EUROPEAN ENVIRONMENTAL CITIZENS ORGANISATION FOR STANDARDISATION

ORGANISATION EUROPÉENNE ENVIRONNEMENTALE CITOYENNE POUR LA NORMALISATION

ECOS

Approaches to address circumvention of ecodesign and energy label requirements – an ECOS discussion paper

"These new regulations will fundamentally change the way we get around them."

Credit: Peter C. Vey/The New Yorker Collection/The Cartoon Bank

Authors:
Jeremy Tait, Tait Consulting Limited, ECOS expert; Christoforos Spiliotopoulos, ECOS Senior Programme Manager

ECOS - The European Environmental Citizens' Organisation for Standardisation
Mundo B, Rue d'Edimbourg 26 I 1050 Brussels, Belgium
EU Transparency Register number 96668093651-33

T. +32 2 894 46 68
info@ecostandard.org
www.ecostandard.org

Table of Contents

1 Introduction: The cost of circumvention to consumers and to society

Attempts at circumvention are as old as regulation but a much higher political priority has been placed on fighting it in recent years. When suppliers choose to invest time and money to circumvent energy and environmental requirements rather than invest to develop good products, there are serious impacts on users, on society, and on the supplier:

- The energy and environmental savings anticipated from the policy cannot be delivered, users are misinformed and suffer higher costs and society suffers more severe consequences of climate change or other environmental damage;
- The competitive market based on product performance is undermined and genuine product improvement is stalled, with long term degradation of savings potential;
- The credibility of labels and standards policy itself can be damaged as buyers become less trusting in labels and are more easily swayed by other factors such as price;
- Exposed suppliers suffer damage to their brand reputation, lower confidence in their product quality and loss of product differentiation.

Authorities must apply the full force of the law to tackle suppliers that choose to circumvent, even if the cost to address it is high, because of the corrosive effect that circumvention has on fair competition and how it undermines regulations. Within the correct regulatory structures, fair competition can and will transform markets to benefit users, society and reputable suppliers.

This discussion paper aims to promote a wider understanding of the issues surrounding circumvention and help enable a productive debate on options to tackle and reduce it. The scope of this paper is the policy area of ecodesign and energy labelling, although some lessons from automotive and other areas are useful to draw on. We set out what circumvention is, what drives suppliers to choose that option and some of the challenges that must be faced to tackle it. We identify many of the varied ways in which it has been and is being at least partially addressed. Finally, we set out some options to stimulate discussion of how it can be tackled more comprehensively, systematically and effectively in future.

2 What do we mean by 'circumvention'?

There are various ways in which regulations and policy measures define and disallow this for products, by:

1. Defining and banning circumvention devices or strategies; and/or
2. Defining how products *must* behave under test; and/or
3. Defining how products *must not* behave under test.

Examples of each are considered below.

2.1 Basic definition of circumvention and its result

At its most basic, circumvention is referred to as "t*he act of finding a way of avoiding a difficulty or rule"*[1]. According to the International Electrotechnical Commission (IEC), circumvention results in[2]: *"false and misleading information being provided to regulators and consumers when measurements are undertaken in a test procedure"*.

2.2 Definitions of defeat or circumvention devices or strategies

IEC has horizontal guidance for standardisers on how to address circumvention which focuses mainly on the 'circumvention device' and an almost identical definition appears in the draft ecodesign

[1] Oxford Advanced Learners Dictionary.
[2] IEC TC59 Internal Guide - The Principles of the Work of IEC TC 59 and its SCs, Edition 4 (ref 59/674/INF).

measure for displays[3] and in the test standard for household refrigerators (IEC 62552: 2015). The IEC definition is[4]:

> *"Any control device, software, component or part that alters the appliance operating characteristics during any test procedure, resulting in measurements that are unrepresentative of the appliance's true characteristics that may occur during intended use under comparable conditions"*
>
> *"A circumvention device saves energy … ONLY during the test procedure [and] not during intended use"*

In a further and more detailed example, the Commission has defined the defeat device for the automotive industry in Regulation (EC) No 715/2007 on vehicle type approval[5]:

> *"'Defeat device' means any element of design which senses temperature, vehicle speed, engine speed (RPM), transmission gear, manifold vacuum or any other parameter for the purpose of activating, modulating, delaying or deactivating the operation of any part of the emission control system, that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and use"*

For the automotive sector, the Commission also prohibits a 'defeat strategy' under type approvals for Heavy Duty Vehicles[6]:

> *"'defeat strategy' means an emission control strategy that reduces the effectiveness of the emission controls under ambient or engine operating conditions encountered either during normal vehicle operation or outside the type-approval test procedures"*

ECOS believes that definitions of defeat devices or circumvention must indeed be sufficiently broad to cover all aspects of product design that could result in circumvention, through the use of phrases such as 'element of design' and include 'software', 'control device', 'defeat strategy'.

In the context of ecodesign and energy labelling, it is also important not to constrain focus of the definitions only to energy as other regulated aspects of performance and environmental impact are important. For the avoidance of doubt, definitions should state the intended outcome of circumvention, i.e. what impact was caused by its use.

2.3 Definitions of how product must not behave

The Energy Labelling Regulation (EU) 2017/1369 defines what a supplier or product is not allowed to do[7], rather than directly defining a circumvention device:

> *"The supplier shall not place on the market products that have been designed so that a model's performance is automatically altered in test conditions with the objective of reaching a more favourable level for any of the parameters specified"*

---

[3] Displays Ecodesign WD, Annex I 3. The definition is: *'Circumvention device' or 'defeat device' means any control device, software, component or part that alters the energy consumption on a product during any test procedure, resulting in measurements that are unrepresentative of the products' true characteristics that occur during normal use under comparable conditions.*

[4] IEC TC 59 Internal Guide – The Principles of the Work of IEC TC 59 and its SCs, Edition 4

[5] Regulation (EC) No 715/2007 on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information

[6] Regulation (EC) No 595/2009 of 18 June 2009 on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (Euro VI) and on access to vehicle repair and maintenance information

[7] Regulation (EU) 2017/1369 of 4 July 2017 setting a framework for energy labelling and repealing Directive 2010/30/EU, Article 3 General obligations of suppliers, paragraph 5

This same paragraph appears in several draft energy labelling working documents of November 2017, including those for lighting, washing machines and dishwashers.

In parallel, international standard IEC 62552:2015 for testing of household refrigerators is being transposed into a European EN standard and includes a section on circumvention devices[8]. This section provides a (non-exhaustive) list of actions that would be considered as circumvention, including devices that alter the compartment temperature set-points during the test or manipulate the defrost interval. It therefore constitutes a specific list of how a refrigerator must not behave if suppliers are to avoid accusations of circumvention.

The United States Department of Energy (US DOE) test procedures for refrigerators take a more general line on energy consumption[9]:

> *"Products should not be designed in a way that would cause energy consumption to drop during testing as a result of [specified test] conditions. Doing so would ... be unrepresentative of average consumer use and would circumvent the total test procedure"*

Despite these examples being applied in practice, ECOS believes there are risks to defining what a product should not do. The implication could be that anything else (not listed) is acceptable.

Furthermore, as also proposed in section 2.2., for these examples too, focus must not be constrained only to energy issues, but also other regulated aspects of performance or environmental impact (e.g. emissions).

2.4 Definitions of how product must behave

For household refrigerators under the US DOE test procedure states[10]:

> *"The unit, when tested under this test procedure, shall operate in a manner equivalent to the unit in typical room conditions"*

The US DOE test procedure for fridges[11] goes on to be more detailed and specific by defining how to interpret the test method and stipulating how features that are often manipulated by circumvention must operate under test conditions; with special provisions for 'Components That Operate Differently During Testing'. For example, it has some very specific and clear requirements regarding behaviour if there is no door opening for a long period; control of defrost heaters; electric heaters for anti-condensation and seals; and adaptive defrost. DOE requires manufacturers to apply for a waiver if their product behaves in a way that runs counter to the expected principles. The onus is thus placed on the supplier to explain that their product is not circumventing, if it exhibits any abnormal behaviour (see also section 5.8).

Requiring behaviour 'equivalent to typical conditions of use' avoids ambiguity over intentional vs. unintentional circumvention (i.e. both are disallowed). However, 'equivalence' to typical conditions of use is not always easy to determine (see also sections 3 and 6.1). This could result in an unenforceable requirement, and so ECOS proposes that it is used only when there is a clear understanding and specification of what are the 'typical conditions' of use.

[8] IEC 62552-3:2015 Household refrigerating appliances - Characteristics and test methods - Part 3: Energy consumption and volume, 6 Circumvention Devices

[9] US DOE guidance on fridges test procedure, FAQ document. Guidance Type: Test Procedures, Enforcement, Category: Residential Products, Product: Refrigerators, Refrigerator-Freezers, and Freezers, Product Sub-type: Guidance Version: FINAL, Issued: May 28, 2013 http://www1.eere.energy.gov/guidance/default.aspx?pid=2&spid=1.

[10] US DOE 10 CFR 430.23(a)(10) (for Refrigerators). Available from http://www.ecfr.gov/cgi-bin/text-idx?SID=07cd48b1bcc1438ce884ab1010d41dcc&mc=true&node=se10.3.430_123&rgn=div8

[11] Ibid.

2.5 Intentional and unintentional circumvention

The EU Energy Labelling Regulation sets out that standards should:

"… be robust in order to deter intentional and unintentional circumvention"[12]

It further suggests that circumvention can be both intentional and unintentional but does not specifically disallow unintentional circumvention. 'Unintentional circumvention' would also cover cases where intention to subvert a rule may be likely but cannot be proven. An example could be a (supposedly) 'smart controller' that saves energy under test conditions but fails to do so in real use which could be claimed as due to flaws in the design.

ECOS believes that ecodesign and energy labelling regulations should disallow both intentional and unintentional improvement of performance under test conditions. It is impractical for authorities to have to prove not only that performance is altered under test, but also that this was the supplier's intention.

Allowing unintended circumvention opens loopholes for suppliers to justify altered performance as resulting from their intention to achieve any plausible but unrelated outcome that "inadvertently" reduced energy consumption during test.

Regulations should also disallow unintentional circumvention, or they risk that circumvention requirements are virtually unenforceable.

3 Ways in which circumvention takes place

Alan Meier of the University of California, Davis, has presented a useful classification of ways in which circumvention is achieved or a false or deceptive declaration can end up being made. We elaborate on this list[13] for this paper as follows:

a) **Outright lies and mistakes:** it is rarely possible to definitively distinguish between lies and mistakes, but this category includes falsified or mistaken: results, measurements, calculations and declarations; mis-categorisation of products or selection of wrong calculation factor(s) through 'misunderstanding' criteria, formulae or category definitions; product tested using a withdrawn or inappropriate test method; when a declaration or test is not updated following a design change;

b) **Exploiting poorly designed test methods, regulations & labels:** includes creative use of tolerances, reporting methods; misinterpretation of test standard instructions through ambiguities[14] and mistakes in the test method; exploiting behaviours that achieve a better performance result through those behaviours not being specifically disallowed in the regulation[15]; or where test methods enable misrepresentation through not sufficiently reflecting real use;

c) **Optimised products:** use of a 'Golden product' in the test that is not representative of production models. Note that regulations have to allow for the use of advanced prototypes in

[12] Regulation (EU) 2017/1369 of 4 July 2017 setting a framework for energy labelling and repealing Directive 2010/30/EU, preamble paragraph (35)

[13] Presentation slides: (almost) Everybody Circumvents, Alan Meier, University of California, Davis

[14] The STEP project highlighted examples of exploitation of ambiguities, including measurement of volume for household refrigerators, see section 5.6

[15] For example, washing machines that state a wash temperature of 60ºC but do not achieve anywhere near that temperature in use, but cases cannot be prosecuted as the regulation makes no requirement on if or how the stated temperatures must be achieved (arguably because the standard does not specify how such an achievement can be assessed)

order to secure approvals or compliance in time for full production, but this flexibility can be exploited;

d) **Optimised behaviour:** behaviour under test that does not respect the spirit of the test cycle - for example, switching to an optimised control algorithm when a test is detected[16]; exploiting an 'out of the box' test set up through manipulated factory-settings that are not representative of typical use[17] (see also below);

e) **Altering performance after installation**: achieving test behaviour that is not representative of typical use through control or setting changes during initial set-up in the home (for example encouraging users to switch to a 'quick start-up' mode that has high standby power), or through a 'software update' (see sections 5.6 and 6.2). These result in circumvention when performance in typical use is substantially worse than that under test (the effect of such interventions could, of course, be positive and so perhaps should not be completely ruled out by regulation - but that is not of concern here).

This paper does not attempt to address lies and mistakes but touches on all the other forms of circumvention.

It is important to recognise the material difference between two main ways in which test results may not reflect real use. Firstly, if diverting from an established and defined test methodology that should, by its design, achieve a fair representation of typical use. Secondly, if faithfully following a methodology that does not adequately reflect real-life conditions[18]. The latter could be due to a flawed methodology or when a test method simply cannot reproduce real conditions. Faithfully following a sub-optimal (or even a flawed) test method does not give rise to unfair competition, as long as all suppliers follow the method in good faith.

Regarding 'optimised behaviour', it is important to emphasise that control systems that optimise performance to suit conditions should arguably be encouraged and the IEC accepts that these, generally, can operate during testing. As shown in its guidance[19]:

> *It is important to distinguish between circumvention (which are normally only active during test procedures) and automatic adjustment of controls that provide improved appliance performance for the user (which should be active in intended use and in the test procedure).*

However, a warning is sounded by Alan Meier, who argues that sophisticated controls are 'the root of circumvention'[20] (whilst also being the root of significant energy savings) and bad outcomes from making allowances for changing behaviour under test should be noted from experience with automotive emissions testing (see section 5.7).

ECOS believes that regulations should be drafted with awareness of the many ways in which circumvention could be achieved. Care must be taken if a definition of circumvention relies on comparison with performance under 'real use' when the test method inherently does not or cannot fully replicate real use.

[16] For household refrigerators, this includes adjusting to longer defrost intervals, switching heaters off and changing to longer compressor cycles.

[17] 'Out of the box' testing is used for televisions and displays. An example to avoid circumvention is the mandatory 'peak luminance ratio' in the ecodesign measure, requiring the factory setting for luminance (out of the box) to be no lower than 65% of its maximum.

[18] http://ecostandard.org/wp-content/uploads/ECOS-Testing-Methods-Paper-Final.pdf

[19] IEC TC59 Internal Guide – The Principles of the Work of IEC TC 59 and its SCs, Edition 4

[20] Circumvention through the years, ECEE Columnist Alan Meier, LBNL, 10 November 2015 https://www.eceee.org/all-news/columns/Alan_Meier/circumvention-through-the-years/

If the results of testing are inevitably and substantially different to real use, then such a definition of circumvention is likely to be unenforceable. This does not mean that circumvention cannot be defined or disallowed, simply that linking circumvention only to 'typical use' may pose problems when the latter is difficult to establish.

4 When is circumvention more likely?

With many modern appliances and equipment, it is generally cheaper to reduce energy use through improvements in computation, sensing, and control than through adding more copper, insulation, and exotic materials[21]. Scenarios that make circumvention attractive for some suppliers include:

a) When products or suppliers are transient: a supplier appears on the market only temporarily to make fast profit, and/or product batches are small enough to be sold out before authorities identify them as problematic;

b) When production numbers and selling price are high enough to make the marginal cost of circumvention worthwhile (i.e. marketing edge outweighs the additional cost of hardware or software, especially where the circumvention is sophisticated);

c) When the penalty/sanction is negligible compared to the benefits of cheating, and so circumvention presents a low risk strategy for the manufacturer;

d) When a product has sophisticated programmable controls anyway (sophisticated controls have been called 'the root of circumvention', as explained above);

e) When vigilance or expertise of authorities appears to the supplier inadequate to effectively monitor the market;

f) When regulatory provisions are insufficiently robust and prone to misinterpretation due to, for example, grammatical issues or compromise wording that is either intentionally or unintentionally open to interpretation.

Proposals to address circumvention which take into account such likelihood scenarios are presented in section 6.

5 Initiatives which seek to address circumvention and lessons learnt

As awareness of circumvention has grown, studies and policy measures addressing the issue have increased. Approaches to tackle circumvention by a range of authorities are catalogued here to help inform the current debate and draw lessons from them. ECOS' aspiration is to identify useful elements and develop and apply them to achieve a more comprehensive and coordinated approach in the pursuit to address circumvention.

5.1 The energy label regulation

The EU Energy Labelling Regulation notes in its preamble that:

'*methods and standards should ... be robust in order to deter intentional and unintentional circumvention*'.

[21] Circumvention through the years, ECEE Columnist Alan Meier, LBNL, 10 November 2015. Available from https://www.eceee.org/all-news/columns/Alan_Meier/circumvention-through-the-years/.

Article 3 further states:

> *"The supplier shall not place on the market products that have been designed so that a model's performance is automatically altered in test conditions with the objective of reaching a more favourable level for any of the parameters specified in the relevant delegated act or included in any of the documentation provided with the product."*[22]

The Article 3 requirement is reflected in several of the ecodesign Working Documents for specific products as in section 5.2.

The wording used in the EU Energy Labelling regulation 2017/1369 to address circumvention appears sufficiently generic to capture all forms of circumvention, but perhaps recognising the difficulties explained in section 3, does not specify with what the comparison is made for "a more favourable level".

ECOS recommends that legal requirements addressing circumvention are clear and easily enforceable.

5.2 Ecodesign and energy label Working Documents

Various emerging ecodesign and energy label measures in early 2018 address circumvention in a variety of ways, as shown below:

a) Some (but not all relevant) Working Documents prohibit any software updates that increase consumption without explicit consent of the end-user - only one provides that the user must be able to refuse the update.

b) Only one Working Document includes specific provision that Market Surveillance Authorities may declare a product non-compliant if presence of a circumvention device is confirmed.

c) Some Working Documents specifically prohibit automatic control under test to achieve more favourable result.

d) Some draft energy label regulations place an obligation on suppliers to ensure no automatically altered performance under test.

e) At least one draft (network standby) includes no specific measures on circumvention at all.

f) Only one has been identified that makes a specific mention of requirements on test labs: The 2017 Household Refrigerators Explanatory Memorandum states that '*Test institutes involved in compliance testing are explicitly obliged to investigate anomalies that might be caused by attempts to circumvention and report circumvention to the market surveillance authorities*'. It is assumed that this refers to requirements within international standard IEC 62552: 2015, which are anticipated to be transposed into a harmonised EN standard 62552 in due course, see below. It is however not clear how this obligation can be implemented in practice unless it is part of the regulation.

ECOS believes that the requirements regarding circumvention in the various product-specific Working Documents on Ecodesign lack consistency and an overarching approach.

While variation in approach by product group can be appropriate to take into account product specificities, there is a need for a more comprehensive and coherent approach.

[22] Regulation (EU) 2017/1369 setting a framework for energy labelling and repealing Directive 2010/30/EU, Article 3 General obligations of suppliers, paragraph 5

5.3 Commission Standardisation Requests directly addressing circumvention

Unless tests are performed as part of a market surveillance process, circumvention cannot be effectively tackled. However, it is argued that the way tests are designed can facilitate or hinder circumvention. Thus, standardisation bodies do have a role in addressing the issue by developing measurement methods that are as close as possible to real usage and make it difficult for the product to recognize that it is under test and change its behaviour to circumvent.

Many Standardisation Requests have historically included the exact same text that sets a task for the standards working groups[23]:

> *"to ensure that the prospective harmonised standard(s) includes a procedure that avoids an appliance being programmed to recognize the test conditions and reacting specifically to them."*

ECOS herewith offers some observations on approaches to Standardisation Requests:

a) It may be appropriate for the Commission to provide legally robust text for insertion in standards, especially where this is designed to complement text in regulations (the text used in past SRs mentioned above may be such text);

b) A generic statement of guidance to the relevant standardisation groups on circumvention in the Standardisation Request is necessary but not sufficient to successfully steer the standardisation process: product-specific elements must be seriously considered based on previous experience and technical insights from preparatory studies;

c) A review of the ways in which an existing test/standard has been or could be circumvented should be integral to the process of starting the update of a standard; Market Surveillance Authorities could take an active part in that review, as well as drawing experience from other regions;

d) It is not necessarily appropriate, and certainly not sufficient, that a standard includes a specific step or section on circumvention. Minimising the risk of circumvention should be a systematic consideration in all aspects of the standards, a thread reinforcing the whole standard;

e) It may focus minds if anti-circumvention measures and considerations became a specific issue on which each Working Group reports to its TC and/or to the Commission - for example, if those are specified in a reasonably detailed note accompanying the technical draft;

f) It is widely acknowledged that the role of the standardisation committee is to develop measurement methods to assess a product in as close as possible to real ('typical') usage and this practice in itself can help reduce (but not eliminate) the scope for circumvention;

g) It may be beyond the role of standardisation to develop methodologies within standards to detect circumvention per se. but they do have a role in facilitate its detection. Improving detection could be tackled through development of best practice between Market Surveillance Authorities (MSAs) and test labs and will be a constantly evolving process.

5.4 IEC and CENELEC initiatives to address circumvention

Many standardisation bodies are discussing how to minimise circumvention through careful design of procedures and some standards include a section directly addressing it:

[23] Examples that included this text are: M458 (washing machines); M459 (refrigerators); M476 (variable speed drives); M481 (dishwashers); M488 (air conditioners and comfort fans); M498 (pumps); M500 (fans).

a) The IEC has produced horizontal guidance for its technical committees to help them address circumvention. Its IEC TC59 Internal Guide states that[24]:

> '*TC 59 and SCs can reduce the risk of circumvention by providing a range of realistic tasks for the appliance to undertake during tests. However, TC59 and SCs are encouraged to include a statement on the issue of circumvention in their standards similar to the text contained in the previous paragraph. TC 59 and SCs should also add a statement in their standards that test laboratories may be commissioned to undertake a range of additional tests at different conditions in order to detect circumvention devices. The type and range of tests that may be undertaken should not be specified*'.

b) In 2017, the CEN-CLC Ecodesign Coordination Group, which is responsible for the coordination and supervision of Ecodesign-related standardisation work, has assigned a task to its Task Force 2 'Tolerances and Uncertainties' to examine circumvention.

c) CENELEC TC 59X WG 8 on household refrigerators is working on transposition of IEC 62552: 2015 into an EN standard. IEC 62552 includes its section on circumvention devices[25] that provides a (non-exhaustive) list of actions that would be considered as circumvention, including devices that alter the compartment temperature set-points during the test or manipulate the defrost interval. It also provides that certain devices that only operate under restricted conditions and which aim to reduce energy consumption during normal use will not generally be treated as circumventing as long as the basis and operation is declared. This standard also provides instruction to test houses:

> '*Where the operation of a circumvention device is suspected, a laboratory should subject the appliance to measures such as door openings or other appropriate actions in an attempt to detect presence and operation of any such devices. Details of any such action and their effect shall be included in the test report. Where a circumvention device is suspected or detected during testing, a laboratory shall report that information to the client*'.

d) Other CLC/TC 59X working groups are known to be taking specific steps to consider and address circumvention, but this is not a generally transparent process and so it is not clear how widely this is taken on as a specific activity.

While ECOS welcomes that some standardisation bodies and groups have started considering circumvention, we call for improved horizontal guidance and also support to individual working groups on specific measures, sharing best practice approaches. The precedent of guidance for labs (for refrigerators) should be carefully adapted and applied to other products.

5.5 Initiatives by industry associations & bodies to address circumvention

Industry representatives drive the development of technical standards and, as noted in section 5.4, several of those have started considering circumvention. This is an important way in which industry assists with addressing the challenge of circumvention. No other examples of specific activities led by industry associations and bodies have been identified.

[24] IEC TC59 Internal Guide - The Principles of the Work of IEC TC 59 and its SCs, Edition 4

[25] IEC 62552-3:2015 Household refrigerating appliances - Characteristics and test methods - Part 3: Energy consumption and volume, 6 Circumvention Devices.

5.6 Collaborative EU projects related to circumvention

Two ongoing projects are known to have a specific focus on circumvention:

a) *ANTI-Circumvention of Standards for better market Surveillance* (ANTICSS[26], Horizon 2020) launches spring 2018 and aims to: assess and define circumvention; collect and learn from cases; look for loopholes in EU regulations; confirm and quantify energy saving losses; define test methods less prone to circumvention; build capacity to detect and tackle circumvention.

b) *Energy Efficiency ComPLIANT Products 2* (EEPLIANT2[27], Horizon 2020) develops market surveillance best practice regarding professional refrigerated storage cabinets, household refrigerators and network standby through cooperation between 17 market surveillance authorities across Europe. Work packages on each of those product areas include lab testing of well over 100 appliances and to specifically investigate circumvention issues during 2018/2019.

Two other historical projects provide useful guidance on specific appliances:

a) ComplianTV[28] (Horizon 2020) had the objective of assessing the compliance of TVs for Energy Labelling and Ecodesign regulations. The project included testing of televisions and exposed at least one model that appeared to be detecting that it was under test and achieving far better results in the lab than were typical of the same appliance in homes[29]. See also section 5.8. for a further example on televisions.

b) The project "Smart Testing of Energy Products" (STEP[30]) was led by CLASP, ECOS, EEB and Topten in 2016/2017 and involved lab tests on seven televisions, three dishwashers and ten household refrigerators. Appliances were tested according to European harmonised standards as well as slightly varied test programmes to look for any disproportionate results:

- One of the seven television tests appeared to show a set reacting to the video test loop (that TV had nearly 50% higher on mode power when tested using a specially made video loop). Furthermore "*three of the models had an increase in power consumption after a software update"* where the *"increase in energy consumption was approximately 31% to 37%"*;
- Dishwasher testing did not suggest any circumvention but showed significant variation of consumption between wash programmes.
- Refrigerator testing included single brief and longer door openings, as well as the usual closed-door testing. For one refrigerator, the brief door opening "*resulted in a significantly higher consumption and changes in the internal temperatures for over 24 hours*" and "*the average power consumption impact of door opening was significant both after the brief and long door opening, increasing by more than 30%*". This suggests that the refrigerator achieved far lower consumption under closed door test conditions that it would achieve in real use (which must include some door openings). The STEP report welcomes the IEC 62552 approach of introducing additional measures such as door openings to help identify circumvention if that is suspected. STEP goes further to recommend that "*future European regulations and European harmonised standards should include measurements of the effect of one or more door*

[26] https://cordis.europa.eu/project/rcn/213579_en.html
[27] http://eepliant.eu
[28] http://www.compliantv.eu
[29] http://www.independent.co.uk/news/business/news/samsung-tvs-in-europe-less-energy-efficient-in-real-life-than-in-tests-a6675301.html. See also https://www.theguardian.com/environment/2015/oct/01/samsung-tvs-appear-more-energy-efficient-in-tests-than-in-real-life
[30] Final report 'CLOSING THE 'REALITY GAP' – ENSURING A FAIR ENERGY LABEL FOR CONSUMERS', report from the STEP project, CLASP, ECOS, EEB and Topten, 21 June 2017. http://eeb.org/work-areas/resource-efficiency/product-policy/

openings for all domestic refrigeration appliances as part of the default standard tests related to energy performance, and not only in case of suspected circumvention."

ECOS recommends that planning of anti-circumvention is done considering, or in coordination with, the aforementioned and similar projects, drawing on appliance-specific and horizontal lessons.

5.7 Lessons from EU vehicle emissions testing

Reports on recent automotive emissions testing scandals were examined for lessons to inform ecodesign and energy labelling measures. This is particularly relevant to the circumvention risks associated with smart controls in appliances (as defined in the IEC text) which opens a loophole very similar to that for vehicle emissions defeat devices.

Safeguards have been established for vehicle testing and type approval to overcome this: The Commission's *'new and improved car emission tests'* became mandatory on 1 September 2017[31] to include the real driving emissions (RDE) tests along with the World Harmonised Light Vehicle Test Procedure (WLTP). The Commission proposed a new regulation to overhaul the current type approval system[32] in January 2016. Other sources reviewed include the European Parliament's Report on the inquiry into emission measurements in the automotive sector[33] and the STEP project (see section 5.6) which provided specific recommendations for energy label policy based on learning from automotive emissions assessments.

ECOS offers the following observations and proposals:

a) **Authorities must be obliged to seek out evidence regarding circumvention and this must be followed through, because "evidence cannot be found unless it is sought";**

b) **While Member States have a legal obligation to search for defeat devices, the Commission should check that Member States do this. A chain of responsibility to search for and reduce circumvention should be clearly established;**

c) **Assessment criteria should be established to help authorities to distinguish between circumvention and legitimate controls (this was crucial for automotive emissions);**

d) **As with the new approach for automotive emissions assessment, appliance assessments should retain a standard test but could add supplementary testing that more closely replicates real situations and apply 'Conformity Factors' (acceptable limits of deviation) to determine pass/fail under those conditions; if performance is outside the acceptable limits, the appliance/vehicle is studied further and/or declared non-compliant;**

e) **Alternatively (or in addition) to introduce some element of randomisation into the lab testing to make circumvention more challenging. This would also require associated Conformity Factors to enable the lab to make pass/fail judgements;**

f) **If an appliance includes controls or another design element bringing energy (or other) benefits in use, but that could be interpreted as circumvention, then the regulations should require the manufacturer to notify authorities and justify their design. The regulatory approach must require transparency and give clear guidance on expectations. Further lessons could be drawn from the US DOE approach of requiring waivers to be approved for**

[31] Commission Press release 'New and improved car emissions tests become mandatory on 1 September', 31 August 2017, http://europa.eu/rapid/press-release_IP-17-2822_en.htm.
[32] Commission Press release 'EU action to curb air pollution by cars: Questions and Answers', 31 August 2017, http://europa.eu/rapid/press-release_MEMO-17-2821_en.htm.
[33] European Parliament 2014-2019, Committee of Inquiry into Emission Measurements in the Automotive Sector, 2016/2215(INI), rapporteurs: Jens Gieseke, Gerben-Jan Gerbrandy

refrigerator testing, where control system behaviour deviates from that specified in the Rule.

5.8 Examples from other regions of the world

The US-based Natural Resources Defense Council (NRDC) published a report in 2016[34] suggesting that some television manufacturers were using a motion-detection dimming (MDD) feature to reduce energy consumption when the set sensed *"rapid motion and frequent scene changes, as is common in commercials and music videos".* This feature was found to result in a 58% drop in energy consumption when the IEC test clip was viewed, but only 13% less when playing a "*real-world content video loop*" created by the test engineers. The report recommended that:

> *"Changes to the test loop are critically needed … A new test loop would … contain content that is more representative of real- world viewing (i.e., uses more typical scene lengths)."*[35]

ECOS strongly advocates for testing in conditions which are as close as possible to those of real life. See also section 5.6 on televisions and section 3 regarding real life testing.

US DOE test procedure for fridges[36] defines how to interpret the test method and stipulates how features that are often manipulated by circumvention must operate under test conditions; with special provisions for 'Components That Operate Differently During Testing'. For example, it has some very specific and clear requirements regarding behaviour if there is no door opening for a long period; control of defrost heaters; electric heaters for anti-condensation and seals; and adaptive defrost. This US approach is notably different to that under IEC 62552. IEC 62552 describes circumvention and how to detect it, and so runs the risk of implying that any features or functionality *not* mentioned are acceptable.

In the DOE test procedure: '*the unit, when tested under this test procedure, shall operate in a manner equivalent to the unit in typical room conditions*'. The DOE view is stated that '*products should not be designed in a way that would cause energy consumption to drop during testing as a result of* [certain test] *conditions*'. DOE requires manufacturers to apply for a waiver if their product behaves in a way that runs counter to the expected principles[37]. The onus is placed on the supplier to prove that the product is not circumventing, if it exhibits any abnormal behaviour.

ECOS believes that an anti-circumvention approach which merits careful consideration for specific appliance groups (including refrigerators) is to define how a product must behave under test conditions and to require the supplier to seek a waiver if behaviour deviates from that, as is done in the USA.

6 Summary of options to address circumvention

Measures to address circumvention are emerging within the EU but have yet to prove that they are sufficient, coherent, and comprehensive. EU measures so far lack the depth and rigour of, for example, anti-circumvention measures for household refrigerators in the USA.

---

[34] The secret costs of manufacturers exploiting loopholes in the government's TV energy test: $1.2 billion for consumers & millions of tons of pollution (September 2016), report ref. R-16-09-B, Horowitz N, Calwell C, Hardy G, Hohenhausen R.
[35] Ibid, section 6, page 27
[36] US DOE 10 CFR 430.23(a)(10) (for Refrigerators)
[37] US DOE Guidance on Refrigerators, '*Q: When do […] the "anti-circumvention" provisions require a manufacturer to apply for a test procedure waiver?*', 28 May 2013
http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/rf_anticircumvention_faq_2013_5_28.pdf

Three particular challenges to be addressed in tackling circumvention are summarised in Annex 1. These must be borne in mind when designing a comprehensive system of measures to address circumvention.

Circumvention should be tackled using a wide variety of coordinated and comprehensive measures, starting, first and foremost, by strong regulatory provisions, and then supported by initiatives to train and build capacity of those monitoring the market in authorities and in independent labs. Options to be considered are summarised in this section.

6.1 Define and disallow circumvention in regulations

The example regulations described variously include a comprehensive definition of circumvention, give MSAs and labs authority to seek out circumvention and enable MSAs to declare any product shown to circumvent as non-compliant (whether intentional or not).

In particular, the definition must consider what acceptable or unacceptable behaviour of the product is judged against – comparing lab results to some other baseline. In many cases, a simple baseline of 'real use' may be unenforceable if the test process or product is complex and the lab tests can only ever be representative of a proportion of real use applications. For such cases, field measurements with agreed conformity factors used to determine pass/fail may be necessary, as with vehicle emissions testing.

The approach to disallow can be based on a mixture of:

i. Banning the element of design that achieves circumvention;
ii. Defining how a product *must* behave under test and requiring a waiver to approve any behaviour that deviates from that (such as under the US DOE system for household refrigerators);
iii. Defining how a product *must not* behave under test (may be included but should not be the sole basis).

The most difficult to circumvent, and therefore most effective measure, is probably option ii), as it puts the onus on the supplier to justify behaviour that does not meet a defined expectation.

6.2 Design regulations to discourage circumvention

A comprehensive approach requires both horizontal and vertical (product-specific) measures. Considerations for regulation should include:

- Regulatory provisions should be drafted with no room for interpretation and loopholes;
- Establish a chain of responsibility to seek out and investigate circumvention between the Commission, Member States and their Authorities, including a mechanism by which the Commission verifies that the Member States are fulfilling their responsibility;
- Investigation of circumvention risks and examples could be included in the scope of the preparatory study and used to inform Standardisation Requests and drafting of regulations;
- Ensure that the regulation controls or specifies all aspects of performance that are critical to the energy and environmental impact (for example, how the stated temperature of a wash is to be ensured);
- Consider if the manufacturer should have to disclose the presence of any design element that could be viewed as a defeat device or strategy, and prove that it is necessary with no viable alternative, with clear guidance on exceptions in a waiver system;

- Require the testing of standard production models, ideally randomly selected with a transitional system to deal with pre-production situations;
- Require both lab and field test results to be reported (or examined by authorities);
- Encourage energy reporting from appliances to build an evidence base of performance;
- Mandate transparency to authorities on functionality of software;
- Carefully articulate how representative a given test is of 'real life' and define circumvention in that context (avoid unenforceable definitions where real use is inevitably different to the lab);
- Ensure that lab accreditation takes into account the need for vigilance for circumvention and allows screening for and investigation of circumvention;
- Directly address the ways in which behaviour of products is modified after manufacture or installation, including: user intervention on settings, software updates and adaptive learning[38]. Regulation must consider:
    - Requiring that software updates are ensured before a test is made
    - Whether the product must meet requirements in force at time of its placement on the market regardless of future control algorithm/software updates;
    - What information must be given to users about software or other control modifications and if they influence any performance aspect of the product (including energy performance);
    - Whether the user can decline the modification;
    - How modifications are allowed to impact energy or environmental performance (e.g. emissions).

6.3 Integrate anti-circumvention into Standardisation Requests and standardisation policy

Some aspects of addressing circumvention in standardisation can and should be horizontal, for example a basic requirement in all Standardisation Requests to consider and counter opportunities for circumvention. However, vertical product-specific measures must also be applied since opportunities, risks and solutions vary greatly by product.

ECOS puts forward the following considerations for standardisation policy:

- Standardisation Requests which include both generic and product-specific requirements regarding circumvention are most likely to be effective. They can also encourage a systematic consideration of circumvention throughout the standardisation process;
- Ensure that regulators, civil society and test labs are represented on technical committees developing standards;
- Anti-circumvention considerations are reported by each Working Group to its mother Technical Committee and to the Commission, accompanying the technical draft;
- Include a review of ways in which a previous standard has been or could be circumvented as a mandatory step during update of a standard, including input from Market Surveillance Authorities and labs;
- European and international standardisation bodies continue to develop and expand horizontal guidance, training and support to convenors and working groups;

[38] Source: IEC TC59 guide.

- Further develop consumer-relevant testing[39] and detailed consideration of the extent to which the method can be representative of 'real use', backed up by field measurements to build a statistical case for chosen test conditions;
- New approaches for test methods to focus on software behaviour and measure field performance (source: Alan Meier).

6.4 Design standards that make circumvention difficult

The discouragement of circumvention should be fully integrated into the whole process to develop standards, meaning that the standardisation committees should systematically design the test method to make it difficult for the product to recognise that it is under test and change its behaviour to circumvent.

ECOS proposes:

- Inclusion of test sequences that explore behaviour outside of a standard test but within a set framework that includes conformity factors to assess pass/fail, as recommended in the STEP report and as implemented for vehicle emissions testing. This could include randomisation of aspects of testing (likely 'triggers') to avoid pattern recognition[40], with required reporting of the actual sequence used so that MSAs and others can reproduce the same test;
- Supplement lab test(s) with field measurements to be made as part of the approval process, as now being implemented for vehicle emissions. To facilitate this, the indicative range of results to be expected must be published, or 'conformity factors' that are to be used;
- Empowering labs to report findings on circumvention objectively (through drafting of processes and test reports);
- Require software updates to be carried out before testing (both for initial approval and for subsequent compliance testing);
- Standards should take into account in their design as far as possible how a lab can distinguish between smart controls and circumvention;
- During monitoring of the standardisation process and before harmonisation, the European Commission should make sure that standards sufficiently consider circumvention.

6.5 Build capacity of MSAs and labs and empower them to address circumvention

Test labs and MSAs are the front line to identify and tackle circumvention but sometimes lack the administrative and technical tools (and budget) to make these complex judgements and pursue suspected circumvention.

ECOS proposes the following ways for improvement:

- Consult with MSAs and test labs about the challenges they experience in their efforts to find and tackle circumvention and/or to understand why they cannot or do not attempt to address it – their views could have input to any or all of the approaches set out in this paper;
- Recognise that to honour their accreditation, labs must ensure that they follow the test methods accurately and completely; this does not allow scope to test in non-standard conditions necessary to expose circumvention. A test report that includes non-standard conditions may even be at risk of rejection in a court case to prosecute non-compliance

[39] Spiliotopoulos C., Stamminger R., Siderius H.P (2017): Bringing the home in the lab: consumer relevant testing for household electrical products, eceee Summer Study 2017

[40] Allow windows for timing of triggers to be as generous as possible whilst not significantly affecting the energy result (e.g. door opening sequences). As long as the exact regime used for test is noted in the test report, the MSA can replicate it when compliance-testing.

(serious risk: notified bodies (that provide accreditation of labs) allow no speculative content in any test report and such professional opinions must be in a separate report). Labs must therefore be specifically instructed regarding steps to tackle circumvention;

- Further to this, commercial and legal pressures must be considered in order to give a lab the ability and encouragement to act on suspicions. For example, the lab could end up in an awkward legal position if it has to make a judgement about whether a product is circumventing or not and risks being sued by a client (especially if that report is passed to authorities or anyone other than the client);
- Enabling and building capability for labs to screen for circumvention within the test standard and to report findings to appropriate bodies;
- Encourage market surveillance strategies to 'institutionalise vigilance'[41] for circumvention, making sure that all necessary market players are proactive on anti-circumvention;
- Encourage specialist independent labs with high expertise in challenging products and good working relationships with MSAs;
- Develop collaborative projects to systematically scan for circumvention, provide training for MSAs and lab staff;
- Ensure involvement of MSAs and lab staff in developing standards – at least input to development of Standardisation Requests;
- Require 3rd party tests under some circumstances;
- Ensure that MSAs and labs understand and apply conformity factors to assess the credibility of results when tests are done to slightly different conditions (e.g. test at a higher ambient temperature);
- Facilitate civil society and collaborative projects to scrutinise the testing and performance of products and ensure that results are publicised to authorities and regulators.

6.6 Prosecute circumvention and publicise cases

High profile prosecutions can discourage those considering circumvention (authorities in Australia have made prominent examples).

ECOS calls for:

- Discouraging circumvention by highlighting the rules regarding circumvention and publicity for resolutions reached with perpetrators, including prosecutions;
- Establishing sanctions on suppliers found to be circumventing that are substantive and reflect the energy/environmental savings that were lost, as well as redressing any effective financial gain achieved by the supplier;
- Building capacity and institutionalise learning from circumvention cases and testing experience for authorities, labs and standards bodies;
- Aiming to systematically set out to detect circumvention, catalogue examples, close loopholes and further reduce scope to circumvent. This should be further explored in the ANTICSS project.

[41] Recommendation as formulated by Alan Meier.

Annex 1. Three challenges to be met by anti-circumvention measures, with some possible mitigation options.

Challenge	Description	Mitigation measure options
It can be hard for a test lab to distinguish a smart and appropriate control system from circumvention	Both smart controls and circumvention give adapted behaviour that may be complex and dependent on many input criteria. As Alan Meier puts it: "*How to encourage innovative energy savings and at the same time discourage circumvention?*" Complex controls can also extend and vary the time taken to reach the stable condition which is essential for repeatable tests. Ideally, tests would ensure that smart controls are encouraged but circumvention is exposed or defeated but this is tough due to similar outcomes of 'smart' and 'circumvention' under test. Detection often relies on detailed observation, technical insight and experience of lab staff.	• Define what controls are allowed to do and require waiver for additional functions; • Training of lab staff and joint projects to develop good practice with MSAs; • Encourage specialist independent labs with high expertise in challenging products.
Tests, products or usage conditions can be so complex that it's hard or impossible to accurately simulate 'real use' in a lab.	The complexity of some recently regulated appliances and equipment and the resultant complexity of some test methods can mean that an affordable test cannot approximate 'real use' or cover the many permutations of conditions of usage when quantifying performance. Whilst a test gives a useful indicator of performance, it can only simulate a few specific sets of conditions (for example, the 'rating points' of HVAC products) which represent a portion of real use conditions. At least two specific challenges arise from this complexity: a) it could void any definitions of circumvention that use difference from 'real use' as their reference point; b) a test lab may need manufacturer assistance to set the parameters for testing, giving cover for an unscrupulous supplier to implement 'special' settings[42].	• Research on appliance usage to ensure statistically robust test parameters; • Verify performance with field measurements; • Implement energy reporting from appliances.
It's hard to balance maximum repeatability & reproducibility against including enough variability to foil circumvention.	Precise test conditions and processes that achieve repeatability and reproducibility mean it's easy for the appliance to detect when it's under test. Working Groups are specifically and increasingly having to quantify and maximise repeatability and reproducibility.	• Randomisation of possible triggers for detecting the test (e.g. door opening sequence of a commercial fridges); • Develop conformity factors (see section 5.7); • Verify performance with field measurements.

[42] One Market Surveillance Authority recounted the example of a heat pump manufacturer who had to provide a tailor-made remote-control unit that gave the necessary control signals for the unit to operate at the specified rating conditions (temperatures, flows etc.).