circumvention. Input parameters and results for the case Cold 3 are presented in Table 4.

Table 4: Input parameters and results for case COLD3

Input parameters	Calculation values of the input parameters and results		
Annual electricity consumption of a display	17.39 kWh/year		
Forecast of annual sales of all domestic freezers and refrigerator-freezers in 2020	19,799,000 units (Wierda und Kemna 2018)		
Share of devices using the technology (assumption)	**Realistic scenario**		**Extensive circumvention scenario**
	min	**max**	
	2 % *	12.5 % **	25 % ***
Potential annual loss of energy savings by all domestic stand-alone freezers and refrigerators-freezers sold in 2020	6.9 GWh	43.0 GWh	86.1 GWh

*the realistic minimum share of 2 % of the devices sold in 2020, is based on a sound educated guess, made by test house experts; **the realistic maximum share of 12.5 % is based on the assumption that half of all stand-alone cooling and freezing appliances with integrated display use the technology, ***the extensive circumvention scenario assumes that all devices with integrated display (about 25% of the total sales) adapt the technology in the future.

The realistic scenario shows that between 6.9 GWh and 43 GWh of potential electricity savings are lost through the activated display.

In the extensive scenario there are even 86.1 GWh of potential electricity savings that are lost. However, in terms of the current market situation, the assumption that all refrigerators and freezers with an integrated display, will keep the display switched on for at least 24 hours after door opening, must be considered rather hypothetical.

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4.3.3 Domestic dishwashers: Case DISH3 – Removal/ alteration of accessories

Short description of the case

According to regulation and standard, the instructions of the manufacturer regarding installation and use of the appliance shall be followed, before the appliance is tested. The instructions of multiple manufacturers for many dishwasher models state that, it is necessary to remove or alter the position of many of the 'accessories' fitted to the appliance when supplied. For example, when multiple cup racks are present, it may be necessary to remove one or more sections and reposition them. This is not always a straightforward task and may risk breaking some of the components. It is highly unlikely that a consumer would do the same.

In the tested appliance, multiple push on supports and components need to be removed from the dishwasher. The dishwasher, as supplied, can only be loaded with the rated full capacity of 16 place settings when the removable accessories are taken out of the machine interior. The instructions on removal of all the relevant parts are only given in the 'Instructions for Test Laboratories' and unlikely to be carried out by the consumer in day to day use. It is supposed that the dishwasher cannot be tested at the rated capacity, without removing the accessories, and also the rated capacity displayed on the Energy Label will not be reached unless all removable accessories are removed.

Description of differences between harmonised and alternative test methods

The purpose of the alternative test method is to evaluate the possible effects of not removing or altering the accessories on the number of place settings that can be loaded into the appliance and also on energy and water consumption.

Harmonised test method	Alternative test method
Tests are conducted according to the standard conditions (EN 50242:2016) and instructions of the manufacturer. All instructions related to the removal or alteration of accessories are followed. All parameters required in Regulation (EU) 1016/2010 and Regulation (EU) 1059/2010 are measured within 3 cycles (i.e. energy and water consumption, programme duration, cleaning and drying efficiency).	Tests are conducted according to the standard conditions (EN 50242:2016) and instructions of the manufacturer without removing or altering accessories. An alternative loading scheme is designed, fitting the maximum number of place settings and corresponding serving pieces, when the machine is loaded as supplied. All parameters required in Regulation (EU) 1016/2010 and Regulation (EU) 1059/2010 are measured within 3 cycles.

Results of standard and alternative test methods – energy consumption

If the accessories are not removed in the machine under test, only 12 place settings could be loaded and sufficiently cleaned (instead of 16 place settings), which results in more cycles/year in order to clean the same amount of dishes, and thus increases the annual energy and water consumption of the appliance.

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The values obtained per dishwashing cycle by the alternative test show a slightly lower energy consumption of the dishwasher due to the smaller load: 0.731 kWh/cycle instead of 0.755 kWh/cycle[10]. However, the decrease in place settings from 16 to 12 fitting into the appliance leads to an increase of 33 % of the number of wash cycles that would have to be run in order to clean the same number of of dishes, see the following formula.

$$\frac{280\ cycles/year\ *\ 16\ ps/cycle}{280\ cycles/year\ *\ 12\ ps/cycle} = 1.3\overline{3}$$

Converted to the number of cycles per year used for the calculation of the annual resource consumption, about 373 cycles instead of 280 standard wash cycles would have to be run per year.

Calculation of losses of potential energy and water savings per appliance

For the tested dishwasher with 16 ps the measured electricity consumption per cycle under harmonised standard conditions was 0.755 kWh, while the energy consumption measured under alternative test conditions, with 12 ps fit into the machine was 0.731 kWh. Taking the additional number of wash cycles into account, the energy consumption for the dishwashing machine with a rated capacity of 16 ps (E_{16ps}) and an actual number of 12 ps/cycle (E_{12ps}) can be calculated:

$$E_{16ps} = 280\text{ cycles/year} * 0.755\text{ kWh/cycle} = 211.40\text{ kWh/year}$$

$$E_{12ps} = 373\text{ cycles/year} * 0.731\text{kWh/cycle} = 272.66\text{ kWh/year}$$

$$E_{add} = 272.66\text{ kWh/year} - 211.40\text{ kWh/year} = 61.3\text{ kWh/year}$$

E_{add} is the additional annual energy consumption caused by the fact that only 12 place settings fit in the appliance instead of the stated 16 place settings.

Calculation of losses of potential energy savings on EU level

The following steps were taken to calculate the losses of potential energy and water savings for all dishwashing machines in the EU with a declared capacity of 15, 16 or 17 place settings (ps):

1. Determining the additional number of cycles necessary to clean the number of ps that fit into the machine without removing any accessories compared to the annual number of ps (declared capacity); see above.

2. Calculating the additional annual energy and water consumption of the dishwashing machine.

[10] See also Deliverable D18: Test Reports – Part 5: Domestic Dishwashers, p 18; online available at https://www.anti-circumvention.eu/about-project/documents-and-deliverables

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3. Scaling the additional annual energy and water consumption to all dishwashing machines with a declared number 15, 16 or 17 ps considering the market share of the respective product type.
4. Cumulating the additional annual energy and water consumption of the three product types for the realistic scenario (50 % respectively 100 % of dishwashing machines with a declared capacity of 16 and 17 ps) and the extensive circumvention scenario (all dishwashing machines with a declared number of 15, 16 and 17 ps).

Step 2: Calculating the additional annual energy and water consumption of dishwashers

It is assumed that the lack of space not only applies to dishwashers with 16 place settings but in principle to all dishwashers with a rated capacity of 15 and more place settings. As no measurements have been conducted for dishwashing machines with a rated capacity of 15 ps or 17 ps respectively, the measured energy consumption of the dishwasher with a rated capacity of 16 ps both under standard and alternative test conditions (0.755 kWh/cycle and 0.731 kWh/cycle) is also used for calculating the additional annual energy consumption needed to clean the same amount of dishes if only 12 ps are fitted into 15 ps and 17 ps-machines. The results calculated as described exemplarily for the 16 ps dishwashing machine by the formula above are presented in Table 5.

Table 5: Additional annual energy consumption of dishwashers with a rated capacity of 15 place settings and more

Declared number of place settings	Cycles/year if only 12 ps fit in number	Energy consumption 280 cycles/year kWh	Energy consumption 12 ps/cycle kWh	Add. annual Energy consumption kWh
17	397	211.4	290.21	78.8
16	373	211.4	272.66	61.3
15	350	211.4	255.85	44.5

For the tested dishwasher with 16 ps declared capacity, the measured water consumption (*Wc*) per cycle was 10.9 L in both, the standard and the alternative test. Taking the additional number of wash cycles into account, the water consumption for the dishwashing machine with a rated capacity of 16 ps (Wc_{16ps}) and an actual number of 12 ps/cycle (Wc_{12ps}) can be calculated:

$$Wc_{16ps} = 280 \text{ cycles/year} * 10.9 \text{ L/cycle} = 3{,}052.0 \text{ L/year}$$

$$Wc_{12ps} = 373 \text{ cycles/year} * 10.9 \text{ L/cycle} = 4{,}065.7 \text{ L/year}$$

$$Wc_{add} = 4{,}065.7 \text{ L/year} - 3{,}052.0 \text{ L/year} = 1{,}013.7 \text{ L/year}$$

Wc_{add} is the additional annual water consumption caused by the fact that only 12 place settings fit in the appliance instead the stated 16 place settings.

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The water consumption of 10.9 L/cycle is also used for calculating the additional annual water consumption needed to clean the same number of dishes if only 12 ps are fitted into machines with a rated capacity of 15 ps and 17 ps. The results of the calculations are presented in Table 6.

Table 6: Additional annual water consumption of dishwashers with a rated capacity of 15 place settings and more

Declared number of place settings	Cycles/year if only 12 ps fit in number	Water consumption 280 cycles/year L	Water consumption 12 ps/cycle L	Add. annual water consumption L
17	397	3,052.0	4,327.3	1,275.3
16	373	3,052.0	4,065.7	1,013.7
15	350	3,052.0	3,815.0	763.0

Step 3: Scaling the additional annual energy and water consumption to all dishwashers at EU level

The APPLiA market overview of dishwashing machine models[11] provides the rated number of place settings of all dishwasher models sold in the year 2017. Thus, a reliable basis of the share of devices with a rated capacity of 15 or more place settings is available. In addition, the market share of the respective dishwasher category (15, 16 or 17 ps) must be taken into account. Therefore, the additional annual energy consumption per dishwasher category was calculated first and then cumulated.

Example: The market share of dishwashing machines with a rated capacity of 16 ps is 4 % (APPLIA). For calculating the additional annual energy consumption ($E_{add/year}$) of all dishwashing machines with a rated capacity of 16 ps, if only 12 ps fit into the machine, the annual additional energy consumption of the appliance in the test (61.3 kWh) is multiplied by the total number of dishwashing machines in the sales forecast for 2020 (9.28 Million) and the respective market share of 4 %.

$$E_{add/year} = 61.3\ \text{kWh} * 9{,}280{,}000 * 4.0\ \% / 1{,}000{,}000 = 22.8\ \text{GWh/year}$$

The additional annual energy consumption of all dishwashing machines with 17 ps and 15 ps is calculated accordingly (Table 7). For the determination of the market share of appliances that should be considered in the realistic and the extensive circumvention scenario, the additional annual energy consumption of the different categories of dishwashing machines are cumulated, the cumulated figures are also presented in Table 7.

[11] APPLIA (2017): Database of dishwasher models in European markets for the year 2017

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Table 7: Additional annual energy consumption considering the number of place settings and the market share

Declared place settings (ps) number	Market share of appliances %	Cumulated market share of appliances with ≥ ps in %	Add. annual energy consumption GWh	Cumulated add. annual energy consumption with ≥ ps in GWh
17	0.1	0.1	0.7	0.7
16	4.0	4.1	22.8	23.5
15	5.0	9.1	20.6	44.1

According to the estimation of the additional annual energy consumption of dishwashing machines, the additional annual **water consumption** that might be caused by this type of circumvention is calculated.*Example:* The market share of dishwashing machines with a rated capacity of 16 ps is 4 % (APPLIA). For calculating the additional annual water consumption (Wc_{add}) of all dishwashing machines with a rated capacity of 16 ps, if only 12 ps fit into the machine, the annual additional water consumption of the appliance in the test (1,013.7 L) is multiplied by the total number of dishwashing machines in the sales forecast for 2020 (9.28 Million) and the respective market share of 4 %.

$$Wc_{add/year} = 1{,}013.7 \text{ L} * 9{,}280{,}000 * 4.0\ \% \ / \ 1{,}000 = 376{,}285.4 \text{ m}^3/\text{year}$$

The additional annual water consumption of all dishwashing machines with 17 ps and 15 ps is calculated accordingly (Table 8). For the determination of the market share of appliances that should be considered in the realistic and the extensive circumvention scenario, the additional annual water consumption of the different categories of dishwashing machines are cumulated, the cumulated figures are also presented in Table 8.

Table 8: Additional annual water consumption considering the number of place settings and the market share

Declared place settings number	Market share of appliances %	Cumulated market share of appliances %	Add. annual water consumption m^3	Cumulated add. annual water consumption m^3
17	0.1	0.1	11,835	11,835
16	4.0	4.1	376,285	388,120
15	5.0	9.1	354,032	742,152

Step 4: Cumulating the additional annual energy and water consumption for different scenarios

For the impact assessment of dishwashing machines on the losses of potential energy and water savings, assumptions for the realistic minimum and maximum scenario and the extensive circumvention scenario are made.

- For the realistic maximum scenario, it is assumed that all dishwashing machines with a rated capacity of 16 and 17 ps are prone to this type of circumvention (market share 4.1 %).

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However, it might also be likely that not all dishwashing machines with a rated capacity of 16 and 17 ps have a notable number of accessories that need to be removed. Thus, the realistic minimum scenario includes only 50 % of the respective devices (market share 2.05 %).

- The calculations for the extensive circumvention scenario include also dishwashing machines with a rated capacity of 15 ps (market share 9.1 %). Table 9 for the energy consumption and Table 10 for the water consumption comprise the input parameters and the results for the impact assessment of the described case of circumvention.

Table 9: Input for calculations and results for case DISH3 – energy consumption

Input parameters	Calculation values of the input parameters and results		
Additional annual energy consumption of the dishwasher if only 12 ps/cycle can be loaded	17 ps 78.8 kWh	16 ps 61.3 kWh	15 ps 44.5 kWh
Forecast of annual sales of dishwashers in 2020	9,280,000 units (Wierda und Kemna 2018)[8]		
Share of devices showing this behaviour (assumption based on market offer as shown by APPLiA data)	**Realistic scenario** **min** 2.05 % *	 **max** 4.1 % **	**Extensive circumvention scenario** 9.1 % ***
Potential annual losses of energy savings by all dishwashers sold in 2020	11.7 GWh	23.5 GWh	44.1 GWh

*50 % of dishwashers with a rated capacity of 16 and 17 place settings, **All dishwashers with a rated capacity of 16 and 17 place settings, ***all dishwashers with a rated capacity of 15, 16 and 17 place settings.

Table 10: Input for calculations and results for case DISH3 – water consumption

Input parameters	Calculation values of the input parameters and results		
Additional annual water consumption of the dishwasher if only 12 ps/cycle can be loaded	17 ps 1,275.3 L	16 ps 1,013.7 L	15 ps 763 L
Forecast of annual sales of dishwashers in 2020	9.280.000 units (Wierda und Kemna 2018)[8]		
Share of devices showing this behaviour (assumption based on market offer as shown by APPLiA data)	**Realistic scenario** **min** 2.05 % *	 **max** 4.1 % **	**Extensive circumvention scenario** 9.1 % ***
Potential annual losses of water savings by all dishwashers sold in 2020	194,060 m³	388,120 m³	742,152 m³

*50 % of dishwashers with a rated capacity of 16 and 17 place settings, **All dishwashers with a rated capacity of 16 and 17 place settings, ***all dishwashers with a rated capacity of 15, 16 and 17 place settings.

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The alternative test method shows that the removal of accessories from the dishwasher in order to fit in the rated number of 15 or more place settings causes a notable increase in the annual electricity and water consumption for automatic dishwashing in European households. Much more than the 280 wash cycles as declared on the energy label have to be run per year, if only 12 place settings can be loaded into these devices to clean the stated number of place settings per year.

The realistic scenario refers to dishwashing machines with a rated capacity of 16 or 17 place settings, which leads to a range between 11.7 GWh and 23.5 GWh of losses of potential energy savings respectively 194 thousand to 388 thousand m^3 of losses of potential water savings that could be avoided if the described type of circumvention would not be possible.

The extensive scenario takes all dishwashing machines with a declared capacity of 15, 16 and 17 place settings into account assuming that even dishwashing machines with a rated capacity of 15 place settings do not provide enough space for a full load of 15 place settings without taking out accessories. In this scenario about 44.1 GWh of losses of potential energy savings and about 742 thousand m^3 of losses of potential water savings could be avoided per year.

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4.3.4 Domestic ovens: Case OVEN1 – Volume without shelf guides

Short description of the case

The harmonized standard EN 60350-1:2016 states that removable items specified in the user instructions, and not essential for the operation of the appliance, shall be removed before the volume measurement is carried out if this is described in the user instruction. According to some user manuals, for some recipes the oven cavity must be empty, i.e. the removal of the side racks and removable side walls (e.g. optional catalytic walls) is required. In the tested case, the measurement of the oven volume is done after removal of shelf guides, which leads to a better EEI.

Description of differences between harmonised and alternative test methods

The purpose of the alternative test method is to quantify, how the difference in the volume of the oven cavity (measurement with/ without shelf-guides) affects the EEI and the corresponding energy efficiency class.

Harmonised test method	Alternative test method
The tests were conducted according to the harmonised standard EN 60350-1:201. The shelf-guides specified in the user instructions as not being essential for the operation of the appliance in the manner for which it is intended were removed. If the user instruction did not contain this specification, the shelf-guides were considered as essential for the operation of the oven and the measurement of the volume was made with the shelf-guides in their position.	The volume of the oven is measured with the shelf-guides in their position.

Results of standard and alternative test methods

Two oven models that included a recipe in the user instructions requiring the removal of the shelf-guides were tested with the ANTICSS alternative test method, i.e. with the shelf-guides in their position.

Model A: The volume of the oven, measured in the alternative test method with the shelf-guides in their position, is 13 % lower than the volume measured under harmonised standard test conditions (71 l versus 62 l). The energy consumption measured under harmonised standard conditions and in the alternative test is 0.71 kWh in both test methods. The Energy Efficiency Index rises from 83.5 (harmonised standard test method) to 87.7 (alternative test method). The figures obtained from the alternative test method do not affect the energy efficiency class.

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Model C: The oven volume measured in the alternative test, with the shelf-guides in their place (62 l) is 10 % lower than the volume measured under standard conditions (69 l). The Energy consumption measured in the conventional, fan assisted programme under standard test conditions and in the alternative test is 0.91 kWh in both methods which is much higher than the declared value (0.68 kWh). The EEI rises from 108.3 (standard test) to 112.3 (alternative test) in the conventional fan assisted programme, which results in the energy efficiency class B in both test methods. When the measurements are carried out in ECO mode, the energy consumption is 0.81 kWh in both, the standard and the alternative test method. The EEI rises from 96.4 (standard test) to 100 (alternative test), which results in the energy efficiency class A in both test methods.[12]

For the two oven models in the test, the EEI values are within the energy efficiency class A respectively class B in the standard and in the alternative test. For other models, when the standard value is narrower to the lower border of the class, the difference in the oven volume could well affect the energy efficiency class of the device.

Calculation of losses of potential energy savings per appliance

The results show that the removal of the shelf-guides leads to an increase in the oven volume that notably affects the resulting EEI of the device. The measured energy consumption was identical for both oven models in all test modes. Due to the method used for the calculation of the *EEI*, a higher oven volume leads to a more favourable EEI, if the energy consumption is constant, see the following formulas:

$$EEI_{cavity} = \frac{EC_{electric\ cavity}}{SEC_{electric\ cavity}} \times 100$$

$$SEC_{electric\ cavity} = 0{,}0042 \times V + 0{,}55 \text{ (in kWh)}$$

i.e. the larger the volume (V) the smaller the EEI. A smaller EEI can thus be reached by either lowering the energy consumption of the appliance or by increasing the volume.

With the measured energy consumption (*E*) and the EEI determined in the standard ($EEI_{standard}$) and in the alternative test ($EEI_{alternative}$), the additional energy consumption (E_{add}) per cycle can be calculated by putting the energy efficiency index derived from the standard test in relation to the energy efficiency index obtained by the alternative test. This ratio is then multiplied by the measured energy consumption. The result is subtracted from the measured energy consumption which was identical in the standard and alternative test:

[12] The declared classification of this oven is „A+"(EEI 81). The lower classification in "B" (fan assisted programme) or "A" (ECO mode) both in the standard and alternative test conditions results from the deviation of the measured energy consumption compared to the declared one.

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$$E_{add} = E\,[kWh] - \frac{E\,[kWh] * EEI_{standard}}{EEI_{alternative}}$$

Table 11: Energy consumption and EEI of oven model A and C

	Model A		Model C	
	standard	**alternative**	**standard**	**alternative**
Oven volume in l	71	62	69	62
Forced air circulation mode				
Measured energy consumption/cycle (*E*) in kWh	0.71	0.71	0.91	0.91
$EEI_{standard/\ alternative}$	83.5	87.7	108.3	112.3
Additional energy consumption/cycle (E_{add}) in kWh	**0.034**		**0.032**	
Eco mode				
Measured energy consumption/ cycle (*E*) in kWh*	0.71	0.71	0.81	0.81
$EEI_{standard/\ alternative}$	83.5	87.7	96.4	100
Additional energy consumption/cycle (E_{add}) in kWh	**0.034**		**0.029**	

* For model A the Eco mode and the forced air circulation mode are identical, as for this model the Eco mode is also a forced air circulation mode

The additional energy consumption that can be consumed due to the larger declared oven volume to reach the same EEI, is in a narrow range of values between 0.029 kWh and 0.034 kWh per cycle. The arithmetic mean of 0.032 kWh is thus used to calculate the annual potential loss of energy savings per appliance based on the tested oven models A and C.

Following Mudgal et al. (2011)[13], an average European household runs 110 oven cycles per year. Multiplied by 0,032 kWh/cycle, the additional annual energy consumption per appliance results in 3.52 kWh/year.

$$E_{add} = 110 \text{ cycles/year} * 0.032 \text{ kWh/cycle} = 3.52 \text{ kWh/year}$$

[13] Mudgal et al. (2011): Lot 22 Domestic and commercial ovens (electric, gas, microwave), including when incorporated in cookers, Task 3: Consumer behaviour and Local infrastructure. Final Version. Bio Intelligence Service; ERA Technology Ltd. Paris, August 2011. Online available at https://www.eup-network.de/fileadmin/user_upload/Produktgruppen/Lots/Final_Documents/Lot22_Task3_Final.pdf, last accessed at 14.08.2019

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Calculation of losses of potential energy savings on EU level

All input parameters for the calculation of the case OVEN1 are presented in Table 12.

Table 12: Input for calculations for case OVEN1

Input parameters	**Calculation values of the input parameters**		
Additional annual energy consumption if the same EEI should be reached with a lower oven volume	3.52 kWh		
Annual sales of ovens in 2020	12,481,000 units (Wierda und Kemna 2018)[8]		
Share of devices showing this behaviour	**Realistic scenario**		**Extensive circumvention scenario**
	min	**max**	
	5 % *	70 % **	70 % **
Potential annual losses of energy savings by all ovens sold in 2020	2.2 GWh	30.8 GWh	30.8 GWh

*as no specific educated guess is available, the minimum share of 5 % is assumed, ** based on observation from test house experts who tested 19 ovens, 13 of which were categorized with the better EEI due to higher oven volume, assumption of identical market shares for the realistic scenario and the extensive scenario.

The realistic minimum scenario results in 2.2 GWh of losses of potential energy savings. This result is based on the very conservative consumption that 5 % of all oven models in the market show this type of circumvention. This assumption was made as no specific educated guess has been available.

However, during an appliance testing action, initiated by MSAs, experts from test houses have observed that 13 out of 19 appliances were categorized with the higher oven volume, without the shelf guides in their place. This results in a market share of 70 % for the realistic maximum scenario, which would lead to about 30.8 GWh of losses of potential energy savings per year.

In principle, all ovens could be reconstructed in a way that e.g. shelf guides, catalytic walls, etc. can be removed from the oven cavity. Thus, it could even be assumed that 100 % of ovens would be prone to this type of circumvention. However, it is unlikely that the current production of all ovens will be changed in a way that all items are removable. Assuming that the observation from the MSA appliance testing action already revealed the maximum of oven models with removable items in the market, the market share of 70 % was also ascribed to the extensive circumvention scenario.

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4.3.5 Domestic ovens: Case OVEN3 – Electronic control

Short description of the case

According to EN 60350-1:2016 the measurement of the energy consumption, with a brick inside the oven cavity, is followed by a subsequent temperature measurement of the empty oven. Thus, after the measurement of the energy consumption (step 1), the oven door is opened, the brick is removed from the oven cavity, the door is closed and the temperature measurement (step 2) starts.

The measurements by an MSA of 7 oven models in ECO mode analogous to EN 60350-1 provided the impression that in 6 of the tested oven models the first opening of the loaded oven was a control-relevant event and led to a changed regulatory behaviour: During the first step, the energy consumption measurement, the temperature in the oven was considerably lower than the temperature setting. The opening (and re-closing) of the oven door caused a significant increase of the temperature in the interior of the oven and the set temperature value was reached. The same measurements were performed in a non-ECO mode and there was no difference between the temperatures of the two steps of the test cycle.

Description of differences between harmonised and alternative test methods

The purpose of the alternative test method is to avoid that the electronic control of the oven detects the test situation due to the door opening in order to better understand the behaviour.

Harmonised test method	Alternative test method
According to EN 60350-1:2016, the test cycle consists of the measurement of the energy consumption and the time for heating a load while the oven is loaded with a brick (step 1), followed by the subsequent temperature measurement in the empty oven (step 2).	The test cycle is carried out as specified in EN 60350-1:2016, whereas the oven temperature is not measured subsequently but in a separate measurement. The alternative testing procedure is equivalent to the standard testing procedure with the exception that there is a delay between step 1 and step 2: the oven was switched off after step 1 and reheated on the next day for step 2.

Results of standard and alternative test methods

Two oven models have been tested, whereas one of the oven models did not show any hint for circumvention. The other oven model was classified as borderline to circumvention.

Conclusion

It is not possible to calculate potential losses of energy savings through this case as it was not possible to calculate exact values with the results of the measurement. The standard deviation was too high and the cavity temperature in step 2 has been determined during the last 20 min without steady state condition because of the behaviour of the oven.

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5 Summary: Impacts of circumvention – potential losses of claimed energy and water savings

For four product groups (televisions, dishwashers, refrigerators and freezers, and ovens) where the ANTICSS laboratory testing confirmed a categorization of 'circumvention' or 'borderline to circumvention' at product level, a quantification of the impacts on energy and water consumption has been conducted. Table 13 and Table 14 show the total annual losses of potential electricity, respectively primary energy savings that could be avoided, if circumvention does not occur during appliance testing, Table 15 presents for dishwashers the annual losses of water consumption.

Table 13: Total annual losses of potential electricity savings due to circumvention

Total potential losses of electricity savings [GWh/year]			
Case	Realistic circumvention scenario		Extensive circumvention scenario
	min	max	
TV2/3	26.1	91.3	522.0
COLD3	6.9	43.0	86.1
DISH3	11.7	23.5	44.1
OVEN1	2.2	30.8	30.8
TOTAL	**46.9**	**188.6**	**682.9**

Table 14: Total annual losses of potential primary energy savings[14] due to circumvention

Total potential losses of primary energy savings [GWh/year]			
Case	Realistic circumvention scenario		Extensive circumvention scenario
	min	max	
TV2/3	54.8	191.8	1096.1
COLD3	14.5	90.4	180.7
DISH3	24.6	49.4	92.6
OVEN1	4.6	64.6	64.6
TOTAL	**98.4**	**396.1**	**1434.0**

Table 15: Total annual losses of potential water savings due to circumvention

Total potential losses of water savings [m³/year]			
Case	Realistic circumvention scenario		Extensive circumvention scenario
	min	max	
DISH3	194,060	388,120	742,152

[14] Primary energy factor: 2.1; according to Directive (EU) 2018/2002 on energy efficiency

Comparing the different contributions of the product groups to the impacts, it gets obvious that Smart TVs offer a very high potential for losses of claimed energy savings due to circumvention, i.e. the detection of fast-moving images being very specific to the current standard test video. The losses of potential primary energy savings sum up to nearly 55 GWh/year in the realistic minimum scenario and nearly 192 GWh/year in the realistic maximum scenario. Provided that this potential act is not prevented and would be applied to all smart TVs currently on the market, the annual losses of potential primary energy savings could increase to 1,096 GWh/year.

A more or less continuously activated display in refrigerators and refrigerator-freezers, which is not accounted for in the standard test and therefore in the declared energy consumption, can also make a relevant contribution to lost claimed energy savings. In the realistic scenario, losses of potential primary energy savings are in a range between 14.5 to 90.4 GWh/year. If this act is not prevented and would be applied to all appliances with integrated display currently on the market, the annual losses of potential primary energy savings could be 180 GWh/year.

For dishwashing machines, the observation that high capacities of 16 or 17 place settings as declared can only be achieved with very specific instructions provided for test laboratories only, offers another potential for losing claimed energy and water savings. The resource consumption mainly depends on the annual number of cleaning cycles and consumers would have to use far more cycles per year to clean the same number of dishes. Assuming that half or even all of the dishwashing machines with a declared capacity of 16 and 17 place settings on the market do not provide enough space to fit in the necessary number of dishes per cycle, 25 to 50 GWh/year of potential primary energy savings and about 194 to 388 thousand m^3 of potential water savings could be lost. If not only dishwashing machines with 16 and 17 place settings but also dishwashing machines with a declared capacity of 15 place settings would be affected, about 93 GWh/year of potential primary energy savings and roughly 742 thousand m^3 of water savings could be lost.

Enlarging the volume of the oven cavity by removal of all mobile items including shelf guides leads to a better Energy Efficiency Index which could lead to a better energy efficiency class, i.e. a competitive advantage on the market. Although the energy consumption of the oven is rather not affected in the realistic scenario assuming that only 5 % of all oven models require this specific test setting, about 4.6 GWh/year of potential primary energy savings could be lost. If about 70 % of all oven models would be affected, 64 GWh/year of potential primary energy savings could be lost.

According to the ANTICSS impact assessment, 98 to 400 GWh (realistic scenario) or 1,434 GWh (extensive scenario) of primary energy savings could be lost per year due to acts of 'circumvention' or 'borderline to circumvention'. However, this reflects only a small proportion because not for all of the reported and tested cases a quantification of the impact on the resource consumption was possible. Also, further acts of circumvention not yet detected by the project could occur. Based on the funding decision of Horizon2020, the activities and outcomes of the ANTICSS project are expected to trigger at least savings of about 30 GWh/year by avoiding primary energy losses due to circumvention acts. The total achievements to this goal will be presented in the ANTICSS final report.

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Austria: BMDW - Bundesministerium für Digitalisierung und Wirtschaftsstandort

Belgium: ECOS - European Environmental Citizens Organisation for Standardisation

Belgium: BHTC - Service public federal sante publique, securite de la chaine alimentaire et environnement

Czech Republic: SEVEn - SEVEn, the Energy Efficiency Center, z.u.

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