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Influence of Environmental European Product Policies on Product Design - Current Status and Future Developments

Maria Calero Pastor[a]*, Fabrice Mathieux[a] and Daniel Brissaud[b]

[a]*European Commission - Joint Research Centre - Institute for the Environment and Sustainability, Via E. Fermi 2749 TP270, Ispra 21027, Italy*
[b]*Univiversity of Grenoble Alpes, Laboratoire G-SCOP, 46 avenue Félix Viallet, Grenoble cedex 1 F-38031, France*

* Corresponding author. Tel.: +39 0332 78 6223; *E-mail address:* maria.calero@jrc.ec.europa.eu

Abstract

Great environmental impacts along the life cycle of products might be avoided in the early steps of design. Thus several EU regulations encourage manufacturers to create products considering the whole life cycle of products. European Product Policies aim at boosting the EU market to be progressively more sustainable by setting product's specific thresholds. With this purpose, several policies that are product-related coexist under the scope of different EU regulations, for example: Ecodesign Directive, Labelling Directive, Green Public Procurement or EU Ecolabel. There are relevant aspects of these policies instruments which need to be considered towards an efficient, future oriented and more sustainable design of products. The objective of this paper is to assess how these product policies currently affect the design of products. An initial analysis presents the main technical relevant criteria for designers of such mandatory and voluntary policies. To anticipate to future environmental requirements leads business to competitive advantages. The analysis shows that the four EU product policies are dynamic and potentially synergetic although several aspects need to be further explored such as the scope extension of product groups, the non-energy aspects or the product systems' link.

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1. Introduction

During the design process, besides the technical, economic and commercial demands, environmental aspects have become not only an added value but also a requirement.

Design has a strong influence on the environmental impacts in further life cycle stages of products e.g. manufacturing, distribution, use and end-of life. If these impacts are forecast and taking into account in the early step of design, it becomes easy to improve the environmental performance of products. Thus several EU regulations encourage manufacturers to create products considering its whole life cycle. In addition, to anticipate to future environmental requirements, leads business to competitive advantages.

The "Roadmap to a Resource Efficient Europe" (COM(2011) 571) [1] which is part of the Europe 2020 Strategy claims for a sustainable consumption and production by 2050 and suggests to use an approach of both voluntary and mandatory measures for several products and services.

Indeed, European regulations provide industry, citizens and public authorities of several product policies to help green markets to expand further. The most relevant are Ecodesign Directive (2009/125/EC) [2], Labelling Directive (2010/30/EU) [3], Green Public Procurement (GPP COM (2008) 400) [4] and EU Ecolabel (Regulation EC No 66/2010) [5].

In addition to European regulations, other international, national and corporate product environmental schemes coexist altogether, many under the framework of the standard ISO 14020 "*Environmental labels and declarations*" [6] such as Type I (e.g. EU Ecolabel, Blue Angel, etc.), Type II or Self-declarations and Type III or Environmental Product Declarations (e.g. Swedish EPD, IBU-EPD, etc.). Thus, the wide range of choices of methods and initiatives of product's green credentials generates confusion among business and

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consumers. Indeed, Building the Single Market for Greener Products (COM (2013) 196 [7] aims at overcoming these problems. It provides and recommends two methods to measure the environmental impacts throughout the lifecycle, the Product Environmental Footprint (PEF) and the Organisation Environmental Footprint (OEF) [8].

Regarding already established EU product policies, Ecodesign and Labelling Directives, EU GPP and EU Ecolabel are based on specific thresholds and have the common goal of reducing the environmental impact of products. There are relevant aspects of these policies instruments which need to be considered towards an efficient, future oriented and more sustainable design of products.

This paper focuses in these 4 European product policies and how they currently affect product design. Their main goals, features, target products and future potentialities are described. An initial analysis presents relevant technical criteria for designers regarding these policies.

2. The European Product Policies: the background

The combination of these 4 European Product Policies aim at boosting the market towards a greater environmental sustainability. Thus, from a market perspective they have different objectives and they are also addressed to different actors (Table 1). Ecodesign and Labelling Directives are compulsory for certain energy-related and energy-using products and GPP and EU Ecolabel establish voluntary measures for some product categories. On the other hand, while manufacturers need to meet the mandatory or voluntary requirements, the consumers or public authorities are the ones in making the product's choice.

Table 1: Principles of European Product Policies

European Product Policies	Market objective	Mandatory?	Targeted actor of the policy
Ecodesign Directive	Cut out from the market the least environmental performing products	Yes	Market authorities
Labelling Directive	Push the market towards more environmentally performing products	Yes	Consumers
EU Green Public Procurement	Increase the market of good environmentally performing products	No	Public administration
EU Ecolabel	Awards the environmental excellence of products	No	Consumer and businesses

2.1 Ecodesing Directive (2009/125/EC)

The Ecodesign Directive [2] establishes a framework for setting ecodesign requirements for energy-related products. These requirements should be met by manufacturers in order to be allowed to access the EU single market. The products are not specially labeled, they only include the CE marking.

Some of the requirements are generic and others should meet specific minimum performances for certain product groups.

Impacts of all over the life cycle of products, including "embedded" impacts can be considered.

This product policy is mandatory and aims at removing the least sustainable products of the market.

2.2 Labelling Directive (2010/30/EU)

The Energy Labelling Directive [3] provides information on the consumption of energy and other resources of energy-related products. This Directive obliges to label how a product performs. Manufacturers compete in a fair market where the performance of products is assessed reliably.

The energy labelling is only focused in the use phase of the product and other "embedded" environmental impacts cannot be labelled. However, additional information can be disclosed regarding the use performance of the product or other consumption of resources.

This policy instrument is followed by all of the products in the market (no banned products). It provides the information to consumers in order to make the right purchasing decision, pulling the market towards more efficient products.

2.3 EU Green Public Procurement (GPP COM (2008) 400)

EU GPP is a voluntary instrument defined "*as a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured"* [4]. It guides public administrations to create environmental criteria for tendering the purchase of products and services.

GPP requirements can only be achieved by products with good environmental performances.

2.4 EU Ecolabel (Regulation EC No 1980/2000)

The EU Ecolabel is a *voluntary ecolabel award scheme intended to promote products with a reduced environmental impact during their entire life cycle and to provide consumers with accurate, non-deceptive, science-based information on the environmental impact of products* [5].

The EU Ecolabel is an environmental label Type I according to ISO 14024 [9] where a third party awards the use of the label according to the compliance of the environmental criteria within a particular product group.

This policy instrument has been created in a way that only the best products in the market can be awarded by the EU Ecolabel.

3. Targeted products

The first mandatory product policy was the Labelling Directive, established in 1992 (Directive 92/75/EEC) [10] affecting just household appliances. Ecodesign requirements were first entry into force in 2005 by Directive 2005/32/EC [11] on Energy-using Products (EuP) which are products that

use, generate, transfer or measure any kind of energy such as electricity, fuel, gas, etc. Later in 2009, its scope was extended by Ecodesign Directive 2009/125/EC to Energy-related Products (ErP) [2] which include any good that has a direct or indirect impact on energy consumption. Also the Energy Labelling extended the scope to ErP (including construction products) and to products in the commercial and industrial sectors (Directive 2010/30/EU) [3].

EU GPP [4] and EU Ecolabel [5] criteria have been developed for EuP, ErP and non-ErP (products which do not have any relationship with energy during its use phase).

Table 2 shows an example of some products groups that have developed requirements or criteria for each of the 4 product policies. Products groups currently implemented and under regulation process are both presented. However, each product group has been defined with a different scope of products depending on the product policy.

Table 2. Some product groups developed by EU product policies

	Product group	ED	LD	EU GPP	EU Ecolabel
EuP	Simple set top boxes	Yes			
	Street & office Lighting	Yes		Yes	
	Televisions	Yes	Yes		Yes
	Domestic dishwashers	Yes	Yes		
	Air conditioners and comfort fans	Yes			
	Water heaters	Yes			
	Laundry driers	Yes	Yes		
	Vacuum cleaners	Yes			
ErP	Thermal insulation			Yes	
	Taps and showers	URP		Yes	URP
Non-ErP	Furniture			URP	Yes
	Textiles			URP	Yes
	Footwear				Yes
Services	Transport			Yes	
	Food and catering services			Yes	URP

ED *Ecodesign Directive*
LD *Labelling Directive*
URP *Under Regulation Process*

4. Initial analysis of policy requirements that affect product design

Generic and specific requirements (for each product group) included in European product policies affect the design of products. Requirements concern the material composition, the technology, the use conditions during the use phase and the packaging of products as well as the information to be provided (e.g. to market authorities, to consumers). These requirements indeed concern important product parameters that need to be taken into account at the design step.

The main rule to be considered in the design step regarding these EU policies is that any of them should lower the functionality of a product nor its safety. The following sections discuss more in detail the requirements of the four policy tools.

4.1 Ecodesign Directive requirements

Ecodesign Directive [2] establishes two types of mandatory requirements: generic and specific. The generic requirements do not set thresholds but may demand compliance with relevant harmonized European standards or information requirements. The specific requirements set limit values on some specific technical aspects (e.g. maximum energy consumption).

A generic requirement is for example, to facilitate the reuse and recycling of plastics by the material coding standards such as including marking of plastic parts in accordance with ISO 11469 [12]. It may also require manufacturer's information regarding the proper use of the product in order to minimize environmental impacts e.g. recommendations for maintenance or replace of spare parts. Regarding specific requirements, for instance for the product group "standby and off modes electric power consumption of electrical and electronic household and office equipment", a requirement defines that domestic electrical and electronic products such as washing machines, TV or personal computers may not consume more than 0.5W in off mode [13].

An alternative to these mandatory requirements are the so called self-regulation by industry or voluntary agreements. The product group called "Complex set top boxes" which includes covers digital convertors for TVs and additional features such as pay-TV and network connectivity, is an example of a product group regulated by a voluntary agreement [14], for which technical requirements to be complied with have been collectively defined by manufacturers.

Implementing Directives or voluntary agreements have been developed for each product group. They define the exact requirements, the tests methods and conditions, and verification procedures.

Requirements have also a dynamic nature as they can evolve with time: for example, the Implementing measures of the Ecodesign Directives for water heaters and hot water storage tanks, published in August 2013, foresee adaptation time for manufacturers. For example, from September 2015, water heaters with a declared load profile of XXL should have an energy efficiency of at least 32%, by 2017 this energy efficiency must be 37% and by 2018, the energy efficiency should be 60% [15].

Mandatory requirements include among others, maximum levels of energy consumption, sound levels or certain chemical emissions as well as minimums on energy efficiencies or on maximum losses of heat. For instance, the annual energy allowance of TV digital convertors functioning with cable is 40kWh/year [14]. These requirements are usually set up for different conditions such as for the load capacity or for others functionalities (off-mode, standby mode, low energy mode, half loads, etc.). For example, for air conditioners and comfort fans, the requirements for minimum energy efficiency are different depending on the type of duct air (double or single) and on the type of refrigerant (GWP greater or lower/equal to 150) [16]. In addition, relevant information for disassembly, recycling and/or disposal at end-of-life are currently required in several implementing measures (e.g. for motors).

Design of products affected by the Ecodesign Directive is currently mainly determined by thresholds on energy

consumption and energy efficiency depending on different working conditions. Other non-energy requirements are been developing and could more strongly impact design in the near future.

Different stakeholders (manufacturers, industrial associations, NGO's, consumer associations, etc.) are actively involved in the policy process to ensure that requirements are in line with their interests. They participate in the technical and economic discussion of the feasibility of product requirements considering the objective of cutting out from the market only the least environmental performing products. Nonetheless, the compliance of the implementing measures of the Ecodesign Directive implies some significant efforts of design teams.

4.2 Energy Labelling Directive requirements

The Labelling Directive 92/75/EEC [10] consists of seven energy classes and colors, from A (most efficient/dark green) to G (least efficient/red). The new Energy Directive 2010/30/EU [3] introduced the A+, A++ and A+++ on top of the existing A, always respecting the total maximum of seven classes and colors. For instance, the air conditioners [17] have recently introduced the additional classes (A+, A++, A+++) thus, the lowest energy class is D (E, F and G classes have been repealed).

These energy classes are established for specific working conditions. For example, for domestic laundry driers, the energy efficiency is measured by the Energy Efficiency Index (EEI=AEC/SAC) calculated dividing the Annual Energy Consumption (AEC) for the standard cotton programme at full and partial load, by its Standard Annual Energy Consumption (SAC). Thereby, the energy efficiency class of household tumble driers is set up from D class (least efficient) where EEI≥85 to A+++ (most efficient) with EEI<24 [18].

Some product groups also include in the label additional information on the functionality such as the vacuum cleaners in [19] which not only energy efficiency classes are disclosed but also cleaning performance and dust re-emission classes.

Each product group is regulated by a supplementing Regulation in which are detailed the required measurement and calculation methods, the technical documentation, the design and content of the label, the location where the label shall be fixed to the product and the duration of label classification. Information in these labels includes energy efficiency, annual energy consumption, function capacity/ quality or sound levels.

As mentioned, this Directive obliges to label the use performance of the target products without setting mandatory requirements. Therefore, competitive products are achieved by technology development and design efforts aiming at improving the consumption of resources, mainly energy but also other resources such as water (e.g. washing machines), as well as their functionality such as the energy efficiency (e.g. water heaters), cleaning performance (e.g. laundry machines) or comfort (e.g. noise levels of air conditioners).

4.3 EU GPP criteria

EU GPP [4] core and comprehensive criteria is developed for each product group. The core criteria are those that address the key environmental impacts (easy verification process and minimum cost). The comprehensive criteria aim at purchasing the best products available on the market (additional verification effort or increase in cost).

Key environmental impacts are identified and linked to a specific approach for the product group. For instance in the case of furniture, for avoiding the "*loss of biodiversity, soil erosion and degradation as a result of unsustainable forest management and illegal logging*", the GPP approach is to "*procure timber from legal and sustainably managed forests*" [20].

Minimum criteria are recommended on technical parameters, energy efficiency and content of hazardous materials or emissions. For example, for thermal insulation products the thermal conductivity should be less than 0.044W/mK [21]. For the product group "Street lighting" minimum luminous efficacies and ballasts efficiencies depending on the luminaries are required [22]. GPP criteria may also ban some chemicals such as for textiles, in which certain dyes shall not be used in the manufacture of the final product [23]. In addition, criteria on the extraction and manufacturing of raw materials, the recycled content, the packaging, durability, reparability or recyclability, may also be considered for certain products groups.

EU GPP is a voluntary and guidance policy so that its criteria can vary reflecting national differences according to their particular requirements, procurement approaches or environmental priorities [24]. Criteria developed for each product group are not binding committed to meet EU GPP policy.

Even though the voluntary nature of this policy, manufacturers willing to win public tenders in which GPP criteria is applied, need to meet restrictive environmental criteria depending on the product group. To consider such criteria in all the steps of the design process is essential in the development of eligible products.

4.4 EU Ecolabel criteria

Products awarded with EU Ecolabel have a lower environmental load than the market average. For instance considering the already mentioned product group of TVs, the general rule for EU Ecolabel is that the energy consumption of the passive standby should be less than 0.3W [25] (against 0.5W for Ecodesign).

EU Ecolabel criteria aim in particular at the reduction of use of energy and water, limitation of hazardous substances for the minimization of toxicity to humans and to the environment, lifetime extension and the reduction of packaging waste, among others.

Therefore, these criteria are often focused on energy and water savings, a banned list or maximum content of hazardous materials, product quality, fitness for use, requirements on packaging, design for disassembly, user information and/or information appearing in the EU Ecolabel.

Some examples of these criteria are:

- For soaps, shampoos and hair conditioners, all the surfactants used should be biodegradables [26].

- For textiles, lead-based pigments shall not be used in the polypropylene fibers [27].
- For taps and showers, the warranty for repair shall be of at least 4 years [28].
- For laundry detergents, the dosage of a powder heavy-duty detergent should be maximum of 17g/kg wash [29].
- For footwear packaging, if cardboard is used, this shall be made of 100% recycled material [30].

EU Commission Decisions have been developed for each product group in which the EU Ecolabel is specifically detailed. Assessment and verification methods are indicated with each criterion. From all the product policies, EU Ecolabel environmental criteria are the most demanding ones since only the best products of the market can be awarded. Usually, in order to be eligible, these products have been designed considering in the initial steps these type of criteria and the ambitious thresholds associated to them.

5. Potentialities of product policies

European regulations provide a dynamic framework of product policies to improve the environmental performance of products throughout their life cycle. EU policies are flexible in order to be adapted to the changing conditions of the technology and the markets. Their requirements and criteria are revised to reflect technical innovation such as evolution of materials, technologies and production processes. The scope of product policies are also continuously reviewed in order to address relevant new product groups.

The current Ecodesign Working Plan establishes Energy-related Products as a priority which are included in an indicative list of 12 product groups to be considered between 2012 and 2014 [31]. Thus for instance, development of Ecodesign requirements for windows, is currently under the Preparatory Study, the earliest step of the policy process. Other products included in the Ecodesign Working Plan 2012-2014 are power cables, water-related products and also new technology intensive products such as smart appliances/meters. Besides, the effectiveness of Labelling Directive is currently being evaluated [32] and the energy classes will be reviewed in 2014.

Regarding the EU Ecolabel, criteria are revised approximately every 4 years and new products groups are being currently developed such as “furniture” or “converted paper”. GPP criteria of products groups such as “toilets and urinals” or “office buildings” are also under regulation process. The design process of new products belonging to these product groups will surely be impacted by these rules, at least for pro-active manufacturers.

The ideal framework of EU product policies is their potential complementarity, to ensure synergies and to overcome potential inconsistencies. Efforts are being already made in integrating better Ecodesign and Labelling Directive, including the targeted products but also the requirements and the measurement methods. On the other hand, EU Ecolabel and EU GPP criteria for the same product groups are often developed in parallel.

The possible extension of the scope of Ecodesign and Labelling Directives to professional and industrial products is under discussion and poses the question of the requirements applicable to Business-to-Business and Business-to-Consumers products that could be of different nature. This is in practice nowadays under discussion during the current development of Ecodesign requirements for “commercial refrigerators” and for “professional wet appliances and driers”. Besides, experiences on developing criteria for services (e.g. EU Ecolabel of transport, food and catering, camping sites) in voluntary policies could be adapted to mandatory initiatives.

The fact that mandatory policies extend their scope to ErP and maybe to non-ErP, increases the importance of non-energy requirements, especially in life cycle phases different than the use phase. Thus, requirements could focus on new relevant aspects such as the consumption of raw materials or the use of recycled materials during the manufacturing, efficient manufacturing processes and in other non-energy aspects such as the water consumption or consumables, or on durability/lifetime of products. Regarding the end-of life, requirements could harden referring to the disassembly or recoverability/recyclability of products, components or materials. This might pose new challenges for the product design process.

The experience of criteria already developed in voluntary policies could be exported and adapted to help developing mandatory criteria. For example, the criteria of EU Ecolabel for TVs on “Design for dismantling” [19] could facilitate the creation of Ecodesgin requirements for the same product group, Ecodesign requirements on TVs could be “to use X minimum types of plastics” or “to set up maximum time for dismantle key parts of the TVs” [33]. Unfortunately, requirements that fit one policy might not always fit another since their objectives are different.

Additionally, different product policy tools could be applied to some products forming a system since substantially higher energy savings can be potentially reached on the system level. Systems are those, which group of products (usually connected) are aimed at performing the same function such for instance heating systems (boilers, control devices, radiators, ductworks, valves, etc.) or lighting systems (lamps, cables, switches. In these cases, certain environmental performance could be achieved by implementing a mix of several product policies solutions. For example, regarding taps (ErP) and boilers (EuP), the energy “related consumption” of the taps relies on the boiler’s efficiency. Both individual products must meet mandatory criteria and could also comply with some voluntary EU policy. There will be a total energy efficiency and consumption and thus, a whole environmental impact associated to the system taps-boiler depending on the policy tool applied to each product (e.g. which will be the environmental performance of the system taps-boilers when the tap is compliant with EU Ecolabel and the boiler presents an Energy Label of C?). Therefore, requirements and criteria of the 4 product policies should be combinable in order to facilitate the design of systems compliant with the mandatory and potentially with the voluntary policies. Thus, by applying the right policy mix, environmental improvement could be easily achieved on systems.

6. Conclusions

This paper offers an initial analysis of the influence of four EU product policies on design.. Mandatory and voluntary criteria technically relevant for designers have been presented. This information has been complemented with examples of specific requirements of some product groups. Refining the analysis of the influence of environmental policies on product design would lead to a more efficient product development.

The four EU product policies are dynamic and potentially synergetic. However, several aspects need to be further explored: scope extension to non-household products, to ErP and to non-ErP, so that to non-energy aspects. Particularly, the link between product and system criteria will be of importance in the future policy development.

Further research should be done in joining efforts in the development/review of each of the policies. Consistency among EU product policies, would create requirements and criteria easier to implement by manufacturers and designers.

Note

The views expressed in the article are personal and do not necessarily reflect an official position of the European Commission.

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