Introduction to Panel 7
Appliances, products, lighting and ICT

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Introduction

Product policy, minimum efficiency performance standards (MEPS) and energy labels, is a well established policy tool with an impressive track record. An IEA study[1] concludes, based on evidence from a wide cross-section of countries with standards and labelling programs, that the energy efficiency of major appliances in these countries have increased at more than three times the underlying rate of technology improvement. Ever more products worldwide are covered by MEPS, energy labels or voluntary agreements, creating a challenge in itself, which the very success of product efficiency policy increases.

Panel 7 explores a number of these challenges such as monitoring, verification and enforcement, how to take circular economy aspects such as durability into account, and how to (better) monitor the effects of energy labels and ecodesign measures in practice. Panel 7 also provides opportunities to learn from experiences outside the EU (Latin America, Asia) and to gain insight into a number of specific issues or products, such as network standby, the extended product approach and LED lighting.

Testing and compliance

Expected savings of product efficiency policy are lost if products not fulfilling the requirements are still placed on the market, or when products perform well in tests but less so in practice. Less than 1% of the European market is currently verified via testing as either reaching the minimum performance standards laid out by the Ecodesign Directive, or that the energy class declared is indeed correct. Member States are the sole bearers of the responsibility of market surveillance, yet despite tireless efforts, are barely able to scratch the surface in terms of the work needed to be done to reduce the estimated 15–25 % non-compliance rates found in this sector. Therefore, the title of paper by Jones (7-029-17 "Is it time for a European market surveillance coordination body?") should be read as rhetorical: yes, it is time for such a body. The paper outlines the potential model for a European coordination body, and highlights key areas where such a body would improve market surveillance across the whole of Europe.

A European market surveillance coordination body can build upon a number of pan-EU projects that facilitate and support the cooperation of national and regional market surveillance authorities. Ahlén (7-038-17) describes the EEPLIANT 2014 project which focused on three product groups: LED lamps, imaging equipment and space heaters and combination heaters. Results were still preliminary, as not all tests were complete, but suggested that while compliance with energy efficiency requirements was generally good, that other aspects, for LED lamps in particular, were an issue; more than 25 % of lamp models showing non-compliance (on luminous flux, colour temperature, power input, power factor or lifetime) after 1,000 hours of testing.

Monitoring the market is an important aspect of MV&E. In recent years, new techniques have been developed to monitor the market more efficiently, the so called webcrawler techniques. With intelligent software, it is possible to scrape large volumes of data from publicly available data sources on the Internet, basically in real time. Bennich et a. (7-354-17) focus on

1. IEA 4E, Achievements of appliance energy efficiency standards and labelling programs – a global assessment in 2016; available from http://www.iea-4e.org/publications.

the use of webcrawler techniques for market surveillance, including aspects like retailer acceptance and legal aspects. In the "NordCrawl" project, under the Nordic Council of Ministers, market surveillance authorities (MSAs) from the Nordic countries work together to develop a web-based application. They have found that there are numerous potential advantages to this technique including better market coverage, greater speed and reduced cost.

Standards are at the heart of product testing, including testing for verification and enforcement. Standards should produce results that are repeatable, reproducible and valid at a reasonable cost. Spiliotopoulos et al. (7-039-17) focus on the validity (correspondence to practice) of standards. Test methods that do not reflect real use may lead to an energy savings deficit: consumers do not get the savings that are expected from the label class as measured by the standard. However, unlike the other criteria that standards should meet, there is no methodology to assess the correspondence to real life (validity) of a standard. The methodology developed in the paper is applied to washing machines, refrigerators and vacuum cleaners. The authors find that consumer usage is not well reflected in the test standards for these products, and suggest that these standards should be reviewed; they propose that using this approach with other products could be beneficial also.

Knieschewski et al. (7-131-17) present a specific example of how the consumer relevance of a standard can be improved. They look at range hoods testing, EN 61591, focusing particularly on the evaluation of grease absorption. Currently, the grease absorption class is obtained by heating up oil and water in a pot, which creates vapour and splashes of grease. They propose replacing this with an atomizer nozzle is used so that exact amount of atomized oil is known and the ratio of filtered to atomized oil can be measured. In this way, the proposed new method is able to take into account aerodynamic designs and leaks, allowing the energy label classification to be more relevant to consumers. It also allows manufacturers to develop innovative grease absorption methods with little airflow.

Display luminance ("brightness") is the largest energy consuming function in televisions and monitors. Research has shown if displays are dimmed when ambient light levels are low, power consumption is reduced without affecting the quality of the viewing experience. Thus, there is potential for an energy-saving feature, 'automatic brightness control' (ABC), which works by dimming the display's brightness in relation to the room illuminance. However, a good practical test method for ABC was lacking and thereby the ability to characterise and quantify an optimum energy saving benefit of ABC. Scholand et al. (7-422-17) describe a novel and repeatable approach to the measurement of television power consumption and display luminance versus controlled ambient illumination under ABC control. Robust test methods like this one can help policy-makers design more effective energy-efficiency policies and programs and can catalyse energy efficient design standardisation in the display manufacturing industry.

Palkowski et al. (7-130-17) analyse European standards EN 14511 and EN 14825 used for testing the energy efficiency of heat pumps and air conditioners with electrically driven compressors for both space heating and cooling. They find that the currently used methods are highly complex and expensive. Test laboratories claim that for certain types of construction, e.g. air sourced heat pumps, the standard procedures fail to deliver repeatable and reproducible results in inter- and also intra-laboratory tests. The authors propose new screening procedures and new test procedures which should offer the market surveillance authorities reliable, quick and cost-effective test alternatives to the existing standards.

Beyond the impact of energy in use

Including circular economy aspects in ecodesign requirements and energy labels marks a new step in EU product policy. Mandatory durability ecodesign requirements have recently been set for vacuum cleaners and lighting products and it is envisaged that circular economy aspects will be integrated in the energy labelling scheme. Richter et al. (7-244-17) focus on durability aspects by presenting the case of LEDs. They propose an innovative method for calculating an attribute-adjusted least life cycle cost (LLCC) when durability is included. The results indicate that greater durability is important for cases with lower discount rates and more intensive use of the product. From an LLCC perspective, longer lifetimes than currently required by standards may be desirable, but this would require adequate test methods to verify these longer lifetimes.

For white goods, durability can play a role in reducing the consumption of raw materials long-term and to contribute to waste minimisation. However, the same challenge as for LEDs apply – how can the test method verify that these durability standards are met in a limited time period? Stamminger et al. (7-233-17) report on the development of a procedure to test minimum durability performance of washing machines, mimicking the stress induced on a washing machine by doing a high number of pure spinning cycles with fixed unbalanced loads. While these did stress the washing machines this did not provide equal testing conditions, as the actions of the control procedure regarding unbalance loads differ from machine to machine. This work provides a basis to develop standardised durability tests, but further developments are needed.

Baton and Scholand (7-424-17) aim to estimate the greenhouse gas emission savings that could be delivered by applying circular economy principles to all products covered by the ecodesign and energy labelling regulations. The circular economy principles modelled in this paper were: improved recyclability, extended service life, service economy approach (e.g., product leasing, pay-per-unit-of-service) and improved refurbishment. Consumer electronics were found to have the largest greenhouse gas savings potential, particularly for recyclability and extended service life. The authors suggest a range of possible steps which would contribute to these savings being achieved, including the development of metrics and standards.

Policy beyond the EU

Unlike in the EU, MEPS and labels in other parts of the world are mostly introduced at a national or regional level with little attention to harmonisation. The lack of harmonisation poses considerable challenges for product manufacturers, importers, retailers and end consumers and largely reduces the effectiveness of the programmes. Braungardt and Göthner (7-219-17) describe how strengthening the national and regional stand-

ardisation bodies, metrology institutes, conformity assessment bodies and regulatory agencies and supporting interaction between them can help to make EE programs more effective. However, complete alignment and harmonisation is not practicable: programmes have to be adapted to the resources of the countries involved, amongst other reasons.

In China the mandatory China Energy Label has contributed to driving market transformation with growing shares for efficient products and appliances. However policy and technical barriers to effective implementation exist, particularly in terms of compliance. Key barriers include an incomplete legal basis, unclear responsibilities, lack of effective information sharing and distribution, lack of necessary resources and lack of systematic monitoring of compliance. Zhou and Khanna (7-363-17) review labelling programs in the EU, US, Australia and Japan in order to derive lessons for the China Energy Label, which include increased budget and technical resources, expanding stakeholder involvement and a greater emphasis on market surveillance.

Energy use in Southeast Asian countries increases annually, and will continue to rise with improving living standards. However, obtaining data on residential energy consumption and understanding the drivers of rising consumption is challenging. Murakoshi et al. (7-013-17) report on a field study of residential energy consumption in Malaysia, Thailand, Vietnam and Cambodia. This found that energy consumption of lighting, plug loads, cooling and cooking in urban areas of Southeast Asia approaches that found in developed countries and in some cases exceeds it. The paper also explains the new energy efficiency policy in Thailand, Energy Efficiency Development Plan 2015, and discusses the importance of strengthening of MEPS, energy efficiency labelling and promotion of smart appliances.

What effect has policy had?

One of the success factors of EU product efficiency policy is that it drives purchase decisions towards more efficient products by influencing consumer purchase behaviour. However, sales data show that the uptake of energy efficient products differs considerably between the various EU Member States. Therefore, improved knowledge of how consumers make purchase decisions could make product efficiency policy even more effective. Fries et al. (7-259-17) analyse data from a large-scale household survey on purchasers of washing machines, refrigerators, dishwashers and light bulbs, that was conducted in eight EU member states (DE, FR, IT, ES, PL, RO, SE, UK) in June 2016. The role of the different factors varies between the countries but only slightly between different population groups according to age, income or education. For household appliances and lighting, purchase criteria are rated similarly overall but energy consumption is most important for lighting while the purchase price is most important for appliances.

Practice theory is widely used to provide more insight in why and how people do (or do not) the things they do, resulting in a certain energy consumption. Fell and Shipworth (7-311-17) use a practice framework to explore how to achieve the maximum possible demand response which people are happy and able to provide. The framework is based around 'electricity-relevant dimensions', or factors which may be considered to be associated in some way with a person or people's electricity use – activities engaged in, location, room temperature, and so on. Effective demand response is understood as involving influencing adoption of those states with lower (or higher, as necessary) electricity outcomes at certain times, from a 'phase space' of possible options. The paper describes how the framework can be used to consider the role of demand response interventions with their roots in different theoretical positions.

Monitoring campaigns over a period of 20 years have shown that domestic electricity consumption structure has drastically changed. Effective product efficiency policy – amongst others – has reduced the energy consumption per product. However, these energy savings have been counterbalanced by new additional consumption, because of increased ownership level and appliance size, as well as emergence of new devices. Dupret and Zimmermann (7-019-17) analyse different monitoring campaigns in France to assess the different factors that influence the consumption, both technical features and behavioural changes.

Also Fischer et al. (7-345-17) look at monitoring the effects of ecodesign and energy labelling measures – this time in Germany – for six product groups (boilers, water heaters, light sources, electric motors, household cold appliances, and ventilation units). The paper uses national sales and energy consumption data wherever possible. This provides more reliable insights than before, especially for those product groups that have been regulated for some years so that actual market developments could be taken into account. The assessment suggests considerable savings from policy compared to BAU. However, these savings do not always mean that total energy consumption decreases over time. Also the estimated national (German) savings are consistently smaller than what would be expected if the EU-wide Ecodesign Impact Accounting figures had been scaled down for Germany. The authors suggest that the main reason for this is that the German appliance stock was already more efficient than the EU average in the baseline scenario so the scope for savings was less.

Taking policy beyond the obvious

The next papers each look at a specific issue or product in a non-standard way. Altamira and Vølcker Andersen (7-321-17) explore the application of the Extended Product Approach (EPA) in ecodesign measures and apply its findings to a case study on water pumps. Important aspects to consider are the definition of the scope, which in this case was the 'pump unit', i.e. the pump and the electric motor (and a drive, which is optional). Furthermore the test methodology should be able to deal with different type of pump units. The yearly energy savings potential from applying the EPA to pump units was calculated as 37–40 TWh by 2030.

Data centres are the backbone of a growing number of activities in modern economies. Small and medium data centres account for more than 50 % of the total electricity consumption in this sector and surveys indicate that this data centre profile wastes more energy than larger facilities. Therefore Vasques et al. (7-086-17) focus on small and medium data centres by presenting best energy efficiency practices. They highlight that while data centres are recognised as a central part of organisations' energy efficiency strategies, many are improving energy

efficiency rather slowly compared with the metrics, evidences, and case studies published by academia and industry.

The standby power use of appliances continues to consume large amounts of electricity. Considerable success has been achieved in reducing each device's use, but these savings have been offset by a huge increase in the number of products using standby power and new power requirements for maintaining network connections. Current strategies to reduce standby have limitations and may not be most appropriate for emerging energy consumption trends. Meier and Siderius (7-004-17) propose a new strategy for further reductions in standby, the "Standzero" option, which encourages electrical products to be designed to operate for short periods without relying on mains-supplied electricity. Energy savings are achieved through enhanced efficiency and by harvesting ambient energy. A sensitivity analysis suggests many appliances could be designed to operate for at least an hour without relying on mains power and, in some cases, may be able to operate indefinitely at zero watts until activated.

Boughey et al. (7-429-17) highlight a portfolio of market transformation policy and programme tools used around the world to support and sustain the market for high quality, energy-efficient LED products. Across all the key segments of the supply chain, governments and energy-efficiency programmes can play an important role in raising awareness of efficiency opportunities, while helping to build demand for, and stimulating supply of, quality energy-efficient lighting. Brief case-studies are offered in this paper highlighting lessons learned and programmes developed. Kimble et al. (7-427-17) focus on one of these initiatives, the Global Lighting Challenge that was launched in December 2015 by the Clean Energy Ministerial and the US Department of Energy and aims to accelerate the transition to energy efficient lighting.