The EU Ecodesign Framework Directive: Voluntary or Mandatory – As Industry Likes It

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ABSTRACT

The European Union has finally approved legislation to develop and issue minimum efficiency standards for energy using products. The Ecodesign Framework Directive establishes procedures that will create minimum efficiency performance standards for most major (household and commercial) appliances in the next five years, including a "horizontal" standard limiting standby power use.

The Ecodesign Directive resembles in many ways enabling legislation in Japan, Korea, the United States and California. For example, the general goal will be to set standards that minimize life cycle cost. But the Ecodesign Directive also contains unique features; for example, it allows standards to be set for key environmental aspects of the product besides energy use. It also provides an opportunity for industry to forestall a mandatory standard for a product by proposing a voluntary agreement. The intent of the Ecodesign Directive is to provide consistent guidelines to market actors for both mandatory and voluntary mechanisms.

Introduction

Every developed country has some form of mandatory efficiency standards for appliances. The number of countries adopting energy efficiency standards and labels grew from 9 in 1984 to 36 in 1994 to 56 in 2004 (du Pont, 2006, p. Preface 11). The European Union (EU) implemented its first appliance standards (directives) in the 1990's for three products: boilers (1992), refrigerators (1996) and fluorescent light ballasts (2000). However, this legislation was not general enough to allow the European Commission (EC)[1] to develop standards for other products. In 2005, the European Parliament and the Council adopted new legislation (Official Journal 2005) that empowered the EC to develop appliance standards through administrative procedures rather than through further action by Parliament. This Directive provides a legal basis for EU-wide standards on environmental ('eco') aspects, including minimum efficiency performance standards, for energy-using products; in this paper it is abbreviated to Ecodesign Directive. Since one of the goals of the Directive is to remove barriers to trade and distortion of competition within the EU, individual countries in the EU are not allowed to impose national standards on products covered by the Directive. Although the standards resulting from the Ecodesign Directive only apply to products placed on the market in the EU, the impact of these standards will be worldwide because many energy-using products are manufactured outside the EU but have to comply with the standards, in order to be sold in the EU market. Furthermore, the approach and its guidelines could be useful for other countries seeking to develop or expand their regulation of energy-using products while also incorporating some environmental criteria.

[1] the administrative apparatus of the European Union

This paper reviews the major aspects of the EcoDesign Directive and illustrates the approach through description of the ecodesign procedure for minimum efficiency performance standards for dishwashers. Finally, this paper compares the Ecodesign Directive to similar legislation in other countries.

The EU Ecodesign Framework Directive

Structure

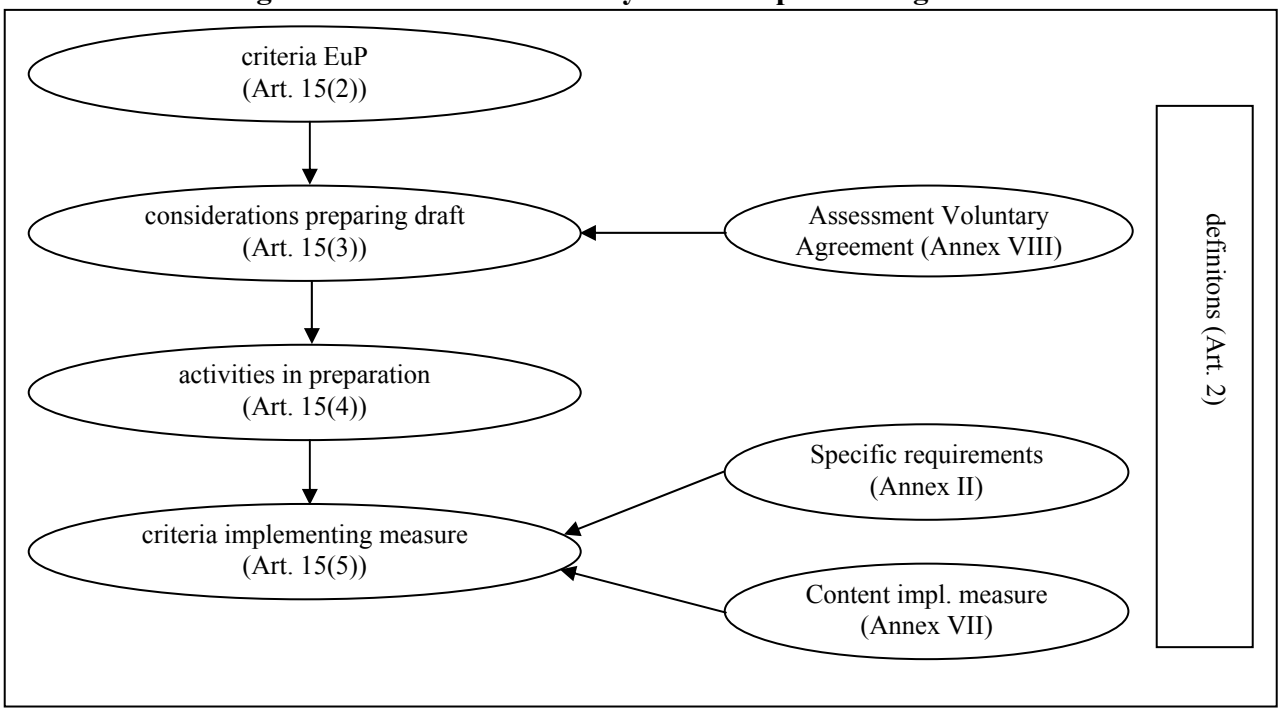
The Ecodesign Directive is a framework directive, which means that the directive itself does not contain any standard for any product but merely provides the framework – that is the criteria and procedures – that must be followed for implementing measures to be put into force. These implementing measures can contain specific technical standards that specify and regulate an energy using product.

The Ecodesign Directive provides:

- definitions;
- rules for which products to choose;
- guidelines as to whether to prepare a draft implementing measure;
- rules for preparing a draft implementing measure;
- criteria for an implementing measure; and
- criteria for self-regulatory initiatives.

These parts of the framework directive are shown in the following flow chart, which shows the pathway for preparation of an implementing measure. In the following sections, we explain these steps further.

Figure 1. Procedural Pathway for an Implementing Measure



The scope of the Ecodesign Directive is restricted to energy-using products (EuP)[2], while means of transport for persons or goods are explicitly excluded by the Directive. This scope further implies that e.g. building materials (isolation, double/triple glazing, etc.) are also excluded because building materials, *in and of themselves*, do not use energy.

Despite the restriction to energy-using products, the potential number of products for which an implementing measure could be established is still enormous. Therefore, the scope is in practice limited by "priority" products that have been identified by the ECCP[3] as offering a high potential for cost-effective reduction of greenhouse gas emissions, and by the criteria put forward in Article 15(2) of the Directive (see section on implementing measures).

Table 1 lists the products for which studies to prepare for an implementing measure are being carried out.

Table 1. Products for Which an Implementing Measure Has Been Initiated

Boilers, including combi-boilers (all fuels)
Water heaters (all fuels)
PCs and computer monitors
Copiers, faxes, printers, scanners, multifunctional devices (imaging equipment)
Consumer electronics: televisions
Standby- and off-mode losses*
Battery chargers and external power supplies
Office lighting
Street lighting
Residential room-conditioning appliances
Electric motors
Commercial refrigerators and freezers
Domestic refrigerators and freezers
Domestic dishwashers and washing machines

*Regarding a "horizontal" standby measure, see the paper "Regulating Standby" (Meier and Siderius 2006)

Implementing Measures

The Ecodesign Directive distinguishes between two types of implementing measures:

- Implementing measures laying down ***generic*** ecodesign requirements. This class of requirements aim to improve the environmental performance of EuPs without setting standards for specific aspects. The core of the requirement is that the manufacturer establishes an ecological profile of the EuP and uses this assessment to evaluate alternative design solutions to improve the environmental performance. Since these implementing measures do not contain (e.g., minimum energy efficiency) standards they will not be considered in this paper.
- Implementing measures laying down ***specific*** ecodesign requirements. This class of requirements aims at improving one or more selected environmental aspect of the product and will contain standards (e.g., threshold limits and values) for these selected environmental aspects. Within the scope of this paper, emphasis will be put on minimum performance standards for energy consumption or energy efficiency.

[2] This is the reason why the directive sometimes is referred to as 'EuP directive'.
[3] European Climate Change Programme

An implementing measure will be put in place for mass-produced energy-using products that have a significant environmental impact and a significant potential for improvement not yet targeted by other measures. The Directive establishes the following criteria in Article 15(2):

a) volume of sales and trade of more than 200,000 units a year (within the EU)
b) significant environmental impact, considering the quantities placed on the market
c) significant potential for improvement without entailing excessive costs; subcriteria:
    - absence of other relevant EU legislation
    - failure of market forces to address the issue
    - a wide difference in the environmental performance of EuPs available on the market

In theory, the Ecodesign Directive captures all potential environmental improvements of EuP. The choice between (mandatory) implementing measures and voluntary agreements (called self-regulation measures in the Directive) will be discussed in the next section.

Energy Efficiency and Other Environmental Aspects

The Ecodesign Directive deals in principle with all significant environmental aspects, not only energy efficiency. This provides an opportunity to:

- develop an integrated approach towards improvement of environmental aspects, e.g. to avoid improving one aspect at cost of deterioration of others; and
- prevent multiple regulation (with possible conflicting results) for the same product.

However, specific ecodesign requirements shall be introduced for selected environmental aspects that have a significant environmental impact. The Directive does not indicate what is significant, but when an aspect has a significant environmental impact, a specific ecodesign requirement will be introduced.

Kemna et. al. conducted 10 preliminary product studies in the framework of their study to establish a common methodology for the studies that prepare for an implementing measure (Kemna 2005). Energy consumption is an important aspect; the 10 product cases represent more than a quarter of total EU residential energy consumption. Taking into account the point of least life-cycle costs, Kemna et al. found that a minimum target could be set that could reduce the environmental impact[4] by around 20-30 % for almost all product cases.

The procedures used to identify and then establish a level for an efficiency standard are crucial to the EcoDesign Directive's success. Annex II of the Directive provides the method for setting specific ecodesign requirements. According to Annex II of the Directive, the level of energy efficiency or consumption will be set aiming at the life-cycle cost minimum to end-users for representative EuP models, taking into account the consequences of other environmental aspects.

[4] i.e. the impact on the following environmental aspects: energy, water, waste, emissions to air and water (GHG, acidification, heavy metals, PAHs, eutrophication).

Voluntary versus Mandatory

An important feature of the Ecodesign Directive is that it provides the EC with the choice as to whether a product will be covered by an implementing measure or a voluntary agreement. Voluntary agreements were seen by policymakers as more flexible, having a shorter implementation time and being less costly than implementing measures. These advantages would be especially effective for products in markets with a short development cycle, e.g., consumer electronics and office equipment (European Commission, 1999). This section discusses the criteria for evaluation of voluntary agreements listed in the Ecodesign Directive and then provides some lessons learned from voluntary agreements in Europe, using the criteria of the Directive.

Criteria for Voluntary Agreements

The Directive provides the following criteria to evaluate the admissibility of voluntary agreements as an alternative to an implementing measure:

1. openness of participation;
2. added value;
3. representativeness, that is, market share of participants;
4. quantified and staged objectives;
5. involvement of civil society;
6. monitoring and reporting;
7. cost-effectiveness of administering a self-regulatory initiative;
8. consistent with sustainability; and
9. incentive compatibility.

With respect to market share, the Directive states that industry and its related associations taking part in voluntary agreeements shall represent a large majority of the relevant economic sector. In practice, this means that at least 70 to 80 % of the market (sales volume) should be covered by the participants in the self-regulation.

The other criteria are mostly qualitative. Apart from item 3 (representativeness) and 9 (incentive compatibility[5]) the criteria reflect aspects that are under the control of the participants of the voluntary agreement. This means that the participants can design the agreement in such way that it has added value, is open, has quantified and staged objectives, etc. However, participants can not force all manufacturers to participate since this would be incompatible with the voluntary nature of agreement.

Lessons Learned from Voluntary Agreements

Does the history of voluntary agreements justify the reliance on them suggested in the Directive? Even voluntary agreements take time to organize. Manufacturers do not want to be restricted by energy-efficiency requirements and may try to reduce the criteria through protracted negotiations. New costs are involved for manufacturers, so (higher) management will get

[5] Refers to policy consistency; to be evaluated by policy makers and not further dealt with in this paper.

involved in approving the voluntary agreement. However, once a voluntary agreement is in place, ensuring market share seems to be the most important aspect in determining its impact. The following table describes voluntary agreements in Europe and provides estimates of market coverage.

Table 2. Overview of Voluntary Agreements in Europe

Voluntary agreement	Products covered	Aspects covered	Representativeness (market coverage)
Code of conduct for external power supplies	Single (output) voltage external ac-dc and ac-ac power supplies in the range between 0.3 W and 150 W.	no load power consumption on mode efficiency	< 50 % (coverage is good for mobile telephones and laptop computers)
Code of conduct for Digital TV Service Systems	Set-top boxes, adapter boxes, IDTV	standby on-mode (only for adapter boxes)	< 50 % (estimate)
Code of conduct for broadband equipment (planned)	Broadband equipment	standby on-mode	n.a.
Industry Self-Commitment to improve the energy performance of household consumer electronic products sold in the EU (EICTA)	CRT-TVs non CRT-TVs	energy efficiency index	70 % 50 %
	DVD-players	standby mode	50 %
EU Energy Star (*planned in new specifications)	System units (PCs)* monitors printers* copiers*	standby, on-mode or duty cycle consumption	currently >80 % new specifications: > 60 %
CECED Unilateral Industry Commitments	cold appliances	duty cycle	> 80 %
	washing machines, dishwashers	consumption of cycle (standby not covered)	> 80 %
Europump energy label for circulators	central heating circulators	on-mode (energy efficiency index)	n.a.

n.a.: no data available

From this table, the following preliminary conclusions can be drawn. Voluntary agreements for white goods and the current Energy Star specifications have a high market coverage, whereas for the other products the market coverage is lower. The industry organization CECED represents almost all manufacturers of white goods that are active on the EU market; this probably explains the difference. Energy Star is accepted by industry because it is a worldwide voluntary program and because it is negotiated at a corporate level. For the other voluntary agreements, either several industry organizations are relevant (in case of external power supplies) or the relevant industry organization does not represents all manufacturers. If a significant number of manufacturers is not covered by the industry organization, e.g. because they produce outside – in this case – the EU, these manufacturers might not be aware of the agreement or might not care. If the share of manufacturers outside the agreement is (too) large, this has two consequences. First, other manufacturers (even members of the industry organization) are less or not willing to join because it provides them a small disadvantage, which is relevant in products where every €cent counts. Second, (some) manufacturers will press for less stringent targets, e.g. targets more in line with autonomous developments, because stringent

targets will increase the cost. All in all, this results in voluntary agreements that do not create a "level playing field".

Conclusion on Voluntary Agreements

The Ecodesign Directive explicitly provides an opportunity for industry to forestall (mandatory) implementing measures by adopting voluntary agreements. Europe (like other countries[6]) has had both successes and failures with previous voluntary agreements, so there is no assurance that these will be effective. Furthermore, there are administrative weaknesses within the Directive that limit the EC's ability to negotiate effectively with the manufacturers. First, a voluntary agreement can be reached before completion of an independent life cycle cost analysis[7]. This means that the EC may not be aware of the life cycle cost minimum prior to negotiations. Second, failure to meet the objectives of a voluntary agreement will be only assessed *ex-post*; and by that time large quantities of non complying EuP might be already on the market. Third, the limited staff availability of the EC in this area, could encourage the EC to enter into voluntary agreements simply to minimize staffing requirements.

One way to compensate for these weaknesses is to require that any voluntary agreement should have, at a minimum, an efficiency level that equals the best existing (or announced) mandatory energy performance standard anywhere else in the world. In other words: a VEPS (Voluntary Energy Performance Standard) should meet the worlds best MEPS (Mandatory Energy Performance Standard) for that product. This requirement also gives manufacturers an early and more clear (compared to the current requirement of "added value") indication of the likely levels.

Example: The Ecodesign Directive Applied to Dishwashers

In this section the Ecodesign Directive will be illustrated by the example of (domestic) dishwashers[8]; based upon Kemna (2005a). The example will follow the procedural pathway of the Directive in Figure 1, concentrating on a specific ecodesign requirement on energy efficiency.

Criteria Energy-Using Products

Market data show that dishwashers have a volume of sales and trade of about 6.7 million per year in the EU (figures for the year 2002), thus far exceeding the criterion of 200,000 units per year as mentioned in article 15(2). Dishwashers constitute a significant environmental impact because of their estimated 21.7 TWh per year of electricity consumption in addition to their consumption of water and detergent. Regarding the significant potential for improvement, two of the three subcriteria will be discussed here: the absence of other relevant EU legislation and failure of market forces to address the issue. Regarding the first, dishwashers are subject to EU energy labelling legislation (Directive 1997/17/EC). The energy label does not interfere with

[6] See http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=921

[7] The Directive only requires that the voluntary agreement has 'added value' in terms of the improved overall environmental performance of the EuP covered.

[8] This example does not provide any indication that in reality an implementing measure on dishwashers will be (or will not be) imposed. This depends – amongst others – on the preparatory study that is currently carried out.

minimum energy efficiency requirements, since it requests among others the presentation of the energy efficiency class of the product and the energy consumption in kWh/cycle (on the label at the point of sale). Regarding the criteria for voluntary agreements the market coverage of the CECED Unilateral Industry Commitment is estimated at > 80 % (see Table 2). The final parameter, the added value of self-regulation, will be addressed later in the context of energy efficiency potential.

Preparing a Draft Implementing Measure

Considerations in preparing a draft implementing measure (Article 15(3)). These considerations mainly refer to the political process of taking into account the views of the Committee that assists the Commission in preparing a draft, the environmental priorities set out in the ECCP and relevant self-regulation (dealt with later on).

Activities in preparing a draft ((Article 15(4)). The directive includes the following activities to be carried out when preparing a draft implementing measure:

a) consider the life cycle of the EuP and all its significant environmental aspects, inter alia, energy efficiency;
b) carry out an assessment, which will consider the impact on environment, consumers and manufacturers, including small and medium size enterprises (SMEs);
c) take into account existing national environmental legislation;
d) carry out appropriate consultation with stakeholders;
e) prepare an explanatory memorandum of the draft implementing measure;
f) set implementing date(s), any staged or transitional measure or periods.

In this example, we will focus on item a): the life cycle assessment, in combination with the procedure in Annex II of the Directive regarding setting the levels for specific ecodesign requirements. Before doing so, we will briefly discuss the other subjects. Regarding item b) the following is noted. Aiming at minimum life-cycle costs to end-users means that – in general – both environment and consumers should benefit: operating costs for dishwashers are mainly determined by energy, water and detergent use, these determine also the main environmental impacts. However, there is a trade-off between duration of the cycle, detergent dose and temperature of the cycle; this suggests a need to balance the environmental impact of detergent use and energy use. The assessment on manufacturers is partly included in the life-cycle cost analysis because the (extra) cost of (technical) options to reduce energy consumption is indicated in this analysis. Regarding innovation, it is noted that stringent requirements can spur innovation. National environmental legislation on (minimum efficiency standards for) dishwashers does not exist in EU Member States. The items d), e) and f) refer to procedural items and will not be dealt with in this paper.

Kemna (2005a) analyzed the life cycle of domestic dishwashers and its significant environmental aspects, showing that the use phase is the most important phase for most of the environmental aspects. In the rest of this section we will examine the results[9] for reducing the life-cycle costs of dishwashers and provide an indication of the life-cycle cost minimum, which according to the Directive is the aim of an energy efficiency level of an implementing measure.

[9] Note that these results do not include standby energy use because the current test procedures do not capture this.

Table 3. Energy Consumption and Life-Cycle Costs Dishwashers (12 Settings)

	Energy Consumption [kWh/cycle]	Life-Cycle Costs [€]
Market data		
Average machine sold in 2003	1.11	-
Average machine in 2005 with energy class A	1.05	-
Minimum standard in CECED Unilateral Industry Commitment	1.45	-
Results analysis		
Minimum life-cycle cost point	0.991	1343
Best available technology point	0.828	1478
Point where life-cycle cost equals current life-cycle cost	0.880	1378

Source: Kemna (2005a), CECED (2004)

The results of Table 3 indicate that compared to the average machine sold in 2003, best available technology offers 25 % improvement. Furthermore, the minimum standard CECED Unilateral Industry Commitment does not offer added value (any longer).

Criteria for an Implementing Measure

Article 15(5) lists the criteria that implementing measures have to meet. They should ***not***:

a) diminish functionality of the product;
b) adversely affect health, safety and the environment;
c) negatively impact the affordability and the life cycle cost of the product;
d) negatively impact industry's competitiveness;
e) impose a proprietary technology on manufacturers; and
f) place an excessive administrative burden on manufacturers.

These aspects have already been dealt with in the foregoing paragraphs, as far as it was possible in this example. They are mentioned explicitly in the Directive to have a clear set of criteria to assess a (draft) implementing measure. The setting of the *specific* minimum efficiency level (and levels for other environmental aspects) that products have to comply with will determine to a great extent the impact on the criteria mentioned. Note that the functionality of the product (the performance) is treated as a limiting condition. This prevents that stringent efficiency criteria would be set that significantly downgrade the performance. In practice this would result in consumers choosing a 'stronger' program or using more detergent, thereby negating the energy and/or environmental savings. Experiences with the EU energy label show that most products (dishwashers, washing machines) with energy class A also achieve class A for (dish)washing performance. Regarding the administrative burden, this depends mainly on the way the conformity check is organized. Since the ecodesign requirements are to be integrated in the CE marking, the (additional) burden should be minimal.

Dishwashers: Self-Regulation or (Mandatory) Implementing Measure?

The results of the – indicative – analysis presented in this section show that industry has the key regarding an implementing measure for dishwashers. If industry would propose a voluntary agreement with minimum efficiency levels (close to) the minimum life-cycle cost level (i.e. 0.991 kWh/cycle) along with a maximum allowable level for standby energy use, then it can

be argued that market forces are addressing the issue properly, and therefore an implementing measure is not needed.

Comparison with Appliance Standards Regulations in Other Countries

Strong differences exist between the Ecodesign Directive and legislation implementing appliance efficiency standards in the United States[10], Japan[11], Australia[12], and elsewhere. Some of those differences are presented below.

Two aspects of the Ecodesign Directive are unique. First, the Directive requires explicit consideration of environmental aspects and establishing limits and tradeoffs as appropriate. In contrast, regulations in the United States, Japan, and Australia focus almost exclusively on energy aspects. To be sure, certain environmental constraints were recognized and incorporated - but these were done on a case-by-case basis. (The most obvious case is modifications to standards to accommodate the transition to CFC-free products.) Although the LCA methodology to be used in preparatory studies (Kemna 2005) does balance parameters that effect the same environmental impact[13], it is not clear how parameters that effect different environmental impacts will be balanced.

A second unique aspect of the Ecodesign Directive is the possibility of relying on a voluntary agreement with industry in place of a regulation. No such option exists in the United States or Australia; either the product is regulated or is not regulated. Voluntary agreements to improve efficiency are the responsibility of Energy Star and are usually based on agreements with individual manufacturers (rather than an association of manufacturers). Japan has occasionally relied on "administrative guidance" instead of explicit regulations (although this is increasingly rare). The voluntary agreement option may be particularly suitable for the European situation – i.e. where many products need to be addressed quickly. A voluntary agreement put in place immediately may save more energy than a mandatory standard put into place several years in the future. However, a strong caveat is that the option to have a voluntary agreement is vulnerable to abuse. One way to minimize the abuse is to insist that the negotiations begin with the assumption that the efficiency levels set in a voluntary agreement must surpass mandatory levels in all other countries.

Only the European Union and the United States rely on a life cycle cost calculation to determine the optimum level of energy use. Many elements of the life cycle cost investigation outlined in the Directive still need to be clarified. A key issue will be the gathering of data regarding efficiency improvements and their costs. At present, the analysis will rely on publicly available information, information voluntary disclosed by industry and technical expertise of the consultants. The United States draws on these sources plus mandatory disclosures of certain technical data from industry. Furthermore, the United States has developed - through decades of excruciating negotiation - a relatively consistent and transparent methodology[14]. Japan mostly sidesteps a life cycle cost analysis by focusing on the efficiency of existing models and then

[10] http://www.access.gpo.gov/nara/cfr/waisidx_01/10cfr430_01.html
[11] http://www.eccj.or.jp/top_runner/index.html
[12] http://www.energyrating.gov.au/meps1.html
[13] E.g. fluorescent lights have a (minimal) mercury contribution from the product but produce a net negative mecury contribution over the product life due to energy efficiency benefits resulting in avoided mercury contributions from fossil fuel power plants.
[14] Reflected in the Technical Source Document (http://ees.ead.lbl.gov/eesDev_2/standards.cfm) prepared for each new standard (or update to the standard).

setting the future minimum efficiency level equal to the highest efficiency available in today's market. Australia sidesteps the analysis by searching for the strictest efficiency standard in the world and then applying it to the Australian market (after a delay of a few years).

A related topic is *who* does the analysis. To date, the European Union has relied on private consultants to perform the analyses. These consultants in some cases also perform services for industry. On one hand this could be useful because the consultants gain access to detailed information; however, on the other hand it opens up the possibility of conflicts of interest. The United States mostly avoided this problem by relying on national laboratories to perform the analyses though it, too, is relying increasingly on private consults.

After an efficiency specification is created through the Ecodesign Directive, it must be transposed into national law of the 25 Member States. This procedure is similar to Australia's appliance standards, where each state must implement regulations established by the Australian Greenhouse Office. This introduces another layer of uncertainty and delay not present in the United States or Japan.

Conclusions

In this paper we described in detail the new EU Ecodesign Directive, which can be used to set minimum criteria for energy efficiency and other environmental aspects of energy using products sold in the EU. Since a significant share of products sold in the EU are produced outside the EU, this legislation can have an impact on stakeholders worldwide.

The Ecodesign Directive addresses both (mandatory) implementing measures and voluntary agreements: a product meeting the criteria of Article 15(2) shall be covered by either an implementing measure or by a voluntary agreement. The Directive provides criteria to evaluate the admissibility of voluntary agreements as an alternative to an implementing measure. The most important criteria in our opinion are the "representative-ness" (market coverage) and added value of the agreement. Looking at current voluntary agreements in the EU, we noticed that having an industry association representing (almost) all manufacturers active on EU markets is a vital prerequisite. Low market coverage is expected for products that are produced and traded worldwide and have no strong (worldwide) industry organization.

An example on dishwashers illustrated the choice between a mandatory measure and a voluntary agreement. Not surprisingly, life-cycle analysis of domestic dishwashers in the EU shows that energy consumption in the use phase is an important environmental aspect: 90 % of the total energy consumption during the life of the product, stems from the consumption in the use phase (electricity consumption). For a 12 setting dishwasher – the most common type in Europe - the minimum life-cycle cost point is at 0.991 kWh/cycle. Given the minimum standard in the voluntary agreement at 1.45 kWh/cycle, the conclusion is that this offers no added value (any longer). However, given that the current average machine sold is only about 10 % less efficient than the minimum life cycle cost point, it would require relatively little effort from industry to propose a voluntary agreement with levels at or close to this point (and including standby energy use). Since the agreement for dishwashers has a good market coverage, such a proposal would forestall a (mandatory) implementing measure.

The Ecodesign Directive has some unique features compared to other legislation that governs appliance efficiency standards elsewhere in the world. The two main unique features are explicit consideration of all significant environmental aspects, including energy use; and the possibility of relying on a voluntary agreement with industry in place of a regulation. However,

as a downside of these features we also noted the following weaknesses. First, a voluntary agreement with industry can be reached before completion of an independent life-cycle cost analysis, and therefore might not reach the life cycle cost minimum. Second, the success or failure of a voluntary agreement will be only assessed *ex-post*. Furthermore, experience in the United States show that using life-cycle cost calculation to determine the optimum level of energy use requires a significant amount of work. Regarding the option of having voluntary agreements replace regulation, we suggest that any voluntary agreement should have, at a minimum, an efficiency level that equals the best existing (or announced) mandatory standard anywhere else in the world: a VEPS should meet the worlds best MEPS.

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