Circumvention of EU ecodesign and energy labelling regulation and standards: impacts, mitigation measures and recommendations for policy and standardisation

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Abstract

Whereas reasons for and remedies against non-compliance under EU ecodesign and energy labelling legislation have already been well analysed, the general topic of suspected manipulation of test results or circumvention received a lot of policy attention only recently, not only for car emissions (dieselgate resp. emissionsgate scandal) but also regarding potential negative effects for other legislation. Among the reactions the European Union's Horizon 2020 research and innovation programme funded the project "ANTICSS – Anti-Circumvention of Standards for better market Surveillance". This paper provides a further developed definition and examples of 'circumvention' in the context of EU ecodesign and energy labelling legislation and relevant harmonised standards. Further, an estimation of the magnitude of possible energy saving losses due to 'circumvention' is given based on collected cases and independently tested products. Finally, recommendations for policy makers and standardisation bodies to prevent future circumvention under EU ecodesign and energy labelling are given.

Introduction

The European Commission estimates that 10–25 % of products put on the EU market do not fully comply with energy efficiency labelling regulations and around 10 % of potential energy savings may be lost due to non-compliance [1]. According to the Special Report 'EU action on ecodesign and energy Labelling: important contribution to greater energy efficiency reduced by significant delays and non-compliance' of the European Court of Auditors this would roughly correspond to the final electricity consumption of Sweden and Hungary combined [2]. The reasons for non-compliance include a missing or incorrect energy label, non-compliance with information requirements, as well as incorrect classification of the energy class.

While these reasons for non-compliance with the requirements, and the possible remedial measures have already been well analysed, the issue of circumvention of standards and legal requirements of the ecodesign and energy labelling legislation through manipulated test results has only recently started to receive due political attention. Triggered by the diesel scandal, in which vehicles contained a certain defeat device that guaranteed compliance with emission limits during the test conditions while emissions in practice were much higher, the investigation on whether such manipulations are also possible under other EU legislations was envisaged.

Against this background, the European Union's Horizon 2020 research and innovation programme funded in 2018–2021 the project 'ANTICSS – Anti-Circumvention of Standards for better market Surveillance' conducted by 19 partners of eight countries, coming from research agencies, Market Surveillance Authorities (MSAs), test laboratories, standardisation and consumer organisations. The overall objective is to assess and clearly define circumvention in relation to EU ecodesign and energy labelling legislation and relevant harmonised standards, assess its potential impacts on projected energy savings and derive recommendations for policy makers and standardisation to facilitate preventing future circumvention acts in the EU legislation.

This paper starts with the regulatory definition of circumvention, provides then a more comprehensive definition including further circumvention acts and jeopardy effects elaborated by the ANTICSS project, and explains the need for alternative tests to detect circumvention which does not become apparent using harmonised standards. In the second part, based on ANTICSS own test results the paper shows six examples of how more favourable test results can be achieved under EU ecodesign and energy labelling by circumventing or exploiting loopholes in standards and legislation. Further, in different scenarios the overall impact, i.e. losses of claimed energy savings, is calculated assuming that the examples found in ANTICSS are applied to a certain share of products on the EU market. Finally, the paper gives initial recommendations to policy and standardisation how to better address and prevent circumvention under EU ecodesign and energy labelling in future.

Definitions of Circumvention

This section starts with the regulatory definition of circumvention under EU ecodesign and energy labelling and then presents a more comprehensive definition of possible circumvention acts and jeopardy effects based on findings of the ANTICSS project.

Box 1. Article on circumvention in 2019 published ecodesign regulations.

CIRCUMVENTION

The manufacturer, importer or authorised representative shall not place on the market products designed to be able to detect they are being tested (e.g. by recognising the test conditions or test cycle), and to react specifically by automatically altering their performance during the test with the aim of reaching a more favourable level for any of the parameters declared by the manufacturer, importer or authorised representative in the technical documentation or included in any of the documentation provided.

Box 2. ANTICSS definition of circumvention.

ANTICSS 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.

CIRCUMVENTION ACCORDING TO 2019 ADOPTED EU ECODESIGN REGULATIONS

After the issue of circumvention entered the policy agenda, a specific article on circumvention was introduced in the most recent EU ecodesign regulations on electronic displays, light sources, dishwashers, washing machines, washer-dryers, refrigerating appliances and those with a direct sales function as shown in Box 1. The focus of the article is on products programmed to recognize the test situation and automatically optimise the performance and/or resource consumption when they are tested. Also, Recital (35) and Article 3 of the Energy Labelling Framework Regulation (EU) 2017/1369 explicitly mention that methods and standards should deter intentional and unintentional 'circumvention', and prohibits the inclusion of software or hardware that automatically alters the performance of a product in test conditions.

MORE COMPREHENSIVE ANTICSS UNDERSTANDING AND DEFINITION OF CIRCUMVENTION

The ANTICSS project has extensively investigated the possibilities for circumvention. Through literature research and analysis of existing legislation and measurement standards on ecodesign and energy labelling, possible gaps and loopholes of the system were identified. In a survey of 278 experts from manufacturers, Market Surveillance Authorities, test laboratories, as well as consumer and environmental organisations, 39 cases of suspicious product behaviour were collected and analysed. The analysis of these cases showed that circumvention can happen not only by automatically detecting the test situation and changing the product performance during the test, that is already prohibited in some ecodesign and all energy labelling regulations, but also in other specific situations.

Better test results can be also achieved by making certain pre-settings or manual alterations to the product to be applied during the test situation. Specific manufacturer's instructions for the preparation and the development of a laboratory test can be necessary, e.g. for safety reasons, and are therefore generally permissible by test standards. However, if such instructions have to be used exclusively by test laboratories and alter the product behaviour to optimise its performance under testing, the ANTICSS project identifies this as circumvention.

A third way of circumvention could be by programming products to provide very good energy efficiency and/or resource consumption for the time in which the conformity verification test is expected, or for a predefined number of cycles. At the time of placing on the market the product is programmed in a way to make it compliant if selected by a Market Surveillance Authority for compliance verification, but to automatically change its performance a certain time after it is put into service. The automatic modification does not take place during the period in which the verification of compliance is expected but only afterwards, for example, to ease performance restrictions imposed by compliance with the regulatory requirements and make the product more attractive to end users in actual use, but also less efficient. The software is already present in the delivered product, i.e. not provided subsequently via software update, as this would be prohibited under the latest ecodesign regulations.

Given this information, the ANTICSS project developed a more comprehensive definition of circumvention, which is including three possible routes (see Box 2).

JEOPARDY EFFECTS

In a number of the cases collected by the ANTICSS project the products' behaviour was not clearly attributable to the above definitions of circumvention, but was nevertheless still suspicious. Against this background, the ANTICSS project developed the concept of jeopardy effects, i.e. a product behaviour that is not circumvention and thus cannot be claimed non-compliant, but allows a distortion of the test results due to loopholes or other weaknesses in standards or regulations (see Box 3). Examples of jeopardy effects are given further below.

Box 3. ANTICSS definition of jeopardy effects.

ANTICSS 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.

The need for alternative test procedures to detect circumvention

Circumvention goes beyond non-compliance: Market Surveillance Authorities can detect non-compliance by inspecting product documentation and/or by laboratory testing, using standard measurement methods. The information and test results are compared with the requirements laid down in legislation and standards. If they do not meet these requirements the product is non-compliant. In case of circumvention the product does not immediately appear to be non-compliant. At first glance, the product appears to comply with all requirements when tested with the harmonised standards. However, this is because the product itself or its settings have been manipulated with the aim of circumvention or for exploiting loopholes, i.e. the test results are influenced in such a way that they turn out more favourable precisely under standard test conditions. For this reason, it is rather impossible to detect circumvention behaviour with the standard measurement methods harmonised for the regulations. This is one of the most important findings of the ANTICSS project as it shows the need for alternative test approaches to address circumvention during compliance assessment.

ANTICSS developed and applied alternative test procedures for a number of suspicious cases that were initially collected or reported to the project. Main characteristics of alternative test procedures specifically addressing circumvention are that only those aspects of the standard test conditions considered prone to manipulation or under suspect of manipulation are slightly varied. At the same time, the alternative test methods are still designed to be as close as possible to the harmonised standards, with the aim of ensuring comparability between the two sets of measurement results. This is an important difference to other alternative tests (see below).

The ANTICSS project considered that, if the alternative measurement method leads to inexplicable changes in the measurement results, this may indicate that the product might have been specifically altered to detect, or manipulated to be optimised for, the harmonised standard test conditions. It has to be noted that within the ANTICSS project no analysis was developed to prove that the alternative methods deliver (i) repeatable and reproducible results which are (ii) directly comparable with the results achieved with the harmonised standards.

DIFFERENCE TO ALTERNATIVE TESTS FOCUSING ON MISSING REPRESENTATIVENESS OF STANDARDS

For applying harmonised standards, there is the need to obtain very similar results when tests are repeated in the same test laboratory at different time (repeatability) as well when the same test is conducted in another laboratory (reproducibility) [3]. To fulfil these requirements, in general, standards require a specific preparation of the product or the conditions under which the test has to be conducted. This includes e.g. the use of a standardised 'dust' for testing vacuum cleaners, standard loads (laundry or dishes) for testing household washing machines and dishwashers, a standard test video for televisions or testing of refrigerating appliances without any door openings during the standard test and, thus, conditions not exactly representative for the actual operation. Although standard test methods should reflect 'real-life' conditions as much as possible, real-life conditions cannot be easily reproduced as tests cannot replicate to 100 % the variety of real-life conditions and of the users.

If these standard conditions, being inevitably to a certain extent different from real-life, result in different outcomes of standard test results compared to real-life testing, this cannot be classified as circumvention, but it is rather the case of the EU legislation prescribing e.g. one or more specific standard programme(s) or conditions that have been considered the best user-relevant at average EU level. This aspect, called missing representativeness of standards in the ANTICSS project, is a well-known issue for harmonised standards, in which the best balance between standardised conditions necessary to ensure repeatability and reproducibility and good simulation of real-life usage has to be found. On the other hand, the more harmonised standards entail very specific conditions or include ambiguities and loopholes, the higher is the risk that products are designed to be able to detect these test condition patterns or that manufacturers exploit the loopholes in a way to achieve more favourable results for their products, i.e. the risk of circumvention or jeopardy effects is increasing.

The ANTICSS alternative testing methods for targeting circumvention differ from alternative test methods developed by other organisations to address the missing representativeness of harmonised standards. Where the ANTICSS methods are intentionally designed to be as close as possible to the current harmonised standards, the latter have the intention to better reflect real-life conditions in future new revisions of harmonised standards. For example, the organisation CLASP developed a new ten-minute test video sequence to measure the energy consumption of televisions as alternative to the existing IEC 62087:2015 test video, better reflecting normal programme content and latest television technologies such as HDR (high dynamic range).

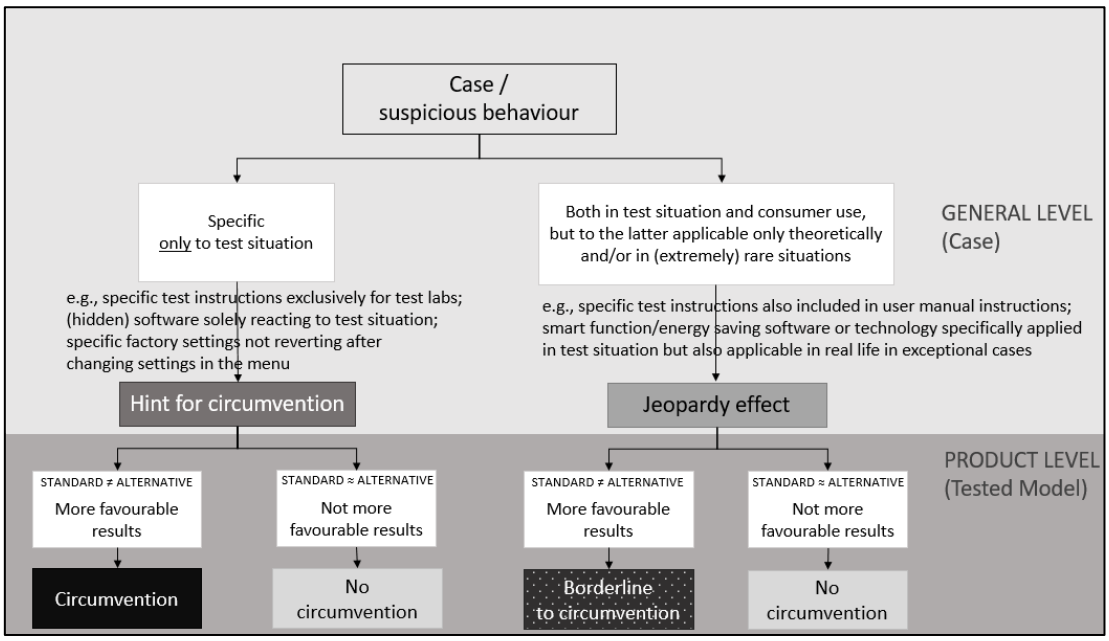

Figure 1. ANTICSS categorisation of cases and tested models.

ANTICSS differentiation between general case and tested model

This section describes how the ANTICSS project distinguishes for the categorisation between the general case and the product level (Figure 1). The *case level* represents suspect behaviours initially reported by third parties to the project, for example by a Market Surveillance Authority or other stakeholders. At this level, ANTICSS differentiates between hints for circumvention (in orange), and jeopardy effects (in yellow):

- Hints for circumvention: Reported cases where the suspect behaviour leading to more favourable results *exclusively* occurs during the test situation but not during consumers' use; e.g., specific test instructions provided exclusively for test labs, (hidden) software solely reacting to the test situation, or specific factory settings not reverting after changing the settings in the menu. Until these acts have not been proven for specific models by laboratory testing in ANTICSS, they are still called hint for circumvention.
- Jeopardy effects: Reported cases where the suspect behaviour occurs *both* in the test situation and in real-life, but to the latter applicable only theoretically or in (extremely) rare situations; e.g., specific test instructions also included in the user manual instructions; or energy or resource saving software or technologies that are specifically applied in the test situation but are also applicable in real life in exceptional cases. These acts are not relevant *only* under test conditions, but nevertheless, the design of the product or the test instructions result in more favourable results especially, but not exclusively, in the test situation.

The *product level* reflects the final assessment of test results after laboratory testing of selected product models within ANTICCS. For this purpose, ANTICSS used the verification tolerances of the tested parameters as provided in the ecodesign and energy labelling regulations for market surveillance purposes as a reference for determining the significance of the deviation between the results achieved under the standard and the alternative testing conditions. If the deviation exceeded the verification tolerances, the result of the alternative test is considered to be significant and thus worth a specific analysis to understand if this would be a consequence of circumvention or – if initially considered a jeopardy effect – of borderline circumvention.

For some of the initially reported suspicious cases, the results of the specific models that were tested within the project resulted as no circumvention. In fact, despite the act of circumvention has not been found in the few models tested in the ANTICSS project, the suspected behaviour might still be applied by other models of the same product category not tested within ANTICSS.

ANTICSS model selection procedure to target circumvention

From the initial 39 suspicious behaviour cases reported to the ANTICSS project, after initial evaluation 21 cases were deemed as non-compliant, compliant or duplicates. For the remaining 18 cases of 8 different product categories, classified either as hint for circumvention or jeopardy effect, the test laboratories in the ANTICSS project developed and applied alternative test methods. For each product category 3 different models should be tested.

The model selection procedure applied within ANTICSS was specifically targeted at finding appliances with a high probability of having a circumvention behaviour. Thus, the following overarching principles were applied:

A targeted selection was implemented in those cases where specific brands and/or models had been identified as part of the ANTICSS consultation of stakeholders. Alternatively, when no specific brand/model was referred to in the reported case, a semi-random selection was applied. The main search focus was on the technical features or peculiarities associated with the reported suspected act of circumvention or jeopardy effect. Test laboratories were supporting with their gained experience

and know-how to assess these technical features. Lastly, if the previous approaches still did not have delimited the necessary shortlist, other selection criteria based on expert judgement and, if necessary, full randomisation was utilised. To avoid unnecessary redundancy, it was taken care that the three different models were not too similar (e.g. variations of the same product model within the same brand), or equivalent (e.g. same model sold under different brand/model names).

ANTICSS test results: Circumvention or borderline to circumvention

This section provides the six most obvious ANTICSS tests results in terms of (borderline to) circumvention.

EXAMPLE 1: WASHING MACHINES – SPECIFIC OPTIMISATION AT FULL AND HALF RATED CAPACITY

According to harmonised standard EN 60456:2016, for washing machines a series of seven tests has to be carried out with three different treatments in the standard programmes as follows: Half load: two test runs at treatment 40 °C and two test runs at treatment 60 °C; and full load: three test runs at treatment 60 °C. The suspicion is that washing machines might be optimised in a way to gain more favourable results for the energy and water consumption exactly at the two testing points of full and half load as specified in the harmonised standard, whereas the consumption values follow a different pattern when the machine is run at different loads.

For the ANTICSS alternative testing procedure, the tests according to the treatments above were also performed according to EN 60456:2016 but with a reduced load of 6 kg instead of the full load of 10 kg as declared by the manufacturer and with a half load of 3 kg (instead of 5 kg). The results for one of the three tested models suggested that this washing machine might be optimised specifically for the standard loads. So, the ANTICSS consortium decided to perform additional tests at 4 kg, 6.5 kg and 8 kg at 60 °C treatment to better understand the machine's behaviour. The results were striking (see Figure 2):

- The energy consumption values at loads lower than half rated capacity of 5 kg (0.55 kWh) were higher (0.63 kWh at 4 kg and 0.67 kWh at 3 kg) and also the energy consumption values at loads lower than full rated capacity of 10 kg (0.81 kWh) were higher (0.88 kWh at 8 kg, 0.92 kWh at 6.5 kg and 0.95 kWh at 6 kg)
- There was a significant, inexplicable increase of the energy consumption from 0.55 kWh at 5 kg to 0.95 kWh at 6 kg load.

The increasing energy consumption at lower loads is remarkable as it could rather be expected that the energy consumption of the washing machine would rise with increasing wash load or getting lower with smaller loads (note: a linear dependency of the washing machine's energy consumption to the load is an approximation introduced by the ANTICSS project for sake of simplicity although it is well known that the relation is not strictly linear). The tested model could be categorised in two different ways:

1. borderline to circumvention, assuming that the more efficient test results for the energy and water consumption more or less exactly at full and half rated capacity (compared to different loads in-between) would also be achieved in real life when consumers load the machine around these capacities.
2. circumvention, imagining that the model could have a sensor that automatically detects the weight of the load, and being programmed in a way that if the weight corresponds to the exact load used in the standard test (full and half load of the rated capacity, standard garments), the energy and the water consumption would be reduced exclusively under these standard test conditions, but not in consumer use.

This case gives strong indications how products whose performance varies with capacity can be optimised towards a legislation setting a reduced number of capacities as representative of the overall product performance.

EXAMPLE 2: DISHWASHERS – SPECIFIC LOADING INSTRUCTIONS

Standard EN 50242:2016 for measuring the performance of electric household dishwashers, states that 'The dishwasher manufacturer's instructions regarding installation and use shall be followed.' The testing of one of the three analysed dishwasher models following the manufacturer's instructions according to the harmonised standard required the removal or change of

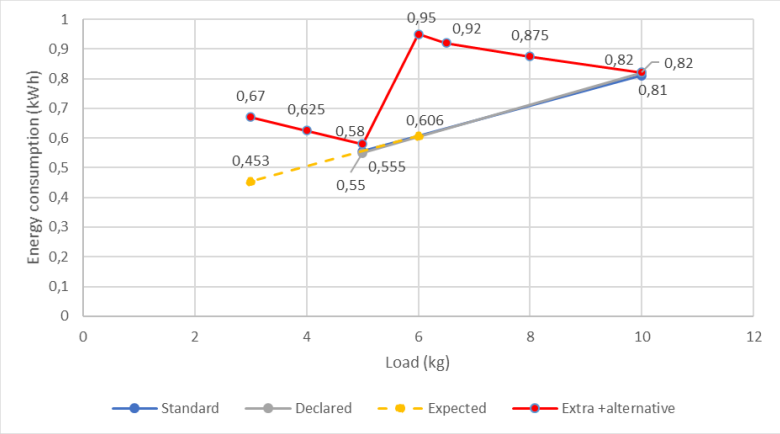

Figure 2. ANTICSS results of a washing machine model: energy consumption of the 60 °C standard programme using different loads.

the position of many of the accessories that were fitted to the appliance as supplied. Instructions, e.g. removal of a third rack or alteration of relevant parts (e.g. split of cutlery basket into two parts at different positions) were exclusively given in the Instructions for Test Laboratories, not in the user instructions; therefore, this case was categorised as hint for circumvention according to Figure 1.

The ANTICSS alternative testing procedure was conducted also according to harmonised standard EN 50242:2016 and manufacturer's instructions but *without* removing or altering the accessories. The loading scheme was applied with the maximum number of place settings and corresponding serving pieces that fit in the machine as delivered. With this alternative loading scheme and all accessories kept in place in the machine, only 12 instead of 16 place settings could be fitted into the dishwasher, see Table 1. By this means, the load capacity, i.e. the number of loadable place settings, was reduced by 25 %. Although the absolute water consumption did not change and the total energy consumption was slightly lower (-3.2 %) compared to the standard test results due to the reduced weight of the load, the specific energy and water consumption per place setting increased by 29 % and 34 % compared to the standard test results. For consumers, this means that in real-life operation only 12 instead of declared 16 place settings could be loaded and sufficiently cleaned, which results in more cycles needed per year to clean the same amount of dishes, i.e. increases their annual energy and water consumption.

Considering that the manufacturer's instructions regarding a loading scheme are exclusively provided for test institutes, the product is considered to be manually altered, and the resource consumption affected only during the laboratory testing. The deviation of the specific energy and water consumption exceeded the verification tolerances; therefore, the result of the alternative test is considered to be significant and the tested model is categorised as circumvention according to Figure 1. The loading capacity is one of the declared parameters on the Energy Label and thus a purchase criterion for consumers. Since the loading capacity is also used to calculate the energy efficiency index, a higher loading capacity might help reaching a better energy efficiency class, although this was not the case for the specific model tested within ANTICSS.

EXAMPLE 3: OVENS – VOLUME MEASUREMENT WITHOUT SHELF GUIDES

Standard EN 60350-1:2016 for measuring the performance of household electric cooking appliances states for measuring the volume: 'Removable items specified in the user instructions to be not essential for the operation of the appliance in the manner for which it is intended shall be removed before measurement is carried out.' In one of the three tested oven models, the user instructions contained one specific recipe for making yoghurt, which indicated that it is necessary to remove the accessories and shelves and that the cooking compartment must be empty. Due to this specific recipe in the user instructions, the standard test of the volume had to be done removing all shelf guides. The ANTICSS alternative testing procedure was conducted also according to standard conditions of EN 60350-1:2016, except the volume was measured *with* the shelf guides in their position.

In the alternative procedure, the volume with shelf guides included was lower (9 litres or around 13 %) than in the standard procedure without the shelf guides, see Table 2. The energy consumption was the same for the standard and the alternative testing. However, the difference in the volume had an impact on the calculated Energy Efficiency Index (EEI), which was 5 % higher than under standard test conditions. For the tested model, however, the higher EEI did not result in a change of the energy efficiency class.

The inclusion of a recipe where the shelf guides are not needed (which is then the setting of the oven for the standard test) was not exclusively provided in the instructions for test laboratories but also included in the user instructions. This provides the possibility of such a setting in consumer use. Nevertheless, the use of an oven without shelf guides seems to be an exceptional use and not the operation of the appliance in the manner for which it is usually intended, so it remains suspected that the inclusion of such a recipe is intended to achieve more favourable results specifically under testing; the case is categorised as jeopardy effect. The deviation of the volume exceeded the verification tolerances, i.e. the result of the alternative test is considered to be significant and the tested model is categorised as borderline to circumvention according to Figure 1. The volume of ovens is one of the declared parameters on the energy label, i.e. purchase criterion for consumers. Since the volume is also

Table 1. ANTICSS test results, dishwasher.

	Standard test results	ANTICSS alternative test results	Deviation
Standard place settings (ps)	16	12	-25 %
Specific energy consumption (Wh/ps)	47.2	60.9	+29 %
Specific water consumption (L/ps)	0.68	0.91	+34 %
Energy efficiency class	A+++	A+++	No difference

Table 2. ANTICSS test results, oven.

	Standard test results	ANTICSS alternative test results	Deviation
Volume (L)	71	62	-13 %
Energy consumption (kWh/cycle)	0.71	0.71	0 %
Energy Efficiency Index	83.5	87.7	+5 %
Energy efficiency class	A	A	No difference

used to calculate the Energy Efficiency Index, a higher volume might help reaching a better energy efficiency class, although this was not the case for the specific model tested within ANTICSS.

EXAMPLE 4: OVENS – AUTOMATIC TEMPERATURE REDUCTION FUNCTION

The first step of the test cycle according to EN 60350-1:2016 for measuring the performance of household electric cooking appliances, the energy consumption measurement, is done with a brick (soaked up with water to simulate a piece of beef) loaded in the centre of the oven. In the second step, a consecutive temperature measurement of the empty oven is done. Between the two steps, the door necessarily has to be opened to remove the brick. To measure the energy consumption of the oven in the first step, a certain temperature-rise as defined in the standard has to be reached in the centre of the brick.

The results of the ANTICSS testing for one of the three tested models is shown in Figure 3. During the first step (energy consumption measurement) in the ECO mode, the temperature in the oven was considerably lower than the targeted temperature setting: the total length of the first step was 54 minutes, but the temperature of the centre of the oven was around the set temperature of 190 °C for only approx. 20 minutes. After this, the temperature dropped down to 89 °C, whereas the expected and normal behaviour of an oven would be to maintain the temperature of around 190 °C for most of the time. The temperature was only increased again ***after*** the door was opened to remove the brick. In the second step (temperature measurement), the temperature remained stable during the test period.

In a tested non-ECO mode ("fan assisted" mode) of the same model, the temperature in the centre of the oven remained stable for both the energy consumption measurement and the temperature measurement. Also, the second oven model tested in ANTICSS did not show this behaviour: both in ECO and in "Conventional with fan" mode of that model, the temperature in the centre of the oven remained stable for both steps.

It seems that the ECO mode of the first model has been specifically designed to reach lower, i.e. more favourable values for the energy consumption by reducing the temperature while still maintaining the target temperature rise in the centre of the brick. Only *after* the first hour, i.e. usually when the testing duration of the energy measurement is finished, the temperature remained stable at the required temperature setting. Probably the opening (and re-closing) of the oven door in the standard testing, or, alternatively, a certain pre-set period of time, triggered the temperature to increase so that the required temperature value could be reached for the subsequent temperature measurement. The temperature decrease does not apply exclusively during the test situation but occurs always during the first hour, i.e. applicable both in the test situation and during consumer use; thus, the case is categorised as jeopardy effect according to Figure 1. The temperatures of the alternative test are deviating significantly from standard requirements, i.e. the tested model is categorised as borderline to circumvention according to Figure 1.

EXAMPLE 5: REFRIGERATING APPLIANCES – SCREEN SWITCH-OFF FUNCTION

Standard EN IEC 62552:2013 for measuring the performance of household refrigerating appliances states: 'The refrigerating appliance shall be set up as in service in accordance with the manufacturer's instructions.'

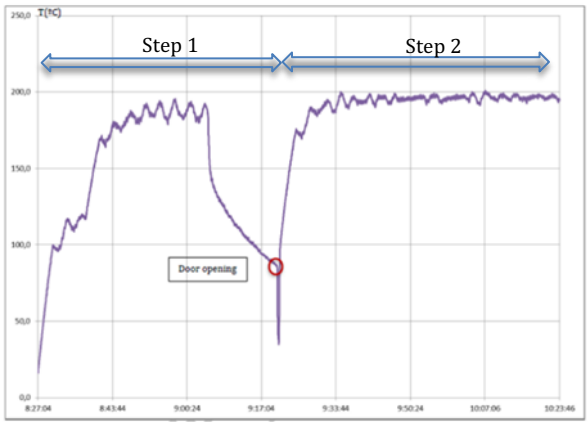

Figure 3. ANTICSS results of an oven model in ECO mode: energy consumption measurement (step 1) and temperature measurement (step 2).

For the tested refrigerating model, the display of a controller, providing a digital clock, is activated each time the door is opened. In case the consumer is away for a longer period, the cabinet can save energy by disabling the display after 24 hours. The appliance does not have a functionality to turn off the display permanently. It only controls whether the display remains always on or is turned off after 24 hours without door opening detection; it is not possible to increase or shorten this time in the settings. The user instructions state to leave the screen switch-off function in the pre-set value (i.e. turn-off after 24 hours without door openings) in order to save energy and in case that the pre-set switch-off function is disabled the energy consumption will slightly increase.

Therefore, the standard test has to be done with the screen switch-off function enabled, i.e. automatic turn-off after 24 hours without door openings. As the harmonised standard does not include any door openings this means that the display will be permanently turned off under standard test conditions, whereas in everyday life, the display will be activated most of the time due to the normal use of the refrigerator with daily door openings.

For the ANTICSS alternative test procedure, the input power of the display was measured separately during an off cycle of the cooling system, while switching the display on and off. The difference of the measured input power (2.1 W) was attributed to the display. The annual energy consumption of the appliance was then calculated by adding the energy consumption of the activated display (estimating 20 days of absence per year with the display being deactivated) to the annual energy consumption measured with the harmonised standard.

The results in Table 3 show that there would be an additional energy consumption of around 17 kWh/year due to the display, which cannot be switched off manually. This is an increase of 10.3 % compared to the results of the test with the harmonised standard conditions. The energy efficiency class would change from an A+++ to A++.

During the standard testing the appliance operates as if the consumer were not at home and deactivated the display to save energy. Thus, the measured and declared energy consumption of the standard test represents the most efficient mode of the appliance, which is not providing a reliable value about the

Table 3. ANTICSS test results, refrigerator.

	Standard test results	ANTICSS alternative test results	Deviation
Energy consumption (kWh/year)	169	186	+10.3 %
Energy Efficiency Index	20.3	22.4	+10.3 %
Energy efficiency class	A+++	A++	1 class

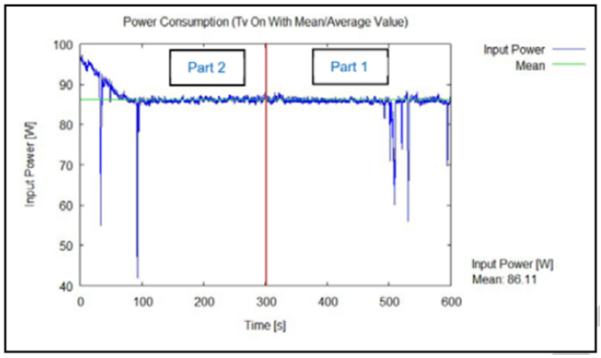

Figure 4. ANTICSS results of alternative testing of a TV model using an automatic back-light reduction function.

actual energy consumption during real use. The turn-off of the display does not apply exclusively during the test situation but occurs also during consumer use, e.g. when the consumer is absent for a holiday period; thus, the case is categorised as jeopardy effect. The deviation of the energy consumption of the tested model exceeded the verification tolerances, i.e. the result of the alternative test is considered to be significant and the tested model is categorised as borderline to circumvention according to Figure 1.

EXAMPLE 6: TELEVISIONS – AUTOMATIC BACKLIGHT REDUCTION FUNCTION

It is well known among experts that the test video to be used for the standard measurement according to IEC 62087-2:2015 for the determination of the power consumption of audio, video, and related equipment such as televisions includes hard cuts every few seconds, i.e. fast moving images which are very different from the characteristics of real life broadcast content. This pattern might facilitate the device recognizing this sequence as a test video and implementing special functions to reduce for example the luminance (backlight or OLED) during this loop to decrease the power consumption specifically in the test situation.

For one of the three models tested in ANTICSS, the results according to the harmonised standard showed that the model indeed has a special function to detect fast changing content: the backlight (finally the input power) was reduced step by step starting at about 95 W at the start of the test video and settling down at about 85 W after 100 seconds for the rest of the 10 minutes test sequence (see Figure 4). The two other models tested in ANTICSS did not use such a backlight reduction function.

This could be either classified as jeopardy effect (following the manufacturer's explanation that the function is also applicable to any content in real life that entails rapid scene changes and/or depicting a large amount of motion such as sports programmes), or as hint for circumvention (based on the experience of the test lab that such fast moving pictures never apply in real-life, i.e. the software exclusively reacts to the specific fast-moving images of the standard test video – which however could not be proven in ANTICSS).

In principle, such a backlight reduction function can be used to gain more favourable results of the declared parameters. However, for the specific model tested in ANTICSS this was not exploited – on the contrary: the *declared* values for the on-mode and annual power consumption were significantly higher, i.e. 23 % worse than the results of the standard measurement, even resulting in a declared lower energy efficiency class A instead of A+ as measured, see Table 4. According to the manufacturer, this over-declaration of power consumption is a safety margin due to variations between units resulting of the construction process, i.e. to ensure all units being compliant with energy efficiency class A when tested by Market Surveillance Authorities.

The specific model tested in ANTICSS is not categorised as circumvention according to Figure 1. However, the use of a backlight reduction function during the standard test to gain more favourable results of the declared parameters can still be considered potentially applicable to other models of the product category not yet tested.

Possible impacts of circumvention and jeopardy effects

The two following impact scenarios were calculated based on the ANTICSS test results of models that were categorised either as circumvention or as borderline to circumvention.

- The *realistic circumvention scenario* aims to show the magnitude of the potential losses of energy savings through circumvention which are considered to be realistic within a range reflecting the likely minimum or maximum losses. They were based on the knowledge about market shares of relevant technical features of the appliances, and estimations of experts e.g. from energy agencies, MSAs, test institutes or standardisation bodies about the market share of products probably showing this kind of behaviour. In case that information was not available, a conservative market share of 5 % was estimated for the realistic minimum scenario.
- The *extensive circumvention scenario* shows the impact on the potential losses of energy savings, if all products that have the technological capability, and are thus theoretically prone to this type of circumvention, are considered in the calculations.

Table 5 shows the total annual losses of potential primary energy savings in EU-27, if circumvention or borderline to circumvention as found in ANTICSS occurs during appliance testing [4]. The calculations take into account the potential loss

Table 4. ANTICSS test results, television model.

	ANTICSS Standard test results	Declared by manufacturer	Deviation
On-mode power consumption (W)	85	110	-23 %
Annual power consumption (kWh/year)	118	153	-23 %
Energy efficiency class	A+	A	1 class

Table 5. Total annual losses of potential primary energy savings (EU-27) due to circumvention.

	Realistic scenario, minimum [GWh/year]	Realistic scenario, maximum [GWh/year]	Extensive scenario [GWh/year]
(in brackets: assumed market share of products showing the circumvention behaviour or jeopardy effect)			
Ovens: volume measurement without shelf guides	5 *(5 %)*	65 *(70 %)*	65 *(70 %)*
Dishwashers: specific loading instructions	25 *(2 %)*	49 *(4 %)*	93 *(9 %)*
Refrigeration appliances: screen switch-off function	15 *(2 %)*	90 *(12.5 %)*	181 *(25 %)*
Smart TVs: automatic backlight reduction function	55 *(5 %)*	192 *(17.5 %)*	1,096 *(100 %)*

per product, the number of appliances expected to be sold in the year 2020 and the assumed market share of appliances that might show this behaviour (given in brackets in Table 5).

According to the ANTICSS impact assessment [4], in summary about 100 to 400 GWh (realistic scenario) or 1,435 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. Further, ANTICSS results show that not only the electricity consumption, but also other performance parameters might be optimised for the standard test. A lower performance of appliances under consumer use conditions will probably be noticed by consumers and might lead them not to use the ECO modes anymore but to switch to other, probably even more resource-intensive programme settings. The resulting effects – should circumvention take place on a larger scale – would be disastrous in several respects: in addition to the lost savings and climate protection potential, the trust of society and business in these key EU policy instruments might be massively damaged.

Conclusions and recommendations

Circumvention is considered an illegal act according to a new Article 6 included in a number of recent product specific ecodesign regulations adopted in 2019. A generic prohibition is also present in Article 3.5 of the energy labelling framework regulation (EU) 2017/1369. However, this prohibition only covers products which actively recognise the test conditions and react by automatically altering their performance during the test, that is considered in point a) of the ANTICSS definition of circumvention. This means that, from a legal point of view, all cases falling under point b) and c) of the ANTICSS definition of circumvention (i.e. pre-set or manual alteration of the product, affecting performance and/or resource consumption during test or pre-set alteration of the performance within a short period after putting the product into service, see Box 2), are compliant for both the ecodesign and the energy labelling legislation. Therefore, based on ANTICSS result, it is proposed that the legal definition of circumvention in ecodesign regulations and the framework energy labelling regulation 2017/1369 should be extended to cover also these other types of circumvention. Furthermore, the prohibition of circumvention in all its forms should be extended to all product specific ecodesign regulations that do not yet include such an article.

The ANTICSS project has highlighted that the existing ecodesign and energy labelling legislation includes loopholes and other weaknesses – the jeopardy effects that can lead also to borderline to circumvention, i.e. situations legally exploited by manufacturers to achieve more favourable results, however, which cannot be classified as circumvention. Although the check for internal consistency is part of the preparation and the impact assessment of any new piece of EU legislation, the practice has shown that some time is needed after the application of a new regulation to understand the actual implications and relations of the different provisions. In this respect, a continuous adaptation of the regulations to new products and configurations is needed, to ensure more robust legislation. The application of legislation should be analysed at regular intervals to identify jeopardy effects, loopholes and other weaknesses that might facilitate circumvention. This assessment could be developed as a routine exercise within the ecodesign and energy labelling Consultation Forum, where all interested parties are present, or within the Administrative Cooperation Group (AdCo), the forum for the Market Surveillance Authorities. Once identified these loopholes could be overcome via a fast track revision procedure of the legislation, or specific FAQs to be included in the Commission Guidelines that usually accompany the ecodesign and energy labelling regulations and/or via AdCo FAQs. The assessment of the technical and legal feasibility of a mid-term revision of non-essential requirements (an essential requirement is e.g. the scale of the label or ecodesign requirements) should be considered by the European Commission.

When products or respective test settings have been manipulated with the aim of circumvention, products appear to comply with the legislation requirements when tested with the harmonised measurement methods. For this reason, it is impossible to

detect circumvention behaviour with the current harmonised standards. The ANTICSS project has developed alternative test methods that may indicate the presence of circumvention. These alternative test methods involve slight variations of the ambient test conditions, such as testing without the specific instructions or accessories; testing a certain number of cycles beyond the defined number of standard cycles or a combination of standard cycles (as set in the legislation and in relevant harmonised standards). It is recommended that standardization mandates issued by the European Commission to the European Standardization bodies include also the request to prepare alternative test methods aimed at indicating the presence of circumvention. In this way the alternative test conditions will become part of the final harmonised standard(s), perhaps in a specific part devoted to prevention of circumvention, which could be legally usable by Market Surveillance Authorities and could constitute the legal basis for an eventual enforcement action against circumventing models.

The obligation to follow manufacturer's instruction for the installation of a product or its setting before laboratory testing is per se correct and unavoidable, because the manufacturer is the only one legally responsible for the characteristics and compliance of a product with all applicable legislation, including the way it has to be used and tested according to its intended use. The misuse of manufacturer's instructions, i.e. prescribing instructions for a specific set-up of the product only for laboratory testing according to the harmonised standard with no comprehensible justification (e.g. technical or safety reasons), in order to achieve more favourable test results should instead be considered an illegal practice, and falls under the ANTICSS circumvention definition. In this respect, this practice should be declared illegal in legislation as well as in standards, and be considered as a sufficient reason for the loss of the presumption of conformity of the measured product (when a harmonised standard is used for the conformity to the EU ecodesign/energy labelling legislation) or for considering invalid the test results achieved via other reliable, accurate and reproducible methods.

As for legislation, also the evolution rate of standards is slower than that of product innovation (technological development and human creativity), whether to improve genuine performance or targeted to reach better test results. The ANTICSS project has highlighted that the existing harmonised standards for the compliance verification of products covered by ecodesign and energy labelling legislation include ambiguities and weaknesses that can be and have been exploited by manufacturers. Although the check for internal consistency is part of the preparation of any new standard or the revision of existing ones, practice has shown that some time is needed after the publication of a new standard to understand the implications of and relations among the different clauses and test conditions. Continuous adaptation of the standards to new products and configurations is needed, through amendments when necessary, to insure better credibility of the overall standardisation activity. The correspondence of standards to legislation should be analysed at regular intervals to identify ambiguities, loopholes, illogical/unintentional interpretations and other weaknesses within the lifetime of a standard edition and at every updating of an existing standard. Once identified, these loopholes could be overcome via a fast track revision procedure of the standard or via an amendment or the preparation of a new edition.

All the material from the ANTICSS project (test results, further recommendations for policy makers and standardisation bodies; and guidelines for MSAs and test laboratories to prevent future circumvention under EU ecodesign and energy labelling) are provided on the project website www.anti-circumvention.eu.

References

[1] European Commission, "New energy efficiency labels explained," 2019. [Online]. Available: https://ec.europa.eu/commission/presscorner/detail/en/MEMO_19_1596 [Accessed May 3, 2021].

[2] European Court of Auditors, "EU action on Ecodesign and Energy Labelling: important contribution to greater energy efficiency reduced by significant delays and non-compliance," Special Report, 2020. [Online]. Available: https://www.eca.europa.eu/Lists/ECADocuments/SR20_01/SR_Ecodesign_and_energy_labels_EN.pdf [Accessed May 3, 2021].

[3] European Parliament, "Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017 setting a frame-work for energy labelling and repealing Directive 2010/30/EU," 2017. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R1369&from=EN [Accessed May 3, 2021].

[4] I. Rüdenauer, R. Stamminger, C. Pakula and K. Graulich, "Impact Assessment of circumvention under EU Ecodesign and Energy labelling," 2021. [Online]. Available: https://www.anti-circumvention.eu/about-project/documents-and-deliverables [Accessed May 3, 2021].