ECODESIGN AND ENERGY LABELLING LEGISLATION AS A DRIVER OF INNOVATION: A QUALITATIVE ANALYSIS FOR TURKISH INDUSTRY

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ABSTRACT

ECODESIGN AND ENERGY LABELLING LEGISLATION AS A DRIVER OF INNOVATION: A QUALITATIVE ANALYSIS FOR TURKISH INDUSTRY

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Sustainable product design, a key component of the transition to a circular economy, aims to reduce the environmental impact of products throughout their life cycle. For this purpose, concepts such as ecodesign and energy labelling have been introduced into the technical requirements of the products. The technical legislation in Turkey is based on the transposition of the EU acquis on Ecodesign and Energy Labelling. By imposing energy consumption and resource efficiency thresholds, Ecodesign Directive, 2009/125/EC, pushes manufacturers to design more efficient products. On the other hand, Energy Labelling Framework Regulation (EU) 2017/1369, increases demand for more efficient products by ensuring that consumers are accurately and effectively informed. The push and pull effect of legislation influences the innovation activities of manufacturers. The purpose of this study is to analyze the Turkish industry's attitude toward Ecodesign and Energy Labelling legislation. To this end, semi-structured interviews were conducted with stakeholders and responses were analyzed. The regulatory compliance of the various sectors and their challenges faced in the field have also been examined. Based on the findings of the study, policy recommendations were developed in three dimensions of the legislation: innovation,

fair and competitive market, and sustainability. The findings of the study is expected to contribute to better implementation of Ecodesign and Energy Labeling legislation in Turkey.

Keywords: Circular economy, resource efficiency, ecodesign, energy labelling, regulatory compliance

ÖZ

YENİLİK İÇİN BİR İTİCİ GÜÇ OLARAK ÇEVREYE DUYARLI TASARIM VE ENERJİ ETİKETİ MEVZUATI: TÜRKİYE SANAYİSİ İÇİN KALİTATİF BİR ANALİZ

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Döngüsel ekonomiye geçişin önemli bir bileşeni olan sürdürülebilir ürün tasarımı ile ürünlerin yaşam döngüsü boyunca çevresel etkisinin en aza indirilmesi amaçlamaktadır. Bu bakış açısı çevreye duyarlı tasarım (ekotasarım) ve enerji etiketlemesi kavramlarıyla ürünlerin teknik gerekliliklerine de yansımış olup, Türkiye'de konuyla ilgili teknik mevzuat Avrupa Birliği'nde yayımlanan 2009/125/EC ve (EU) 2017/1369 sayılı düzenlemelerinin uyumlaştırılmasına dayanmaktadır. Bu düzenlemelerden, Enerji ile İlgili Ürünlerin Çevreye Duyarlı Tasarımına İlişkin Yönetmelik, ürün tasarımında enerji tüketimi ve kaynak verimliliğine ilişkin eşik değerler getirerek üreticileri daha verimli ürün tasarımına zorlamaktadır. Diğer taraftan, Enerji Etiketlemesi Çerçeve Yönetmeliği ise tüketicilerin doğru ve etkili bir şekilde bilgilendirilmesini sağlayarak daha verimli ürün talebini artırmaktadır. Bu çift taraflı etki firmaların yenilik faaliyetlerini etkileyen unsurlar arasında değerlendirilmektedir. Çalışmada ilgili paydaşlarla gerçekleştirilen yarı yapılandırılmış mülakatlar doğrultusunda Türk sanayisinin ekotasarım ve enerji etiketlemesi düzenlemelerine bakışı, sektörlerin uyum seviyesi ve uygulamada karşılaşılan sorunların analiz edilmesi amaçlanmaktadır. Çalışma sonucunda

oluşturulan elde edilen bulgular çerçevesinde yenilik, adil ve rekabetçi piyasa ile sürdürülebilirlik olmak üzere üç ana başlıkta politika önerilerinde bulunulmuştur.

Anahtar Kelimeler: Döngüsel ekonomi, kaynak verimliliği, ekotasarım, enerji etiketlemesi, mevzuat uyumu

To my beloved wife and my dear family

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LIST OF ABBREVIATIONS

CE	European Conformity (Conformité Européene)
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
EA	European Accreditation Association
ESTI	European Telecommunications Standards Institute
EU	European Union
EPREL	European Product Registry on Energy Labelling
HVAC	Heating, Ventilation and Air Conditioning
IPP	Integrated Product Policy
IPR	Intellectual Property Rights
ISO	International Organization for Standardization
LVD	Low Voltage Directive
MEPS	Minimum Energy Performance Standards
NACE	Statistical Classification of Economic Activities in the European Community
NGO	Non-Governmental Organization
REACH	Registration, Evaluation, Authorization, and Restriction of Chemicals
RoHS	Restriction of Hazardous Substances in Electrical and Electronic Equipment
SME	Small and Medium-Sized Enterprises
SPI	Sustainable Product Initiative

TG	Target Group
TSE	Turkish Standards Institution
TÜRKBESD	White Goods Manufacturers' Association of Turkey
TÜRKAK	Turkish Accreditation Agency
TÜRKPATENT	Turkish Patent and Trademark Office
WEEE	Waste Electrical and Electronic Equipment

CHAPTER 1

INTRODUCTION

1.1. Background and Novelty of the Thesis

The world is facing an unprecedented resource crisis and environmental threat. Global population growth and increasing demand for production have put a strain on the limited natural resources in the world. The production of raw materials has increased as well, but it still has not been enough to meet the demands of the ever-growing population. Since there is no foreseeable solution to this problem, it is important to find ways to reduce consumption and produce more efficiently.

The circular economy concept has been introduced as an alternative approach that not only tackles resource problems but also mitigates the effects of global environmental challenges like climate change, biodiversity loss and pollution.

In this respect, sustainability in the design phase of the products is one of the emerging technological trajectories. Within this trajectory, concepts such as resource efficiency and ecodesign have started to be at the top of the agenda of policymakers.

As a pioneer in product rules and environmental laws, the EU has also been at the forefront of incorporating the ecodesign concept in product legislation. EU's Ecodesign and Energy Labelling legislation creates a framework for the design requirements for energy-related products. These requirements are considered public interventions aiming not only at sustainability but also at promoting R&D and innovation efforts (O'Rafferty, 2012; Larsen, 2015; Sihvonen, 2019; Salo et al., 2020). Ecodesign and Energy Labelling requirements interact in a "push and pull" dynamic and influence product innovation. (European Commission, 2019). Ecodesign

Directive[1] sets the minimum energy performance standards (MEPS) and pushes manufacturers to design more efficient and environmentally friendly products. On the other hand, The EU Energy Labelling Framework Regulation[2], which is the mandatory labelling scheme for energy-related products, influences consumer decisions at the point of sale to promote the best environmentally friendly products. It also encourages market demand for more efficient products and positively affects product innovation.

The products in the scope of the Ecodesign Directive should comply with the implementation measures to obtain CE marking, which is the prerequisite for placing on the products in the EU market, Turkey as well. Turkey's position in Customs Union requires the transposition of EU acquis into national legislation, including technical regulations of the products like CE requirements.

Among these regulations, the harmonisation process of the secondary legislation, also known as implementation measures, on Ecodesign and Energy Labelling still ongoing. Global developments in environment and energy, such as the Paris Agreement and the EU Green Deal, have accelerated the harmonisation process of these rules. While it can be considered an opportunity for manufacturers from the sustainability and innovation perspective, it will likely create an extra burden in compliance with the new requirements.

At this point, the industry's approach to new regulations is crucial to their future strategies. According to Dalhammar et al. (2021), the industry attitudes towards to legislation on Ecodesign and Energy Labelling is similar to the S-shape curve in the diffusion of innovation. While the innovators and early adopters in the S-shape curve play an essential role in creating regulations and standards, the laggards take action only when these regulations become a prerequisite for entering a market.

[1] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products. Official Journal of the European Union, L285/10

[2] Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017 setting a framework for energy labelling. Official Journal of the European Union, L198/1

In the literature, there are studies examining the relationship between the effect of these regulations and industrial behaviour at the national level (Santolaria et al., 2011; Dalhammar, 2015; Laruccia & Garcia, 2015, Bundgaard, 2016). However, in studies conducted for Turkey, Ecodesign and Energy Labeling were not addressed from this perspective. In this regard, one of the important outcomes of this research is contributing to filling this gap in the literature.

Furthermore, the study also addresses the level of compliance of the Turkish industry in terms of sectoral differences as well as the problems they have faced in the field during the implementation of the legislation. In this view, the findings of the research and policy recommendations will be beneficial to both policymakers and the industry.

The research mainly seeks the answer to the following question:

- What is the industry's attitude towards Ecodesign and Energy Labelling legislation in Turkey?

Three sub-questions were designed to support the research question and deepen the understanding of regulatory impact:

- To what extent do Ecodesign and Energy Labelling legislation affect the Turkish industry?
- What is the compliance level of the Turkish industry with the Ecodesign and Energy Labelling legislation?
- How do Ecodesign and Energy Labelling legislation promote innovation?

Qualitative research methods were mainly applied to find the answers to these research questions. Semi-structured interviews, which are the core of the study, were held with the people representing various stakeholders related to the product regulations, particularly for Ecodesign and Energy Labelling legislation. Additionally, quantitative data such as market surveillance results and intellectual property rights (IPR) statistics were also analyzed.

According to interview outputs, the analysis of the market surveillance and IPR statistics, an overview of the Turkish industry has been given. Based on the findings

of the study, policy recommendations have been presented for better implementation of Ecodesign and Energy Labelling legislation. The recommendations have been divided into three categories based on three policy goals: innovation, fair and competitive market, and sustainability.

1.2. Organization of Thesis

The organization of this thesis consists of six chapters. The first chapter presents a brief introduction, including background information and the research question of the study. The novelty of the research, its key contributions to the literature, and the organization of the thesis have also been explained.

The main concepts and literature review on Ecodesign and Energy Labelling legislation have been given in the second chapter of the thesis. The circularity and sustainability of the product requirements have been presented briefly. The role of these regulations on product innovation has been explained in the literature review. The dual effect of the legislation has also been introduced: technology push and market pull effect of regulations.

The third chapter provides an outlook of Turkey's legal framework for product regulations from a macro view. This section also contains a brief review of policy documents that include the concept of ecodesign.

The fourth chapter discusses the research methodology of the thesis. Semi-structured interviews are the core of the data collection method in the study. The effects of regulations on innovation, the market, and sustainability have been assessed through interviews with fourteen participants from three different target groups. Furthermore, quantitative data such as market surveillance results and patent statistics have been used to examine regulatory compliance and innovation efforts.

The research's findings and policy recommendations are explained in chapter five. The outputs from the interviews and the conclusions drawn from the statistics are presented first. The findings have been divided into four categories: (i) knowledge access and innovation effect, (ii) transposition procedure of legislation, (iii) regulatory compliance, and (iv) the future of ecodesign: Sustainable Product Initiative. This

section also addresses the problems and obstacles that form the basis of policy recommendations. Second, the policy recommendations based on the findings of the study have been presented in this chapter. These recommendations have been organized to achieve three policy goals: (i) promoting innovation through the acceleration of knowledge diffusion, (ii) improving a fair and competitive market, and (iii) developing sustainability approach in product design.

The final chapter gives a summary of the thesis and discusses the limitation of the study and the potential for future research.

CHAPTER 2

CONCEPTIONAL FRAMEWORK & LITERATURE REVIEW

This chapter briefly describes the main terms and concepts included in this study. Regarding the circular economy and sustainability, environmental aspects of product legislation have been overviewed. A literature review on the impact of product regulations, particularly on ecodesign and energy labelling, has also been presented.

2.1. Circular Economy and Lifecycle Thinking

A circular economy is an approach that minimizes the amount of waste in the economic system. Considering the limited resources, the circular economy concept has emerged as an alternative model to the traditional linear economy. The economic and environmental worth of materials can be maintained as long as they are feasible in the circular economy. Materials can be kept in the economy either by extending the life of the goods made from these materials or by looping them back into the system to be reused (den Hollander et al., 2017). Even though there are various methods for keeping the materials and resources in the system, the goal of a circular economy is to work towards a closed loop, ideally. This phenomenon makes optimal and sustainable use of the limited resources during the whole life cycle of the products.

The lifetime of the materials is crucial for ecodesign. The life cycle approach, which has been widely appreciated as the primary tool for ecodesign, involves the consideration of all environmental aspects of a product throughout its lifespan, from the extraction of resources to disposal.

2.1.1. Principles of Circular Economy Framework

Regarding the life cycle approach to the circular economy, there are various strategies, known as R-framework as illustrated in Figure 1, to achieve less material consumption in the lifespan of the products and make the economy more circular (Bundgaard et al., 2015; Potting et al., 2017).

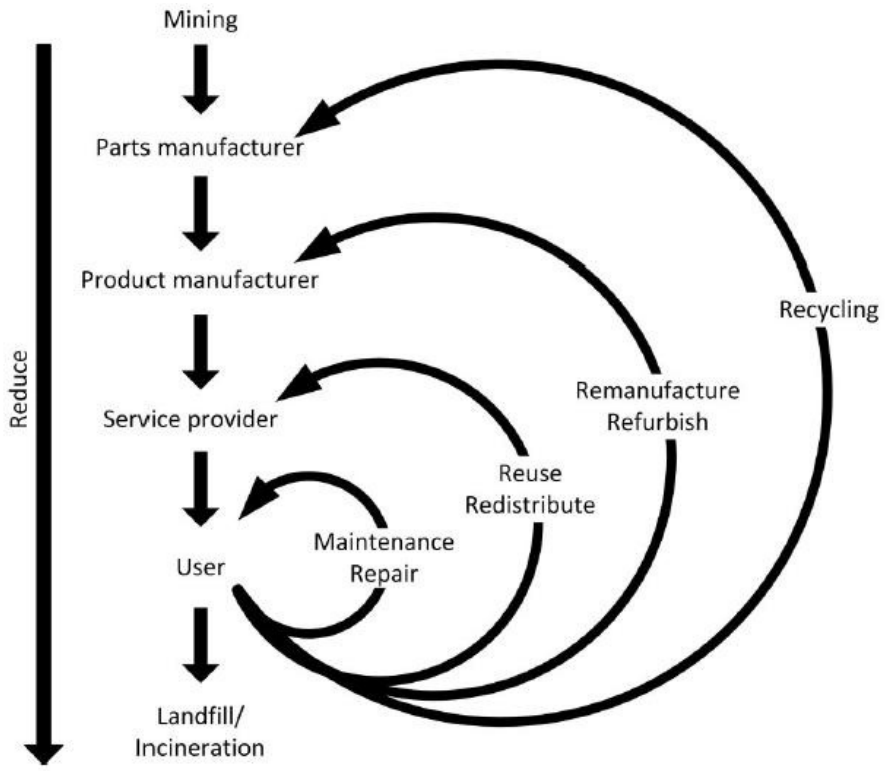


Figure 1: Overview of R-Framework in Product Lifespan

(**Source:** Bundgaard et al., 2015, p.15)

In general, the four terms: reuse, repair, remanufacture, and recycling, are the fundamental concepts of this framework (Prendeville et al., 2014; Weber, 2018). However, in some studies (Bundgaard et al., 2015; Van Buren et al., 2016; Kirchherr et al., 2017; Potting et al., 2017), this framework has expanded and used as a substitute with different gradations and terms such as refuse, reduce, refurbishing, repurpose, and energy recover.

In order to achieve sustainability, the design phase of the products becomes an essential part of a circular economy. According to the European Commission, in the

design stage of a product, more than 80% of the environmental impact is determined (European Commission, 2012b). There are various design strategies in line with the R-framework: improving the material efficiency, reducing the use of raw materials, and increasing the possibility of alternatives such as recycling, reusing, and repairing instead of the materials in the product being wasted.

2.1.2. Definition of Ecodesign

The principle of product design considering the circular economic framework is expressed in various terms and concepts in the literature. The concept of “ecodesign” is used mainly in policy documents, regulations and standards. In certain studies, terms like "green design", "ecological design", "sustainable design", and "design for the environment" are used as alternative terms for "ecodesign" (Dewberry, 1996; Prendeville et al., 2014; Schäfer & Löwer, 2021).

The most general and comprehensive definition of ecodesign is provided by the European Commission as:

> Ecodesign means the integration of environmental aspects into product design with the aim of improving the environmental performance of the product throughout its whole life cycle.
> (European Commission, 2009, p. 16)

In the Circular Economy Action Plan[3], which was declared by the European Commission in 2015, the close relationship between the circular economy and ecodesign has been emphasized. Egenhofer et al. (2018) explained this relation by emphasizing that ecodesign requirements are not solely about energy efficiency but also include the aspects of circular economy as repairability, durability, upgradeability and recyclability of products.

[3] https://ec.europa.eu/environment/circular-economy/pdf/new_circular_economy_action_plan.pdf

2.2. Environmental Aspects of Product Legislation

Environmental trends have had a significant impact on legislative and regulatory activities, as well as standards, sustainability programs, and market needs. The changes can also be associated with the transformation in product policies. In recent years, product policies have included various methods related to the circular economy, such as the approaches and elements in the R-framework.

In the historical process of the product policies, it can be found that they have developed in parallel with the evolution of environmental priorities. Environmental product policies in the 70s and 80s focused mainly on harmful chemicals in products and the health concerns about the individuals and the environment. In the following decades, legislation emphasized product recycling in order to minimize the growing quantity of waste in society and reduce natural resource depletion (Dalhammar, 2014). In these years, the primary focus of product policies and regulations was the safety of the products and waste management.

Increasing concerns about the environmental impact of economic activities, which were especially strong from the early 2000s onwards, started to shape the product policies. As a result, policymakers began to consider environmental aspects when developing product regulations. By establishing new regulations, all major economies throughout the world aim to improve the durability, efficiency, and sustainability of the products. Whether voluntary or compulsory, these regulations accelerate the transition of attitude in product design.

As a pioneer in product policies and environmental laws, the EU has been at the forefront of incorporating the ecodesign in product legislation. The EU's Integrated Product Policy (IPP) establishes a framework for product policies by including environmental impact and product design throughout the whole life cycle of products. Following the implementation of IPP, the major environmental regulations have been enacted as a policy instrument for this approach:

- Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive (2002)

- The Waste Electrical and Electronic Equipment (WEEE) Directive (2003)
- Ecodesign Directive (2005)
- The Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH) Regulation (2007)

One of the major economies outside the EU, Japan has also focused on resource efficiency by implementing voluntary and mandatory labelling schemes. Energy Star, a voluntary labelling program in the US, provides consumers guidance in distinguishing both environmentally friendly and best-performing products in the market (Bundgaard et al., 2017).

Policy instruments and government interventions promoting the environmental dimension of the products vary by country, as mentioned above. They can be restrictive regulations, labelling schemes, and voluntary measures. However, this study covers only the EU's Ecodesign and Energy Labelling legislation, which is one of the key product legislation in Turkey. In the following chapters, the legislative framework for product regulations in Turkey has been examined in detail.

2.2.1. Relevant Environmental Regulations in the EU

One of the significant regulations regarding the design and production processes of products is the Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive. The RoHS Directive, which went into effect in the EU in 2002, seeks to prevent hazardous compounds that endanger human health and the environment. The first version of the Directive, also known as 2002/95/EC, applies to a limitation by a maximum allowed concentration per weight measure. The RoHS compliance became one of the CE marking requirements in the second version of the Directive (European Commission, 2012). Directive 2015/863, known as RoHS 3, adds additional restricted substances to the hazardous material list (European Commission, 2015).

The Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH) Regulation aims to improve chemical management by better identifying the chemical contents of substances. The four steps of the Regulation, registration, evaluation,

authorization, and restriction, enable the better assessment and stricter controls of hazardous chemicals (Machacek, 2012).

Another important piece of legislation is the Waste Electrical and Electronic Equipment (WEEE) Directive, which aims for a better implementation of recycling and reuse of electrical and electronic equipment. This Directive, which has been in force since 2003, regulates the manufacturer's responsibilities that require them to take back WEEE from the consumers (European Commission, 2003).

The voluntary system of EU Ecolabel, which was introduced in 1992 with the EU Regulation EEC No 880/92, is another important legislation that contributes to pollution reduction by environmentally friendly products and services. By implementing Ecolabel criteria and producing Ecolabelled products, manufacturers prove the environmental impacts of their products and guarantee the environmental-friendly actions by third-party certification under the standard ISO 14001. As a voluntary regulation of environmental excellence, the wide range of product groups, including clothing, cleaning products, furniture, and electronic equipment, can be labelled in the scope of the EU Ecolabel (Machacek, 2012).

In addition to the EU Ecolabel, national and regional ecolabel schemes are also available such as the Blue Angel in Germany, Nordic Swan in Nordic countries (Boström & Klintman, 2008). The Turkish Environmental Labeling Regulation was enacted in 2018 to establish the principles of the national labeling system in Turkey. The labeling criteria have been introduced for the following product groups and services: detergents, glassware, personal care, cosmetics, ceramics, textile and touristic accommodation service (Ministry of Environment, Urbanization and Climate Change, 2022).

The Ecodesign Directive, Energy Labelling Framework Regulation and their implementation measures, which are the subjects of this thesis, are examined in more detail in Section 2.3. Ecodesign and Energy Labelling.

2.2.2. Integrated Product Policy

Most environmental rules interact with one another and are mutually beneficial to each other because of their similar impacts, common stakeholders, and their linkages to the different phases of the lifecycle (Egenhofer et al., 2018). In this regard, policymakers take a comprehensive approach to both product and environmental policies. The Integrated Product Policy (IPP), introduced by the EU Green Paper in 2001, aims to take into account all environmental aspects throughout the life cycle of products in a cost-effective way (European Commission, 2001). With the implementation of the IPP and enactment of environmental regulations, lifecycle thinking has become an essential element of product legislation, as well as product safety and consumer protection (Römph & Cramer, 2020).

According to the EU Green Paper, the IPP approach is based on five key principles; *"(i) lifecycle thinking, (ii) working with the market, (iii) stakeholder involvement, (iv) continuous improvement and (v) a variety of policy instruments"*. With these principles, the IPP aims to combine multiple instruments to achieve more environmentally friendly products through cooperation with stakeholders (Machacek, 2012). These policy instruments are financial measures, substance bans, voluntary agreements, environmental labelling, and product design guidelines. In this view, IPP also aims to achieve better cooperation across the product legislation regarding the environment, such as REACH Regulation, RoHS Directive, WEEE Directive, Ecodesign Directive, and Energy Labelling Framework Regulation.

In fact, despite that the primary goal of the Ecodesign Directive is to increase energy efficiency of products, it also adheres to the life cycle approach. Moreover, the Directive integrates additional provisions from other environmental regulations as well as energy efficiency. For instance, the ecodesign implementation measure for televisions (EU 2019/2021) includes mandatory provisions about cadmium limits, marking of plastic components, availability of spare parts, and providing repair and maintenance information about the products (European Commission, 2019b).

2.3. Ecodesign and Energy Labelling

In terms of the product lifecycle, the Ecodesign and Energy Labelling legislation is the most prominent policy tool to regulate the design phase of the products from the IPP perspective (Dalhammar, 2014; Polverini, 2021). The preventive nature of the requirements contributes to sustainable development by increasing energy efficiency and environmental protection. The Ecodesign Directive aims to promote the circular economy aspects of the energy-related products by setting mandatory requirements on environmental impacts, potential improvements and lowering life cycle costs. On the other hand, energy labels help consumers' purchase decisions by categorizing the energy consumption and environmental impact of the products.

As shown in Figure 2, Ecodesign, Energy Labelling and Ecolabel regulations are complementary to each other. The Ecodesign and Energy Labelling legislation focuses on the design requirements of energy-related products regarding general and specific restrictions. However, there is a significant difference for the Ecolabel scheme. Unlike Energy Labelling, Ecolabel sets voluntary requirements to affix this environmental excellence label on the products.

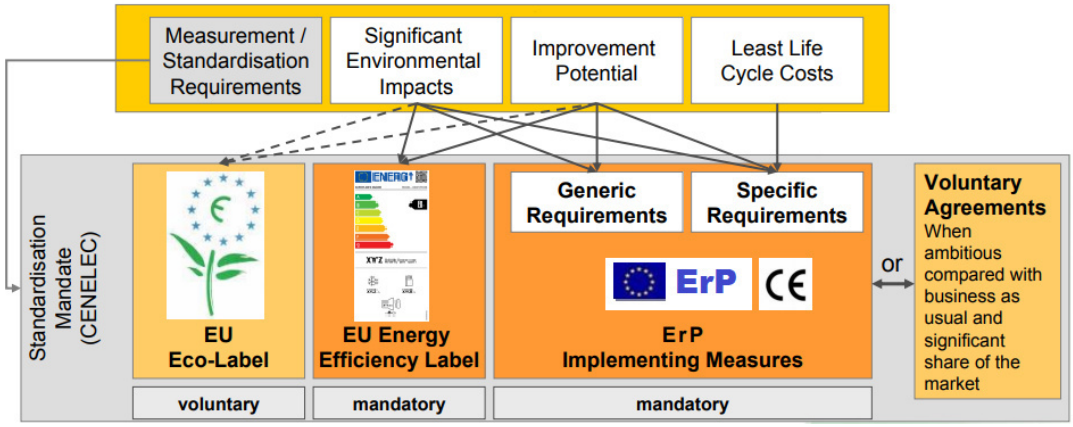


Figure 2: The Relationship Between Ecodesign, Energy Label & Eco-Label

(**Source:** Mudgal, 2008, p.7, reconfigured)

2.3.2. Ecodesign Directive

Even though the first energy performance requirements in the EU date back to the 1990s for most common energy-consuming products such as heaters, refrigerators and

lighting, the framework of ecodesign approach was established in 2005 by the implementation of the Ecodesign Directive (ECA, 2020).

The first version of the Ecodesign Directive (2005/32/EC) created a framework for the ecodesign requirements of energy-using products. The second version of the Ecodesign Directive (2009/125/EC) made a broader approach to the ecodesign rules of the products. The products covered in this version have been extended to include products other than energy-using products, such as insulation materials that contribute to the energy savings for constructions without requiring a power supply (European Commission, 2009). Consequently, the terminology in the Ecodesign Directive has shifted to “energy-related products” rather than “energy-using products”.

The Directive, one of the EU's new approach directives, creates a basic framework of the requirements of the ecodesign of the energy-related products. The detailed requirements are described in secondary legislation, called as implementation measures. (Wimmer et al., 2010). Thresholds and limitations for the products are determined in general or product-specific requirements in the implementation measures. Even though these requirements are explained in detail in the implementation measures, the Ecodesign Directive establishes general principles for the design process of the products in the following issues:

- Methods for setting generic and product-specific ecodesign requirements
- Context of the implementation measures
- Conformity assessment procedures
- Responsibilities of economic operators

The primary focus of the Ecodesign Directive is minimizing the environmental impacts by enabling the design of products that take into account the entire life cycle of products. The following phases of the life cycle of a product are to be considered: raw material selection and use; manufacturing; packaging, transport, and distribution; installation and maintenance; use; and end-of-life. According to the Directive, environmental aspects that must be assessed during the life cycle assessment are:

- Predicted consumption of materials, energy, and other resources
- Emissions to air, water, or soil
- Anticipated pollution
- Waste generation
- Possibilities for reuse, recycling and recovery of materials and/or of energy

In this regard, the overall goal of the Directive can be associated with sustainable development: resource conversation and improvement of energy efficiency of energy-related products.

The Directive sets out the general framework for product-oriented implementing measures on the energy-related products to be placed on the market or to be put into service. The MEPS in the implementation measures contribute to sustainable development by enhancing resource efficiency and environmental protection while also increasing the security of the energy supply.

The Directive also allows for the removal of less efficient products from the market through mandatory restrictions, particularly on energy consumption. Even though one of the priorities of the Directive is energy efficiency, it also pushes manufacturers to circular economy principles in product development activities. For instance, repairability, maintainability and material efficiency have started to become important concerns of designers.

It is important that the degree of ecodesign criteria is determined using technical, economic, and environmental analyses informed by the best-performing products or technologies on the market. The implementation measures on ecodesign include benchmarks for the best available technologies that facilitate the information flow and integration of new design techniques, especially into SMEs. This is another aspect of the Ecodesign Directive related to the impact on manufacturer competitiveness and innovation.

The criteria for which products are to be subject to ecodesign requirements are described in Article 15(2) of the Directive:

- The volume of the annual sale of the product should exceed 200.000 units in the EU market.
- Ecodesign requirements for the selected products should have a significant environmental impact.
- The requirements for selected products should not create a burden for both economic operators and consumers.

In the phase of determining restriction limits like MEPS, impact assessment is a critical legislative step in establishing requirements for each product group. During this stage, the technical content of the implementation measures and which products will be covered by the ecodesign are determined. Therefore, it is very important for manufacturers to participate in these studies by sharing quantitative data and their foresight.

2.3.3. Energy Labelling

While the Ecodesign Directive strives to address how manufacturers design their goods, the Energy Labelling scheme seeks to ensure that customers can make wise decisions. Thanks to the energy labels, customers may make conscious decisions based on the energy and resource usage of energy-related products. Maitre-Ekern (2017) indicates that, the spread of information about efficient and sustainable products contributes significantly to energy savings and lower energy bills while encouraging innovation and investment in creating more energy-efficient products.

According to Energy Labelling Framework Regulation, manufacturers have to provide an energy label and a product information sheet containing information about energy consumption and essential performance parameters of their products before placing them on the market. The dealers have to display the label in a visible manner, both at physical and online market (European Commission, 2017).

The first EU Energy Labelling scheme was first introduced in 1992 by adopting Directive 92/75/EEC. The Directive covered the following types of household appliances;

- refrigerators, freezers and their combinations
- washing machines, driers and their combinations
- dishwashers
- ovens
- water heaters and hot-water storage appliances
- lighting sources
- air conditioning appliances

In the first version of the label, the energy performance of the products was classified into seven energy classes, “A” to “G”. In addition to these energy classes, the label includes basic parameters and product specifications that vary according to the product type.

In 2010, the second version of the label was introduced by the Directive 2010/30/EC. The label format has changed and additional classes of “A+”, “A++” and “A+++” have been introduced. The scope of energy labelling was also expanded. While the first labelling scheme focused on home appliances, it was recast to include energy-related products in the commercial and industrial sectors, such as cold storage rooms and vending machines. Furthermore, according to Bundgaard (2016), the enlargement of the scope strengthens the connection between the EU Energy Labelling with the Ecodesign Directive, allowing for greater use of the synergies between the two policy instruments.

The third generation energy label, shown in Figure 3, was adopted by (EU) 2017/1369. The new labelling regulation reintroduced the original “A” to “G” scale for certain product groups and established a common product registry database.

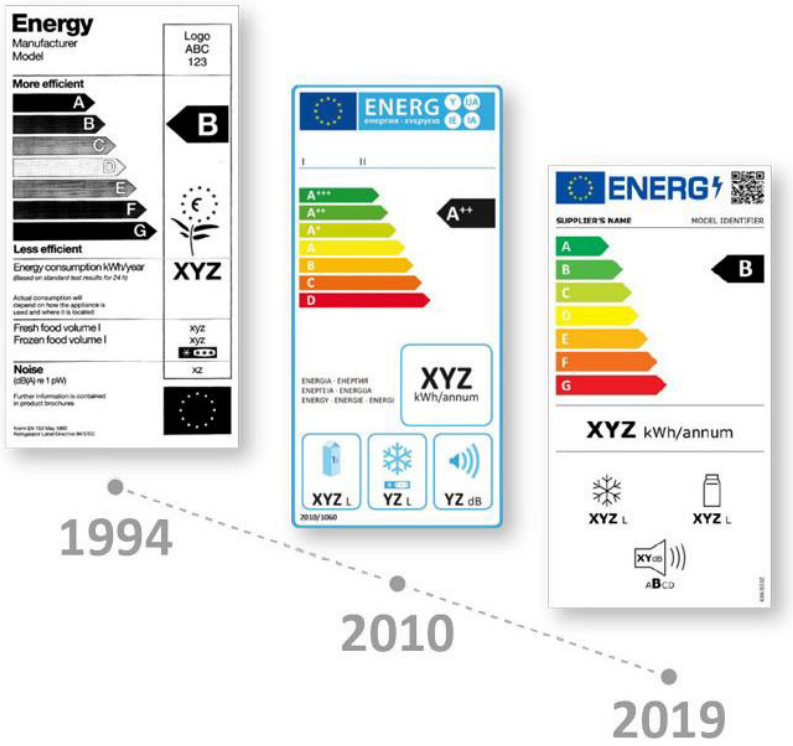


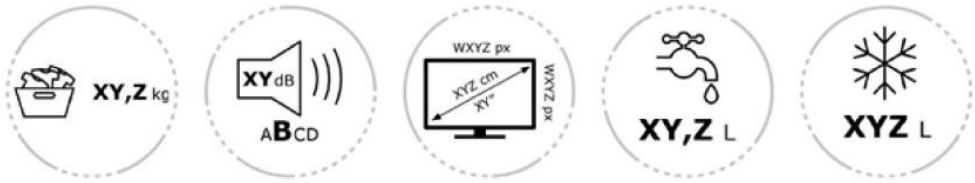
Figure 3: Evolution of EU Energy Labels: An Example for Refrigerators

(**Source:** ECA, 2020, p.9)

A mandatory registration procedure for the suppliers was implemented in this new labelling system. Before placing a unit of the energy-efficient appliance on the EU market, suppliers (manufacturers, importers, or authorized representatives) have to register the information of the product in the European Product Registry for Energy Labelling (EPREL).

Moreover, the third generation of labels became more user-friendly. It introduced the requirement to include a QR code. By scanning the QR code on the label, consumers can access the public interface of the EPREL database and get more information about the product's energy consumption and performance parameters.

Even though the label's primary focus is energy efficiency, the labels also include product specifications and comparative parameters on environmental performance. Figure 4 shows some of the pictograms on the label, such as (a) washing capacity of washing machines, (b) noise emissions, (c) dimensions of electronic displays, (d) water consumption, and (e) freezing capacity for refrigerating appliances.



(a) (b) (c) (d) (e)

Figure 4: Some Pictograms on Energy Labels

(**Source:** ECA, 2020, p.11)

2.3.4. Implementation Measures, Voluntary Agreements and Harmonised Standards

While the Ecodesign Directive and the Energy Labeling Framework Regulation establish the general principles of ecodesign and energy labelling, the design requirements are specified in secondary legislation known as implementation measures. These requirements for energy-related products are classified as generic and specific requirements as follows:

Generic ecodesign requirements are based on the ecological profile of the product and provided in the form of product information without setting any limit values for the particular environmental aspects (European Commission, 2009). Such requirements include the obligation that the mercury content of a product be specified on the packaging, as well as information to consumers about how to use a product in an energy-efficient manner.

Specific ecodesign requirements are quantified and measurable ecodesign requirements relating to particular environmental aspects of a product, such as energy consumption during use, calculated for a given unit of output performance (European Commission, 2009). These parameters are relatively simple to understand, though measuring them can be complicated in practice.

In addition to generic and specific ecodesign requirements, implementation measures also include the following requirements:

- Details of conformity assessment procedures (measurement and calculation methods and contents of technical documentation)

- Verification procedure for market surveillance
- Anti-circumvention measures
- Benchmarks
- Responsibilities of suppliers and dealers
- Content of energy label and energy efficiency classes, if applicable

Table 1 shows the number of implementation measures for each product group, classified by the European Commission's web page[4]. As of 2022, implementation measures cover fourteen product groups, including consumer and professional products, while energy labelling requirements only cover eight of them, namely lighting equipment, heaters, refrigeration, washing machines and dryers, air conditioners and fans, electronic displays and TV boxes, kitchen appliances, and tyres (European Commission, 2022).

In addition to product-specific implementation measures, there is also one horizontal implementation measure for the ecodesign. It includes the essential requirements regarding the power consumption of electrical and electronic equipment in the off mode and standby mode.

Moreover, besides the mandatory implementation measures on ecodesign and energy labelling, there are voluntary agreements for some products like game consoles, imaging equipment and complex set-top boxes. The industry proposes these agreements as an alternative to ecodesign requirements. Through self-regulation as voluntary agreements, manufacturers can achieve ecodesign goals more quickly or at a lower cost.

[4] https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/energy-efficient-products_en

Table 1: Number of Implementation Measures by Product Groups

(**Source:** European Commission, 2022)

Product Group	Ecodesign	Energy Labelling
Lighting equipment	1	1
Heaters	6	4
Refrigeration	3	3
Vacuum cleaners	1	-
Washing machines and dryers	2	2
Air conditioners and fans	3	2
Electronic displays and TV boxes	2	1
Kitchen appliances	2	2
Pumps	2	-
Transformers and converters	2	-
Computers and servers	2	-
Electric motors	1	-
Tyres	-	1
Welding equipment	1	-

Harmonized standards are complementary to obtain an assumption of conformity with the requirements of implementing measures. These standards are developed by standardization organizations on the European level, such as European Committee for Standardization (CEN), European Committee for Electrotechnical Standardization (CENELEC), and European Telecommunications Standards Institute (ESTI). The objective of these standards is to determine the essentials of test procedures and calculations highlighted in implementation measures (e.g. energy efficiency index, water and electricity consumption). The standards' content comprises highly technical details, which closes the possible loopholes in the implementation measures. As codified knowledge, these standards also provide guidance for designers on how to measure and interpret ecodesign parameters in the design phase of the products.

2.3.5. CE Marking & Conformity Assessment of Ecodesign

CE marking is perceived to be one of the most frequently mentioned product safety labels for both consumers and market surveillance authorities (Cetik, 2011). However, it is more than just a product safety mark since the Ecodesign Directive and RoHS Directive were included in the CE marking prerequisites.

The products in the scope of the Ecodesign Directive should comply with the related implementation measures to obtain CE marking, which is the prerequisite for placing on the products in the EU market, Turkey as well. Additionally, the manufacturers must complete the conformity assessment procedures to affix CE marking on the products.

For the conformity assessment of energy-related products, namely Module A, the manufacturers can self-declare that the product satisfies the relevant requirements of the applicable implementing measure. Also, there is no obligation for authorized bodies for conformity tests. These tests can be performed by the manufacturer or by a conformity assessment body of the manufacturer's choice. After preparation of the technical documentation, they can affix the CE marking themselves.

2.4. Ecodesign and Innovation

2.4.1. Role of Regulations and Standards

Product regulations are considered a significant promoter of free trade at the global level as an indicator of interoperability with products and systems. Compliance with regulations and product standards is a prerequisite for the commercialization of products. No matter how high-performance and high-quality a product is, it will not be accepted by the market unless it complies with the compulsory rules and procedures. Therefore, by certifying their products, manufacturers show potential customers that their products meet the essential health, safety, and environment requirements.

Technical documents such as standards and regulations also contain highly codified knowledge (Xie et al., 2016), structured methods and reliable open data, to speed up for innovation. Even though the Frascati Manual does not consider standardization

among R&D activities (OECD, 2015), standards are considered sources of know-how and accelerators for the diffusion of innovation. Nonetheless, the importance of the role of standards and regulations on innovation has been argued in many studies.

According to Blind (2009), product and service standards may have an inhibitory impact on competition and innovation in the short term but have the opposite effect in the long run. Allen & Sriram (2000) also state the relationship between standards and innovation reveals both positive and negative impacts on each other, whether directly or indirectly. In general, they argue that even if standards are considered to have a limiting impact on innovation, the benefits of product innovation outweigh these limitations on creativity. In summary, high thresholds and regulatory restrictions could negatively affect innovation in the short term. If the requirements are too strict, R&D risks increase and discourage the firms from introducing radical innovations. On the other hand, regulations and standards also have the potential that accelerates knowledge transfer and expands innovation capacity. In the long term, regulations and standards shape the routines of firms, and they direct the firms' activity toward emerging technologies and potential markets by increasing R&D expenditure, resulting in higher levels of innovation.

Regarding innovation systems, regulations and standards play an essential role in the diffusion of knowledge. According to the first scholars who introduced the term “system of innovation” (Lundvall, 1992; Freeman, 1995; Edquist, 1997), innovation is not linked solely to technological developments but also social, political and economic influences among organizations. In this concept, the relation of individuals, groups, and organizations influences all innovation-related activities. The rules and procedures, also defined as institutions, regulate the relationship between the organizations in the innovation systems.

Since the product regulations and standards determine the essential requirements and accelerate the codification of knowledge, they can be considered one of the key factors in innovation systems.

Regulations also have a signalling effect on companies' R&D strategies. For some regulations, it may take many years between the preparation of the draft and its enactment. Before the restrictive legislation was officially published, the draft regulations were presented to receive the comments of all stakeholders. Considering the time elapsed between the design and commercialization of products, this process is very important for the future strategies of companies. On the other hand, the long legislative process can reduce the signalling effect. The technology in a published regulation lags behind the market and may not be able to meet its needs. Wimmer et al. (2010) criticized this procedure by giving an example of the RoHS Directive. The time elapsed between the draft preparation and the Directive's entry into force took ten years.

Following international platforms like CEN and ISO can help following new trajectories before competitors. Industry associations and manufacturers' organizations are excellent resources for analyzing trends in upcoming legislation (Wimmer et al., 2010); therefore, the companies need appropriate skills and human resources to acquire knowledge and follow trends.

From this point of view, regulations and standards are considered as effective policy tools in which the government is a facilitator role in innovation policies. As a demand-side policy design, regulations and standards influence innovation both directly and indirectly. Implementation of general rules by public authorities affects the routines and framework conditions of economic actors indirectly. However, product-related regulations and standards can have a direct influence on demand for innovative goods and services by affecting the performance or consequences of products or services (OECD, 2011).

According to Stoneman & Diederen (1994), the creation of technical requirements by governments is considered a policy option to eliminate the uncertainty of R&D activities. No matter how excellent a product may be, it is prohibited from the market unless it conforms to all applicable rules and standards. Therefore, compliance with the standards mitigates the concerns about the commercialization of new products and

minimizes underinvestment problem in R&D. It also provides an opportunity for manufacturers to create long-term plans about product design.

2.4.2. Ecodesign as Technological Trajectory

Dosi (1982) explains the technological trajectory as a pattern of problem-solving activity on certain technology principles. From this perspective, sustainability issues can be accepted as a new technological trajectory for the design process of the products. Such trajectories and paradigms accelerate the emergence of regulations on the sustainability of products, like the Ecodesign Directive, as institutions in the innovation system. On the other hand, these regulations enable all stakeholders to focus on innovation activities based on this technological trajectory.

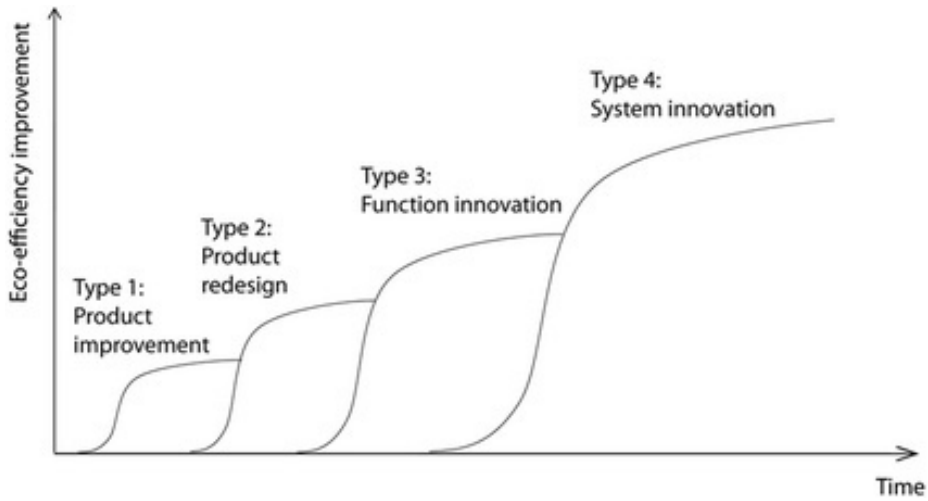


Figure 5: Brezet's Model on Eco-Efficiency and Innovation Level

(**Source:** Brezet, 1997)

Regarding the fundamentals of the circular economy, manufacturers strive for a balance between environmental impact and product performance. Different levels of innovation, such as incremental and radical innovations, can help attain this equilibrium. In fact, there are studies in the literature that link the level of innovations with environmental efficiency. Brezet's model explains improvements in eco-efficiency in four subsequent levels of innovation as shown in Figure 5: (i) product improvement, (ii) product redesign, (iii) function innovation, and (iv) system innovation (Brezet, 1997).

While product regulations mainly focus on product improvements and product redesign, they rarely accelerate radical changes like function and system innovations. For instance, the design of televisions has evolved over years. For television tubes, type of coolant was changed as product improvement, later a functional innovation was realized by replacing television tubes with LED monitors.

The effect of Ecodesign Directive can be associated to Brezet's approach. As the regulations get stricter, the manufacturers have to switch to function or system innovation rather than minor improvements on the environmental performance or redesign of the products. Moreover, energy labelling requirements, together with the Ecodesign Directive, have a complementary effect on industry attitudes on product innovation. The push and pull dynamics of regulations on companies are detailed in the following section.

2.4.3. Innovation Dynamics: Technology Push and Market Pull

Ecodesign and energy labelling regulations interact with each other in a push and pull dynamic. While the Ecodesign Directive sets the minimum performance thresholds by the implementation measures for the products, energy labelling requirements, which have been critical for consumer products, influence the consumer decisions at the point of sale.

Figure 6 explains this push and pull dynamic for three circumstances: (i) no measures for ecodesign and energy labelling, (ii) only ecodesign requirements, and (iii) a combination of ecodesign and energy labelling requirements (European Commission, 2019).

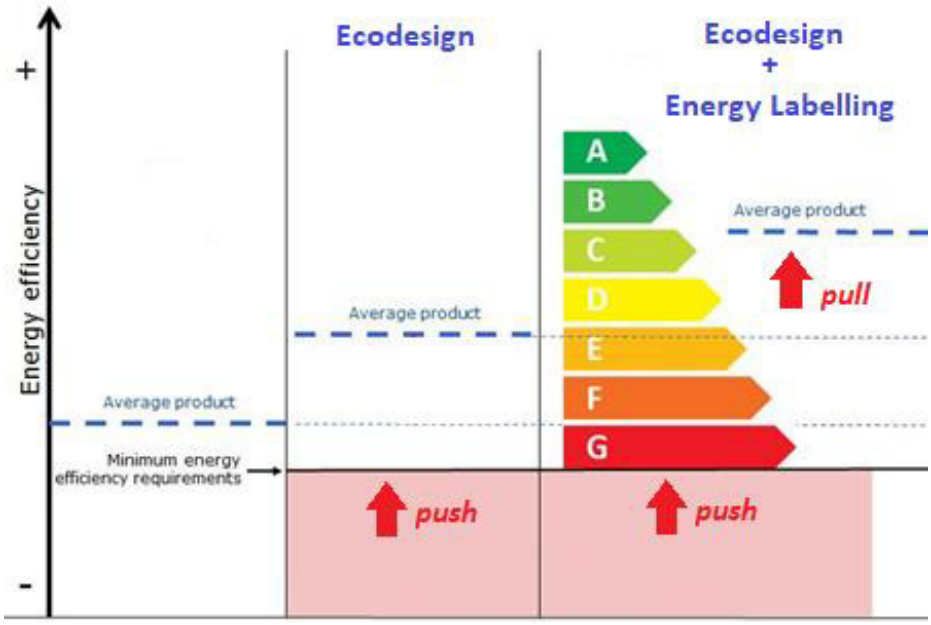


Figure 6: Push & Pull Dynamic of Ecodesign and Energy Labelling Measures

(**Source:** European Commission, 2019)

In the first case, where there are no requirements, the energy efficiency of average products is lowest compared to the other two situations.

In the second instance, the average energy efficiency rises thanks to MEPS ecodesign implementation measures and the products under the thresholds are kicked out of the market. For example, the IE1 efficiency class of electric motors or domestic ovens with an energy class below the "A" level are prohibited to be placed on the market. If a product does not meet such requirements under the Ecodesign Directive, the CE mark cannot be affixed to the product. Such restrictions forced laggard manufacturers to invest in R&D to develop products above the energy and performance threshold. This explains the technology push or regulatory push effect of the Ecodesign Directive.

On the other hand, the energy labelling scheme has a market pulling effect, allowing consumers to compare the energy consumption and environmental performance of products. The energy label classifies products from A to G based on their efficiency level, guiding customers to make choices, and driving market demand towards more energy-efficient products. Consequently, in the third situation, when ecodesign and energy labeling regulations are combined, the energy efficiency is significantly

increased and it can be concluded that it is a result of product innovation (Egenhofer et al., 2018).

In one study on push-pull dynamics, these interactions were considered as a determinant of resource efficiency (Bundgaard et al., 2017). While they draw attention to the complexity of resource efficiency in product design, they also emphasize the guidance provided to firms through regulations.

2.4.4. Recent Studies on Ecodesign and Energy Labelling

In recent years, studies on Ecodesign and Energy Labelling legislation in the literature mainly examine the economic and environmental impact of regulations and their interaction with product policies. Despite the fact that consumer and environmental protection are the primary goals of legislation, these requirements naturally foster innovation and competitiveness. Indeed, in literature, it is found that Ecodesign and Energy Labelling regulations have the potential to stimulate innovation activities (O'Rafferty, 2012; Larsen, 2015; Sihvonen, 2019; Salo et al., 2020). Moreover, the requirements of these regulations are viewed as a public intervention aimed at promoting R&D and innovation efforts while also promoting sustainability.

Dalhammar et al. (2021) liken industry attitudes towards the Ecodesign Directive to the S-shaped curve in the diffusion of innovation. While the innovators and early adopters in the S-shape curve play an essential role in creating regulations, the laggards take action only when these regulations become mandatory requirements for the market (Dalhammar et al., 2021). In another of his works, he includes critics about ecodesign implementation measures pose a double regulation risk that creates a burden for the manufacturer.

Machacek's research (2012) is one of the significant studies investigating the relationship between ecodesign and innovation. Her study examines the possible contributions of the Ecodesign Directive to resource-efficient innovations with a qualitative approach. She discusses the limitations and the pushing effect of the Ecodesign Directive, which removes the worst performing products from the market. The analysis reveals that Ecodesign and Energy label regulations are driving

innovation. She also emphasizes the economic benefits of resource efficiency and, indirectly, ecodesign. At the firm level, innovation leads to higher company profitability and competitiveness, which are related to increased resource efficiency in this study. On the other hand, from a macroeconomic perspective, the advantages of ecodesign are linked to the creation of new employment and contribution to the security of resource supply (Machacek, 2012).

Conversely, there are also counter-arguments that ecodesign requirements affect innovation negatively. In some studies examining the effect of ecodesign on innovation (Dalhammar, 2014; Egenhofer et al., 2018), these views are also included. It has been stated that the wide range of products covered by the Ecodesign Directive may cause a double regulation problem that causes extra burdens and costs for manufacturers and hinders innovation. Some products and their components may be subject to separate ecodesign measures, which makes double regulation for the components of the final products—for example, electric motors integrated within washing machines and circulators used in combi-boilers.

One of the recent studies on ecodesign at the regional and sectoral level is Salo et al.'s research based on survey questions. The research examines how the companies in the Scandinavian textile and information technology industries approach ecodesign. As stated in this study, the critical challenges with promoting ecodesign are about both supply and demand side of the market: higher costs for manufacturers, lack of consumer demand, lack of alternatives for product design, and limited awareness of ecodesign. The top three reasons for organizations to embrace ecodesign, according to the report, are public demand, legal obligations, and consumer requests (Salo et al., 2020).

In general, qualitative methods were used to examine industry attitudes and regulatory effect of Ecodesign and Energy Labelling legislation. In spite of this, many quantitative studies can be found in the literature.

Laruccia & Garcia’s (2015) study examines the ecodesign practices of companies through a quantitative survey. This study analyzes the attitudes of companies in

various steps in the circular economy, such as material selection in production, durability, modularity and multifunctionality of products, packaging of products, and use of renewable resources in production. According to the study's findings, using ecodesign principles helps manufacturers to boost their operating profits by consuming less energy and material. Additionally, the companies improve their social image by demonstrating their concern for environmental issues.

As a result of qualitative and quantitative research findings, policymakers have begun to handle product policies holistically. Several studies (Machacek, 2012; Polverini & Miretti, 2019) in the field of Ecodesign Directive analysis the technical feasibility of legal requirements in various sectors and product groups.

Drawing on the EU's observations, several studies, both national and pan-European (Dalhammar, 2015; Zygierewicz, 2017) show that countries such as Austria, Denmark, Germany, the Netherlands and Sweden are the frontiers in the implementation of ecodesign and energy labelling (Santolaria et al., 2011; Dalhammar, 2015; Bundgaard, 2016).

Wimmer et al. (2010) categorized government interventions in the environmental design of products into three approaches:

- Improvement by competition: The best performing product becomes the standard after certain years. In this system, non-efficient products are phased out. Government intervention is limited for this option.
- Performance classification: The main purpose of this approach is to regulate the demand side of the market. It aims to increase the average product level with the effect of attracting the market by comparing the products among each other. The energy label scheme can be evaluated in this context.
- Direct intervention: It is the approach in which the public directly imposes restrictive rules and intervention is the most effective. Considering the minimum energy performance standards and specific requirements in the ecodesign implementing measures, the Ecodesign Directive can be classified in this category.

Wimmer et al. (2010) also emphasized that these types of government interventions are considered innovation drivers. The inadequacy of old technologies in environmental improvement can lead to innovation jumps and the emergence of new technologies. This cause and effect relation is explained with an example of washing machines in the study. After long years of incremental innovations in washing machines, the best environmental performance is almost reached for them. Consequently, while innovation in washing fluids, materials or technologies is required for better performance and lower costs, companies are looking for alternative solutions such as washing with liquid carbon dioxide.

In this regard, Ecodesign and Energy Labelling legislation can be viewed as significant government intervention in product development. There have also been some studies on the interactions and similarities of these regulations. Cetik's (2011) study explains the similarities in standardization, conformity assessment, and market surveillance between CE marking and environmental labelling schemes. His research predicted that the EU Energy Label and EU Ecolabel would converge to the CE marking in terms of legislative processes and implementation.

The Ecodesign Directive and the Energy Labeling Framework Regulation have been in force in Turkey for over ten years. Even so the studies of Gürakar's (2008) and Bereketli's (2013) can be examined to analyze the situation of the ecodesign from the perspective of a designer; however, considering the literature regarding Turkish industry, there is not a comprehensive study on industry attitude on Ecodesign and Energy Labelling legislation. From this point of view, one of the aims of this thesis is to contribute to the literature regarding to industry and its compliance with these requirements.

CHAPTER 3

ECODESIGN AND ENERGY LABELLING IN TURKEY

This chapter explains the ecodesign-related product policies in Turkey. The legislative framework of ecodesign energy labelling measures and the role of these regulations in main policy papers are discussed.

3.1. Legislative Framework in Turkey

3.1.1. Customs Union Agreement and Product Regulations

The Customs Union Agreement provides the legal baseline of the product regulations in Turkey. The Customs Union was established in 1995 by Decision 1/95 of the EU-Turkey Association Council. It makes the free movement of the products between Turkey and the EU possible by eliminating technical barriers at the EU-Turkey border on all manufactured goods and processed agricultural products (European Commission, 2016). This status of Turkey requires harmonisation the EU's technical legislation in all elements of quality infrastructure as standardization, conformity assessment, accreditation, market surveillance, and CE marking requirements.

In the field of conformity assessment in 2006, Turkey and the EU further agreed on recognition of Turkish notified bodies and the certificates they issued.

Turkish authorities have become part of EU organizations in the accreditation and standardization area. In 2004, the Turkish Accreditation Agency (TÜRKAK) became a full member of the European Accreditation Association (EA) in the field of mutual recognition in accreditation services. In 2012, the Turkish Standards Institution (TSE) status in CEN and CENELEC was also upgraded to full membership.

Regarding harmonisation in product regulations, the framework of sectoral adoptions and legislation list is determined in Decision 2/97 of the EU-Turkey Association Council. According to the Decision, in tandem with the transposition of the legislation in the Decision, including new approach directives, old approach directives and non-harmonised areas, Turkey would have the same rights and obligations as the EU Member States (Sarbay, 2012).

The traditional (old) approach to product legislation aims to include all the technical and administrative requirements of the product in the content of product regulations. Legal metrology, automotive type-approval legislation and food legislation are examples of this approach. However, new approach on product legislation has a more straightforward methodology in a regulatory framework. The regulations in the scope of the new approach are limited to the essential requirements of the product placed on the market (i.e. Machinery Directive, Ecodesign Directive, Low Voltage Directive etc.). The technical specifications for these requirements are laid down in harmonised standards (European Commission, 2016).

The EU's new legislative framework based on the new approach aims to raise the quality of market surveillance and conformity assessment. Additionally, it sets a common terminology and legislative procedures for product regulations and it clarifies the application of CE certification (European Commission, 2016).

3.1.2. The Turkish Legislation on Ecodesign and Energy Labelling

The Ecodesign Directive, among the new approach directives in the EU, is one of the essential regulations on CE marking. If a product is within the scope of the Ecodesign Directive, it must meet the requirements in the ecodesign implementation measures to affix the CE marking. Unlike ecodesign implementation measures, energy labelling requirements do not include conformity assessment and CE marking provisions.

Product groups within the ecodesign and energy labelling scope are expanding with new implementation measures while existing implementation measures are updated periodically.

Ecodesign and energy labelling framework regulations are fully aligned in the product legislation system in Turkey. Regarding the secondary legislation, Turkey has transposed almost all implementing measures related to ecodesign and energy labelling. Table 2 shows the harmonisation status of implementation measures in Turkey by product groups, in comparison with the EU. In order to compare the harmonisation level of legislation on ecodesign and energy labelling, each implementation measure on the European Commission's list (European Commission, n.d.) was scanned from the Turkish Official Journal. All implementation measures were classified into 15 product groups, one of which is the horizontally themed regulating the standby energy consumption of electronic products. Two of the 15 product groups, heaters and transformations, have not been fully transposed yet.

Harmonization length may differ from one industry to another. While harmonising of implementation measures in Turkey for the white goods industry takes around less than two years or done concurrently with the EU, it can be completed in much more time in the machinery sector. For example, it can be seen from Table 2 that the harmonization duration of industrial fans was eight years, while it took one year for cooking appliances.

Moreover, it is possible to conclude that the speed of harmonisation process has increased in recent years. More than half of the implementation measures were harmonised between the period 2019 and 2021. Among these, there are both the product groups for which implementation measures were being published for the first time and the product groups for which implementation measures have been updated.

Table 2: List of Implementation Measures and Harmonisation Status in Turkey[5]

Product Group	Description of products	Ecodesign	Energy Labelling	Status in Turkey
Lighting	Lighting equipment, including LED lamps and control gears	EU 2019/2020	EU 2019/2015	Harmonised in 2021
Heaters	Local space heaters	EU 2015/1188	EU 2015/1186	Not harmonised
	Solid fuel local space heaters	EU 2015/1185	-	Not harmonised
	Water heaters	EU 814/2013	EU 812/2013	Harmonised in 2018
	Space and combination heaters	EU 813/2013	EU 811/2013	Harmonised in 2018
	Solid fuel boilers	EU 2015/1187	EU 2015/1187	Not harmonised
	Air heating and cooling products	EU 2016 /2281	-	Harmonised in 2021
Refrigeration	Fridges and freezers	EU 2019/2019	EU 2019/2016	Harmonised in 2021
	Professional refrigeration	EU 2015/1095	EU 2015/1094	Harmonised in 2020
	Refrigeration with a direct sales function	EU 2019/2024	EU 2019/2018	Harmonised in 2021
Vacuum cleaners	Vacuum cleaners	EU 666/2013	-	Harmonised in 2015
Washing machines & driers	Washing machines and washer-dryers	EU 2019/2023	EU 2019/2014	Harmonised in 2021
	Tumble driers	EU 932/2012	EU 392/2012	Harmonised in 2013

[5] Regulation numbers represent the most updated version of implementation measure as of the April 6, 2022.

Table 2 (Continued)

Product Group	Description of products	Ecodesign	Energy Labelling	Status in Turkey
Air conditioners and fans	Air conditioners and comfort fans	EU 206/2012	EU 626/2011	Harmonised in 2013
	Industrial fans	EU 327/2011	-	Harmonised in 2019
	Ventilation units	EU 1253/2014	EU 1254/2014	Harmonised in 2021
Electronic displays and TV boxes	Electronic displays, including televisions	EU 2019/2021	EU 2019/2013	Harmonised in 2021
	Set-top boxes	EC 107/2009	-	Harmonised in 2011
Kitchen appliances	Cooking appliances	EU 66/2014	EU 65/2014	Harmonised in 2015
	Dishwashers	EU 2019/2022	EU 2019/2017	Harmonised in 2021
Pumps	Water pumps	EU 547/2012	-	Harmonised in 2015
	Circulators	EC 641/2009	-	Harmonised in 2011
Transformers and converters	Power transformers	EU 2019/1783	-	Not harmonised
	External power suppliers	EU 2019/1782	-	Harmonised in 2020
Computers and servers	Computers and servers	EU 617/2013		Harmonised in 2021
	Servers and data storage products	EU 2019/424	-	Harmonised in 2021
Electric motors	Electric motors and variable speed drivers	EU 2019/1781	-	Harmonised in 2021
Tyres	Tyres	-	EU 2020/740	Harmonised in 2021
Off mode, standby and networked standby	Off mode, standby and networked standby	EU 1275/2008	-	Harmonised in 2021
Welding equipment	Welding equipment	EU 2019/1784	-	Harmonised in 2021

3.2. Ecodesign in Policy Papers

Ecodesign and energy labelling legislation create a horizontal framework for product design and is frequently emphasized in major policy papers. In this part of this study, it is discussed how the ecodesign and energy labelling concepts are stated in the following major policy documents in Turkey:

- Turkey's National Action Plan for the EU Accession
- National Energy Efficiency Action Plan
- Green Deal Action Plan
- 11th Development Plan

3.2.1. Turkey's National Action Plan for the EU Accession

The Action Plan covers between 2021-2023, and includes the legal agreements and administrative measures that will be enacted in order to harmonise with the EU acquis in 32 chapters in Turkey's EU accession negotiation. The legislation regarding the Ecodesign and Energy Labelling are subjected in two chapters in the Action Plan: (i) free movements of goods and (ii) energy (Ministry of Foreign Affairs, 2020). The Action Plan envisages the full alignment of the EU's existing implementing measures on Ecodesign and Energy Labelling until the end of 2023.

3.2.2. National Energy Efficiency Action Plan

National Energy Efficiency Action Plan has determined the actions for achieving Turkey's energy efficiency targets between 2017 and 2023. The actions classified 55 actions into six categories: buildings and services, energy, transport, industry and technology, agriculture and horizontal areas (Ministry of Energy and National Resources, 2017).

The three actions classed as energy and industry-technology are closely connected to ecodesign and energy labelling:

- Setting minimum energy performance standard (MEPS) for transformers by the harmonisation related to implementing measures (Energy Sector, Action E5)

- Promoting energy efficiency in the industry by applying the most up-to-date ecodesign regulation in electric motors (Industry and Technology Sector, Action S4)
- Implementing MEPS and 3rd generation labelling system in household appliances (Industry and Technology Sector, Action S4)

3.2.3. Green Deal Action Plan

The European Green Deal, which tackles environmental problems and climate change from a larger perspective, aims to achieve the EU's zero greenhouse gas emissions target in 2050. In addition to reducing emissions with high-level policy measures, the Green Deal also emphasizes creating new jobs and improving the quality of life.

Turkey's approach to compliance with the regulations and policy principles under the European Green Deal announced a national action plan in 2021. The Green Deal Action Plan aims to create the national compliance roadmap of Turkey on European Green Deal in the following areas:

- Carbon border adjustments
- Green and circular economy
- Green finance
- Clean, affordable & secure energy supply
- Sustainable agriculture
- Sustainable smart mobility
- Combating climate change
- Diplomacy
- Dissemination and awareness activities

By the alignment of the regulations and principles of the European Green Deal, actions in the Plan will contribute to Turkey's transition to resource efficiency and a sustainable economy. Under the green and circular economy chapter, two actions address the ecodesign and energy labelling (Ministry of Trade, 2021):

- Strengthening the regulatory framework that will support the green and circular economy by harmonisation with the Sustainable Product Legislation, EU

Chemicals Legislation, Ecodesign, and Energy Labelling Legislation to be implemented by the EU.

- Following the announcement of the Sustainable Product Initiative, the EU legal framework and sectoral strategies in this context, sectoral information activities will be carried out together with the legislative harmonisation studies.

3.2.4. 11th Development Plan

Policy targets regarding the sustainable product legislation are included in the 11th Development Plan covering the years 2019 – 2023[6]. Regarding the ecodesign and energy labelling, completion of the transposition of the EU's new generation energy label legislation in the white goods sector and rising awareness among the manufacturing industry about the energy efficiency of electric motors were aimed at two separate policy targets:

- Action 379.2.: *"In the domestic appliances sector, the need for additional investments due to product designs that comply with the new ecodesign and the new energy label regulation, which will take effect on 1 March 2021 in the EU, which is the main export market of the sector, will be supported within the scope of investment incentives."*
- Action 380.2.: *"Awareness will be raised on efficiency improvement potential by applying energy labels on the electrical motors used in industrial plants."*

[6] https://www.sbb.gov.tr/kalkinma-planlari/

CHAPTER 4

RESEARCH METHODOLOGY

This chapter provides an overview of the methodology of the study. Details of the research methodology like data collection methods, interview structure and target groups are also described.

4.1. Data Collection

Oslo Manual (2018), the international reference guide for collecting and interpreting data on innovation, explains that there are a variety of approaches, both qualitative (case studies, interviews etc.) and quantitative approaches (R&D expenditures, IP statistics etc.) to measure innovation activities and their impacts. (OECD, 2018). For analyzing the innovation effect of product legislation, a variety of these approaches can be applied, either quantitative or qualitative or a combination of both.

As seen in the literature review in Chapter 2, most studies on the impact of regulations on industries consist of qualitative methods. Among these methods, interview-based studies are considered an adequate tool to determine the innovation impact of product regulations. (Braungardt et al., 2014). While there is no standard survey or interview method for this approach, semi-conducted interviews can be the most common methodology for collecting and evaluating the views of different target groups.

A qualitative research strategy was chosen for this thesis, which evaluates the attitude of the sectors towards ecodesign and energy labelling regulations. It is aimed to provide information through semi-structured interviews with stakeholders. Nevertheless, quantitative data such as market surveillance results and patent statistics

were used as a secondary method to analyze the current situation of the different industries.

4.2. Interviews

Considering the diversity of target groups and sectoral differences, semi-structured interviews consisting of open-ended questions were preferred for data collection. At the same time, this method creates a chance for both the researcher and the interviewee to go deeper into a particular topic. The interviews were conducted on the basis of question sets prepared for three different target groups. The collected data were analyzed in line with the classification of the question sets: R&D and innovation, regulatory effect, and sustainability.

4.2.1. Target Groups

The diversity of stakeholders in ecodesign and energy labelling has revealed the need to categorize the interviews' structure and outputs according to the interviewees' profiles. Accordingly, the interviewers were classified into three groups, and a separate set of questions was designed for each target group. A brief description of the target groups is shown in Table 3.

The first target group, called TG1, consists of the professionals in product compliance, quality and R&D departments in manufacturers. In selecting these interviewers, their experience in the sectors related to ecodesign and energy labelling and their past work in this field was taken into account. In order to receive general observations and comments about the sectors, these people were chosen from professionals working in industry associations, leading companies of the sector, as well as SMEs.

Table 3: Target Groups of Interviewees

Target Group	Profile
TG1	Industry representatives in product compliance, quality and R&D departments
TG2	Professionals from trade organizations and NGOs
TG3	Policy officers

The second target group, TG2, forms of representatives from trade organizations, international organizations and NGOs. It is aimed to receive comments from the

interviewers in this group from a macro perspective rather than technical details. This group consists of people with both industry experience and policy experience.

Another target group, TG3, comprises the policy officers dealing with regulatory compliance and product policies, especially on energy efficiency and the environment. These people, who are the implementers of the legislation and who contribute to the preparation of public policies related to ecodesign, work closely with manufacturers and have the potential to give ideas about public policies.

4.2.2. Question Sets

The open-ended questions was created and listed for semi-structured interviews. This list of questions formed the baseline of the interview and it served as a guide. As Leech (2002) and Adams (2015) suggested, these questions were frequently followed by why or how questions. The subsequent questions varied according to the interviewee's background or the interview flow.

Interview questions were basically classified into two parts. While the first part of the question list contains common questions that all target groups can answer, the question list follows with target group-specific questions. As shown in Figure 7, the question sets were prepared based on three main dimensions of ecodesign and energy labelling regulations: (i) R&D and innovation, (ii) regulatory effect, and (iii) sustainability.

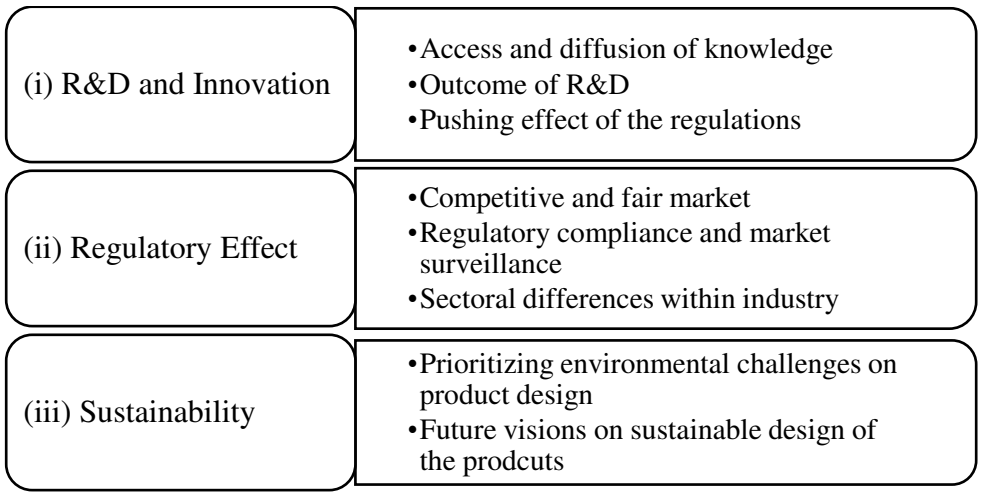


Figure 7: Categorization of Question Themes

In questions about R&D and innovation, manufacturers' approaches to ecodesign and energy labelling regulations were tried to be understood. Regulations can be seen as

an opportunity to design new products and expand into new markets. On the other hand, regulatory requirements may increase production costs by creating additional burdens for producers. Therefore, it was intended to understand whether manufacturers had a favourable or unfavourable opinion of the regulations.

Regulatory impact is one of the key elements of product legislation. To establish a competitive and fair market, the regulatory compliance on the Ecodesign and Energy Labelling legislation, which includes restrictions and minimum requirements for the design of products, is crucial for the whole market. In all the interviews, the factors affecting the compliance issues and what measures can be taken to address the problems were asked.

In questions about sustainability, the aim was to interpret the concept of sustainability in the design of products and to get sectoral predictions from the participants on the future of ecodesign, especially for the first target group.

Before the interviews, these questions were shared with all participants via e-mail so that they had an idea about the interview and could do the research they needed (provided in Appendices B).

4.2.3. Recording of Interviews

It is also important to get the consent of the interviewers for any type of recordings, such as audio or video. Therefore, at the invitation stage, all participants were notified that the interview could be recorded if they accepted, and permission was obtained orally at the beginning of the interview just before the recording started. In addition, it was also stated that the name of the interviewees and the institutions would be anonymous in the thesis.

All interviewees agreed on the recording of the interviews. Some participants requested to stop recording temporarily while expressing their views on specific issues.

The majority of the interviews were conducted with remote access tools. While four interviews were conducted face-to-face, the rest were carried out as video or audio

calls. Detailed information on the type, format and duration of each interview is given in Table 5 in Chapter 5.

As Gray et al. (2007) state, in addition to face-to-face and phone-intensive meetings, e-mail interview methods provide an inexpensive and fast way for semi-structured interviews. In all interviews, it was stated that participants could send their opinions by e-mail if they wanted to give additional opinions on the subject. Subsequently, two interviewees submitted their additional comments in writing via e-mail after the meeting.

4.2.4. Ethical Issues on Interviews

In the data collection phase of the research, ethical issues are indispensable. No matter what is the content of the study, data collection methods should comply with the ethical codes of academic research. Hence, in order to ensure ethical compliance, the METU Human Research Ethics Committee reviews all research performed by METU staff or students that need information from human subjects.

An application, including the study's content and the semi-structured interview questions, was submitted to the METU Human Research Ethics Committee prior to the interviews in this study. On March 14, 2022, the METU Human Research Ethics Committee approved protocol number 0167-METUIAEK-2022 prior to the interviews being conducted (Appendices A).

4.3. Quantitative Research

In addition to the information obtained from the interviews, quantitative data were also employed in the study as a supplementary data source. The quantitative data in this thesis have been gathered from market surveillance reports and patent statistics.

The market surveillance statistics given in Chapter 5 consist of annual data published publicly on the website of the Ministry of Trade. Among the annual data, ecodesign and energy labelling and other technical regulations related to the products (Machinery Directive, Low Voltage Directive, Type Approval Regulations) were evaluated comparatively. Additionally, products that have been sanctioned for violating Ecodesign and Energy Labelling legislation were categorized.

In order to examine the effects of the Ecodesign and Energy Labeling legislation on the innovation activities for various sectors, the number of patent applications in the field of intellectual property rights was evaluated. This was performed using patent statistics published by the Turkish Patent and Trademark Office (TÜRKPATENT). The patent applications issued since 2010, when Turkey began implementing the Ecodesign Directive, have been compared for the industries that may be impacted by the Ecodesign and Energy Labeling legislation.

CHAPTER 5

FINDINGS AND DISCUSSION

This section presents the outputs of stakeholder interviews and quantitative data to explain industry attitudes towards Ecodesign and Energy Labelling legislation. Based on the research findings, this chapter also deals with the policy recommendations on the three dimensions of regulation: innovation, fair and competitive market and sustainability.

5.1. Analysis of Interviews

The semi-structured interviews were carried out with three target groups, consisting of fourteen participants in the three months from April to June 2022. Although only a limited number of experts' opinions may be represented by the interviews, it shows the general situation of Turkish industry. Table 4 summarizes the profile of interviewees by sector, position, experience, and target groups. These participants are professionals with more than ten years of experience in ecodesign and energy labelling representing the private sector, public sector and non-government organizations. Furthermore, some of them represent multiple sectors and target groups.

All of the participants in TG1 are managers of the departments related to the quality, regulation and product management of the manufacturers. They are qualified to comment on their sectors such as white goods, consumer electronics, lighting, machinery, heating, ventilation and air conditioning (HVAC), and the tyre industry. A significant part of interviewees in this target group also serves in industry associations. Thus, their contributions comprised both their company's viewpoints and general observations about their respective sectors.

Table 4: Interviewee Profiles

Interview ID	Job Title	TG1						TG2		TG3	Experience (year)
		Lighting	Electronics	Tyre	HVAC	Machinery	White goods	Trade Assoc.	NGO	Public	
1	Policy Officer									*	10-15
2	Product Manager	*	*								10-15
3	Manager			*				*			20-25
4	Regulatory Expert		*		*		*	*			10-15
5	Regulatory Manager		*				*	*			15-20
6	Head of Department									*	15-20
7	Director							*			10-15
8	Product Manager	*						*			15-20
9	Key Expert								*		15-20
10	Consultant								*		15-20
11	Policy Officer									*	15-20
12	R&D Manager				*	*		*			10-15
13	Product Manager					*		*			20-25
14	Policy Officer									*	15-20

TG2 consist of representatives of trade associations and NGOs. Their contributions were often related to the transposition and implementation of regulations. They also shared their observations about the industry's view of regulations and their vision for the future.

The third target group, TG3, were public officers. Participants in this group contributed by associating Ecodesign and Energy Labelling with the government's role in industrial, environmental, and energy efficiency policies.

The overall contribution of each participant is briefly summarized in Table 5. The technical details about the interviews, including date, method, and duration, are also given in this table.

The interviews were mainly conducted through remote access tools. While ten of the fourteen interviews were conducted in the form of video or audio calls, only four interviews were conducted face-to-face. In all interviews, it was stated that participants

could send their opinions by e-mail if they wanted to give additional opinions on the subject. Indeed, two interviewees sent their written follow-up comments through email after the meeting.

The duration of the interviews can be crucial for research. In very short interviews, obtaining sufficient information could be challenging. Similarly, lengthy meetings may be unproductive for the research. In the latter case, there is a risk that the participant's interest will be reduced, and the main points can be skipped over. Therefore, the number of prepared questions and the level of detail sought for each topic were taken into account when determining the length of the interview. It was foreseen to last for 30 to 60 minutes. In the end, as seen in Table 5, the shortest interview lasted 32 minutes, and the longest one took 76 minutes. The average duration of the interviews was approximately 45 minutes. Correspondingly, it can be concluded that the duration was sufficient for gathering information about the research questions.

The overall outputs of the interviews have been explained in four categories:

- Access to knowledge and innovation effects
- Transposition Procedure of the Secondary Legislation
- Regulatory Compliance
- Insights and Expectations on the Future of Ecodesign: Sustainable Product Initiative

5.1.1. Access to Knowledge and Innovation Effect

In general, all interviewees agreed that Ecodesign and Energy Labelling legislation is one of the essential policy instruments for the sustainable design of the products. In terms of the relationship between innovation and these regulations, most participants considered that the regulations positively influenced the innovation behaviour of the industry. The innovative effect of regulations is strong in the dissemination of knowledge and new technologies.

The main obstacles to better implementation of the Ecodesign and Energy Labelling legislation were asked to the participants and the answers are given in Figure 8. Ten of fourteen interviewees expressed the effects of problems on awareness and readiness of economic operators; thus, it was seen as more important impediment compared to

other possible obstacles. In sectors where actors do not have sufficient awareness and technical infrastructure, requirements of new regulations may cause information asymmetry, which is one of the main causes of market failures.

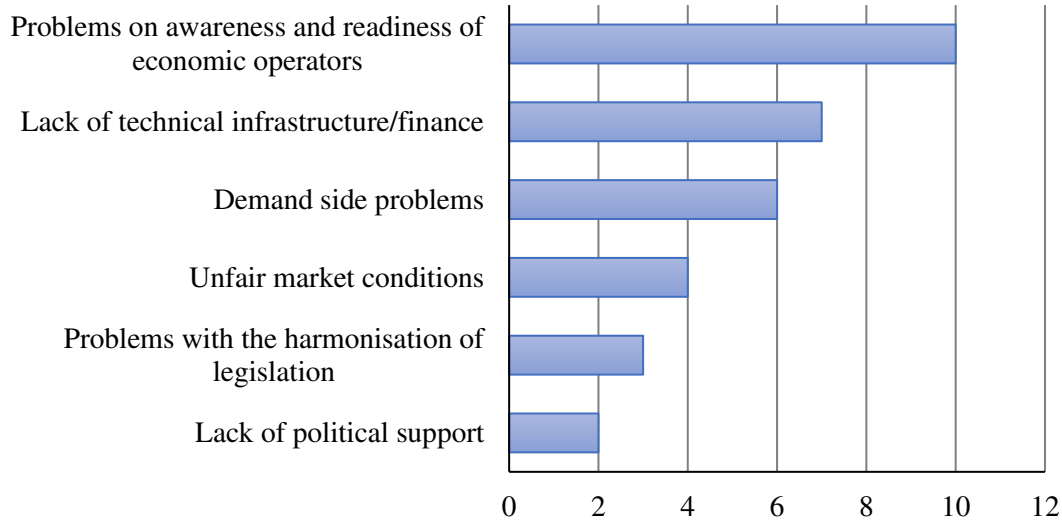


Figure 8: Main Obstacles Perception to Better Implementation of the Regulations

Some participants underlined the technical and financial burdens of complying with the requirements. Although manufacturers access regulations and standards, product compliance requires creation of expertise in addition to R&D investments in design, prototyping, certification and test labs. Participants from lighting industry indicated that, majority of manufacturers in lighting sector prefer to outsource these tasks. However, outsourcing may endanger of creation know-how of manufacturers. Therefore, technical and financial support is needed for regulatory requirements.

Commercialization is another decisive point for the manufacturers' R&D investments. Regulations that are prerequisites for the commercialization of a product include minimum requirements and force manufacturers to comply with them. However, this impact varies by sector and by the size of the manufacturers. Two participants in TG1 expressed that sectors with high export volumes to EU countries have higher levels of awareness because the significance of compliance is understood better when the products are sold in the EU market, which is the core of Ecodesign and Energy Labelling legislation.

In comparison with other sectors, in the white appliances and electronics sectors, where Turkish manufacturers are the frontrunners as the second largest production base after China (TÜRKBESD, 2021), Ecodesign and Energy Labelling legislation was found to be seen as an opportunity for innovation. Interviewees from this sector indicate that Turkish manufacturers actively participate in the preparation stages of the legislative process in the EU.

On the other hand, manufacturers in the machinery and lighting sectors mainly consist of SMEs. It has been stated that awareness of ecodesign and energy labelling legislation is inadequate for some manufacturers, especially in local companies that do not export to the EU or have no global partners. Their technical infrastructure to comply with the regulations is relatively limited. Compliance with regulations is one of the biggest challenges for companies in these sectors. They are having some difficulty meeting the generic Ecodesign requirements due to a general lack of experience with Ecodesign concepts and methodologies. These are frequently related to the selection of parameters for product redesign and the selection of design options that lead to improved product environmental performance. In addition, market surveillance results also support this view. Lighting equipment, electric motors and pumps are among the most sanctioned products in terms of ecodesign requirements.

5.1.2. Transposition Procedure of the Secondary Legislation

The participants often criticize legislative procedures in Turkey. Due to its Customs Union responsibilities, Turkey transposes the EU acquis on Ecodesign and Energy Labeling legislation. Even though the secondary legislation's technical content is identical to that of the EU, no impact assessment is carried out during the secondary legislation's transposition. Thus, policymakers can not evaluate to what degree the regulations affect the industries. Consequently, the lack of impact assessment makes it challenging to design additional policies regarding the implementation of the legislation.

The length of the harmonisation process was another issue underlined by some participants. The majority of TG1 interviewees stated that the late harmonisation of product legislation provides a short-term advantage for SMEs, but, in the long term, it affects negatively. When the rules have not yet entered into force, SMEs do not require

any immediate increases in R&D spending. However, products that fail to meet the new requirements can be easily sent to the Turkish market and this causes hindrance to the long term plans of manufacturers and limits their access to the global market. Furthermore, according to some interviewees, the delay in transposition could hurt the reputation of domestic products because of the disparity in product regulations between the EU and the Turkish market.

5.1.3. Regulatory Compliance

In all three dimensions of the regulations, considering innovation, fair market and sustainability, it was stated by all stakeholders that compliance with the regulations has a significant effect on industry. With non-compliant products on the market, manufacturers are less motivated to innovate, which creates an underinvestment problem. Additionally, insufficient market surveillance can lead to competitiveness issues when products that enter the market do not conform to ecodesign requirements.

According to Egenhofer et al. (2018), 10% to 25% of products on the EU market regulated under the Ecodesign Directive do not comply with its requirements. Similarly, according to market surveillance reports from Turkey, the non-compliance rate for the Eco Design and Energy labeling legislation has reached 17.33% in 2020. (See 5.2.1. Market Surveillance)

The underinvestment problem was stated by some interviewees as a result of the existence of non-compliant products in the market. To comply with the Ecodesign and Energy Labeling requirements, manufacturers can make extra investments. However, in a market where there is no efficient regulation mechanism, they cannot compete with non-compliant products. Although participants agreed that market surveillance in Turkey is adequate, they also stated that there are some areas that could be improved. It is particularly welcomed that the brands and manufacturers of sanctioned products are announced to the public.

It was also noted that the market surveillance for the lighting sector is more difficult because there is a greater variety of brands and models. On the other hand, in the HVAC sector, user-specific and unique product design is another challenge for market surveillance. Due to the differences in the level of compliance and product structure

in the sectors, sector-specific strategies should be created in market surveillance activities.

Participants often emphasized the impact of the market's demand side on regulatory compliance. Consumer preferences have been shown to prioritize product purchase costs, especially in sectors where product prices are high. In contrast, costs incurred during the use, such as those linked to energy and resource consumption and repairability, may be ignored. In this case, non-compliant and non-efficient products continue to be in demand due to their lower initial cost. Consequently, increasing consumer awareness was found to be an accelerator for the demand for compliant and efficient products. It is also agreed that awareness campaigns and financial incentives organized by the public sector would indirectly boost the regulatory compliance of the Turkish market.

5.1.4. The Future of Ecodesign: Sustainable Product Initiative

In terms of the industry's future perspective on Ecodesign and Energy Labelling, some of the participants in TG1 highlighted the Sustainable Product Initiative (SPI). SPI, which is being worked on by the European Commission, aims to revise the Ecodesign Directive. With the revision of the Directive, it is planned to address different approaches in product policies in the future. Since the product range expands, different sectors are expected to be affected by ecodesign requirements.

The revision proposal of the Ecodesign Directive also includes new requirements and measures like mandatory green public procurement criteria, digital product passport, information requirements etc. Interviewees who expressed their thoughts on SPI emphasized that the future of products and business models that ignore sustainability and do not meet SPI's new requirements would be in danger. At this point, it is critical to raise SPI awareness in both the public and private sectors, as well as to collaborate on complementary policies. Moreover, it was also expressed that economic operators require both technical and financial support in order to comply with the new requirements.

Table 5: Overview of Interviews and Their Contribution to the Study

Interview ID	Contribution	Date	Format	Duration (in minutes)
1	The assessment of market surveillance activities and the compliance level of different sectors	22.03.2022	Face to face	37
2	The impact of Ecodesign and Energy Labelling legislation on the lighting and consumer electronics industry and obstacles to the implementation of the Ecodesign Directive	25.03.2022	Video call	43
3	The analysis of the automotive sector's attitudes towards circular economy and innovation, in particular for the tyre industry	31.03.2022	Face to face	32
4	The perception about white goods and HVAC industry on environmental regulations	14.04.2022	Audio call	55
5	The innovation capabilities of the white goods and consumer electronics sector on sustainable product design	19.04.2022	Audio call	57
6	Insights into government policy on energy efficiency and industry's attitude towards energy efficiency	22.04.2022	Face to face	38
7	Turkey-EU relations, the harmonisation of legislation in terms of environment and sustainability and the potential impact of the EU's forthcoming Sustainable Product Initiative on Turkish Industry	27.04.2022	Video call	36

Table 5 (Continued)

Interview ID	Contribution	Date	Format	Duration (in minutes)
8	The impact of regulations on the lighting industry and how innovation activities are linked to the Ecodesign Directive.	16.05.2022	Video call	49
9	The assessment of the level of compliance of the Turkish industry and its comparison with the EU countries in line with all aspects of quality infrastructure	19.05.2022	Video call	76
10	The implementation of product regulations as government intervention and the main obstacles SMEs face in complying with Ecodesign and Energy Labelling legislation	27.05.2022	Video call	55
11	The push-pull dynamics of Ecodesign and Energy Labelling legislation and the government's role in achieving the fair and competitive market	03.06.2022	Face to Face	34
12	The compliance of the machinery sector, especially HVAC, with ecodesign requirements, R&D potential and the problems faced by the sector	07.06.2022	Video call	40
13	Sustainability and regulatory compliance of the machinery sector, in particular electric motors, pumps and circulators.	17.06.2022	Video call	43
14	The role of the government in the field of environmental policy and sustainable design of the product.	21.06.2022	Video call	38

5.2. Quantitative Analysis

Quantitative analysis was done as a secondary method to explain the impact of regulations. In this part of the study, two main indicators, market surveillance results and intellectual property rights statistics, were used to evaluate sectoral behaviour regarding regulatory compliance and innovation efforts.

5.2.1. Market Surveillance

According to annual market surveillance statistics announced by the Ministry of Trade, the coordinator body of market surveillance in Turkey, compliance level on Ecodesign and Energy Labelling legislation is gradually decreasing in Turkey. In the comparison between 2015 and 2020[7], Table 6 shows that the rate of non-compliance with the Ecodesign and Energy Labelling legislation increased from 1.08% to 17.33%. On the other hand, during the same period, non-compliance levels fell down considerably for the other directives, namely the Machinery Directive, the Low Voltage Directive (LVD) and the Type Approval Regulations (Ministry of Trade, 2020). It should be noted that a product can be covered by more than one directive and the products within the scope of Ecodesign and Energy Labeling legislation are commonly within the scope of the above-mentioned directives.

One of the reasons why the non-compliance rate of the Ecodesign and Energy Labelling legislation differs from other directives is that the other directives are in force for many years and their requirements have not changed substantially in a long time. In contrast to these regulations, the Ecodesign and Energy Labelling legislation has a dynamic feature. With the new implementation measures published every year, the range of energy-related products is expanding. Furthermore, the current regulations' thresholds and specific requirements are gradually increasing. As a result, the variety of products is subject to market surveillance and the level of minimum requirements is changing. Therefore, when comparing the degree of compliance level of different regulations, these points should also be taken into account.

[7] The most recent report was published for 2020 as of April 6, 2022.

Table 6: Non-Compliance for Selected Product Regulations (2015 vs 2020)

Legislation	Product Group	2015 (%)	2020 (%)
Ecodesign and Energy Labelling	Energy-related products	1.08	17.33
Machinery Directive	Machinery and its equipment	26.31	14.91
Low Voltage Directive (LVD)	Electronic equipment	16.71	12.89
Type Approval Regulations	Motor vehicles and their components	9.09	4.24

According to Braungardt et al. (2014), enforcement actions play a vital role in innovation impact. Effective market surveillance and sanctions on non-compliances ensure competitiveness and a fair market, motivating manufacturers to innovate. Otherwise, it could lead to an underinvestment problem, where the manufacturers can no longer invest in innovation due to unregulated market conditions.

Figure 8 displays the distribution of sanctions by product groups due to violation of Ecodesign and Energy Labelling legislation since 2015. It was found that lighting products and electric motors accounted for the majority of product groups that were sanctioned and withdrawn from the market (Ministry of Industry and Technology, 2022). When the distribution of non-compliance by sectors is examined, it is seen that sector-specific methods and measures should be applied for market surveillance.

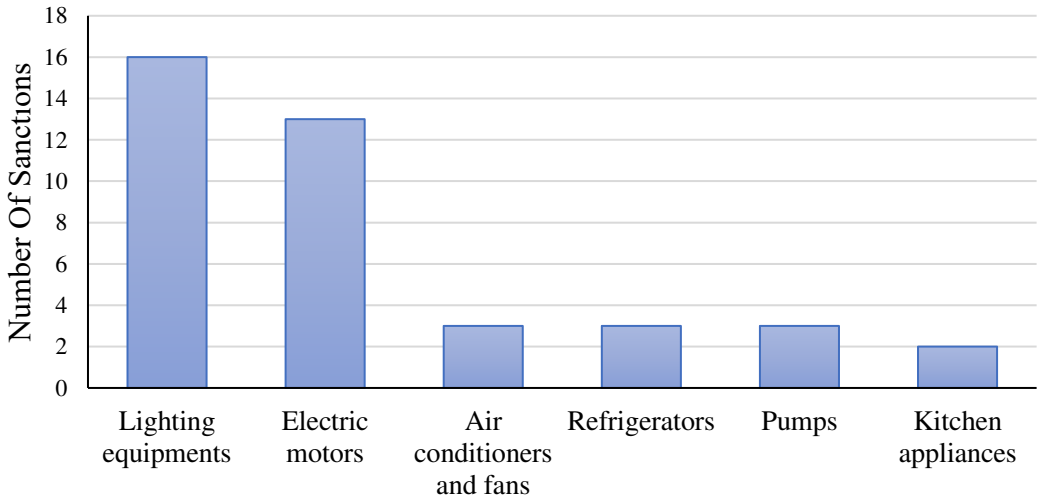


Figure 9: Distribution of Enforcement Actions by Product Groups[8]

[8] 2015 and onwards

5.2.2. Patent Statistics

Although there are many variables affecting IPR statistics, they can be seen as a significant indicator of innovation-related studies. IPR elements such as the patent and utility models, which are the key outputs of R&D activities, allow quantitative benchmarking. These benchmarks are used to measure innovation performance at the sectoral, geographical or firm level.

This section of the study compares the change in the number of patent applications in the sectors regulated by the Ecodesign Directive. Turkish Patent and Trademark Office (TÜRKPATENT) announces the sectoral patent statistics by using the classification of economic activities in the EU (NACE) Rev. 1.1 (TÜRKPATENT, 2022). The sectors determined by considering this classification and their corresponding NACE codes are given in Table 7. However, this classification does not meet all the sectors and product groups covered by Ecodesign and Energy Labelling legislation. Thus, from the NACE codes specified in the patent statistics, the sectors closest to the products covered by Ecodesign and Energy Labelling legislation were chosen for the study (See: 6.2. Limitations of the Research and Discussion for Further Studies).

Table 7: NACE Codes and Classification of Selected Sectors

NACE Code	Sector No[9]	Description
29.1	21	Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines
29.2	22	Manufacture of other general-purpose machinery
29.71	27	Manufacture of electric domestic appliances
30.0	28	Manufacture of office machinery and computers
31.10	29	Manufacture of electric motors, generators and transformers
31.5	32	Manufacture of lighting equipment and electric lamps
32.2	36	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy

[9] Represents the classification of sectors in TÜRKPATENT statistics

The number of patent applications for the sectors indicated in Table 7 was compared from 2010 and onwards, because the transposition of the Ecodesign Directive in 2010 was regarded as a crucial point for the Turkish industry. According to Figure 9, the change in patent applications for sector 28 (office machines and computers) and sector 36 (televisions and radio equipment) are far above the average total patent applications. Only a negligible difference can be observed when the change in the other sectors is compared to the overall situation. Additionally, the change in sectors 27 (domestic appliances) and 32 (lighting equipment and electric lamps) is lower than the average.

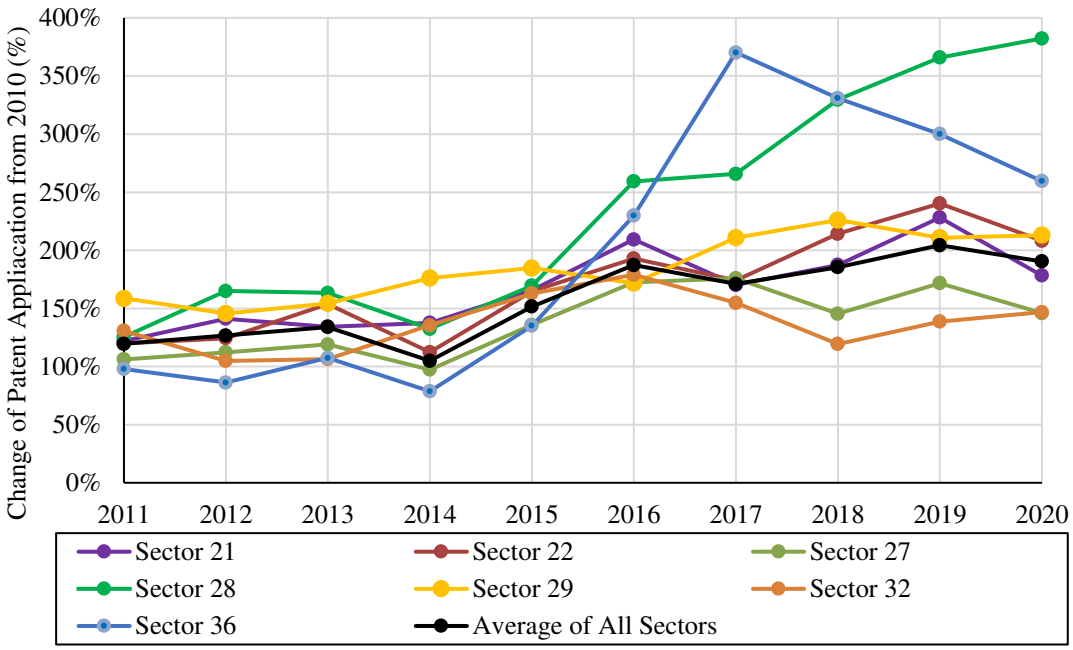


Figure 10: Changes of Patent Applications in Ecodesign Related Sectors

The empirical analysis of patent applications does not support the correlations between the Ecodesign and Energy Labelling legislation and the innovation behaviour of the selected sectors. Despite the "push and pull dynamics" of the legislation, which triggers the innovation, it is difficult to say that Ecodesign and Energy Labelling legislation directly influences IPR activities.

On the other hand, it is important to distinguish between invention and innovation. Since patents are essentially an indicator of inventions, the analysis of patent

applications does not fully cover the impact of regulations on types of innovation such as incremental, process or marketing innovation.

5.3. Policy Recommendations

Policy recommendations were developed in line with the findings of the research and are correlated in a way that contributes to the following policy goals:

Policy Goal 1: Promoting innovation by the acceleration of the knowledge diffusion
Policy Goal 2: Enhancing fair and competitive market
Policy Goal 3: Developing sustainability approach in product design

The policy recommendations are explained in six categories and the correlation with policy goals is given at Table 8.

Table 8: Categories of Policy Recommendations

Policy Recommendations	**Policy Goals**		
	1	**2**	**3**
PR1: Reducing asymmetric information between manufacturers	✓	✓	
PR2: Strengthening the market surveillance mechanism	✓	✓	✓
PR3: Improving the transposition process of implementation measures	✓	✓	
PR4: Stimulating demand for energy efficient products	✓		✓
PR5: Creating financial mechanisms to enhance regulatory compliance	✓	✓	
PR6: Preparing the industry for Sustainable Product Initiative		✓	✓

PR1: Reducing asymmetric information

Eliminating the technical barriers and knowledge gap is the primary step for the successful implementation of the legislation. Among the product regulations that manufacturers find the most challenging to follow and comply with are those relating

to Ecodesign and Energy Labelling legislation. Ecodesign and Energy Labeling legislation are among the product regulations that manufacturers have the most difficulty to follow and achieve the compliance.

For SMEs, the diversity of the products covered by the Ecodesign and Energy Labelling legislation and the dynamic structure of the secondary legislation give rise to particular challenges. In this context, the manufacturers must follow up the new requirements and take extra action at the design phase of the products. These actions include redesigning the products, incremental innovations or material changes. Since the time between the design of the products and their placing on the market can take many years, industry associations must keep up with the developments before the publication of technical legislation. Therefore, it is important to promote SME engagement in these organizations. Additionally, promoting the formation of sectoral associations in industries with low development and regulatory awareness can reduce knowledge asymmetry.

Furthermore, in addition to the activities carried out in sectoral unions, it is recommended to establish intermediary platforms for information exchange on legislation and standards. The missions of these platforms are foreseen as follows:

- Creating and circulating newsletters about developments in secondary legislation and critical technical requirements
- Development and dissemination of frequently asked questions for manufacturing
- Support to national working groups on standardization activities

PR2: Strengthening the market surveillance mechanism

A fair and competitive market depends on preventing the entry non-compliant products into the market. In order to manufacture a product that adheres to ecodesign and energy labelling requirements, companies can invest in material technologies, design, certification, and production. However, manufacturers are not able to compete with non-compliant products in markets that do not have well-established control mechanisms. Therefore, the lack of monitoring, verification and enforcement in the

market could lead to an underinvestment problem, which negatively impacts innovation activities. Thus, in order to improve the effectiveness of inspections the number and capacity of laboratories where energy-related products can be test and where independence and impartiality are in accordance with ISO/IEC 17025 regulations are recommended to be increased.

Secondly, cooperation of market surveillance and customs authorities can strengthen the market surveillance mechanism. Customs inspections are complementary to market surveillance activities in the domestic market. The level of compliance in the domestic market will increase as non-compliant imported goods are detected and prevented at customs. Strengthening the cooperation of market surveillance and customs authorities will be beneficial for ensuring a fair and competitive market. So to ensure a fair and competitive market, market surveillance and customs authorities should work together more closely.

Another step to boost the market surveillance system is to organize joint actions and sectoral inspection campaigns with the EU market surveillance authorities. At these organizations, best practices and benchmarking can be shared at the international or regional level.

PR3: Improving transposition procedure of implementation measures

Results from market surveillance and interview outcomes indicate that there are differences in the sectors' compliance levels and the ways in which the regulations participate in the transposition processes. While some sectors in Turkey are successful in influencing EU legislation beyond the harmonisation process in national base, some sectors have difficulties in complying with the existing rules. Policymakers in Turkey take into consideration this difference by postponing the harmonisation process in some sectors, but it is not a permanent solution in the long term. The reason behind this problem could be that the technical content of the implementation measures is the same as that of the EU and the need for impact assessment is overlooked. However, these disparities amongst the sectors highlight that the need for impact assessment to develop tailored policies for each sector. Therefore, it is recommended to perform an

impact analysis for each implementation measure during the transposition process to increase sector awareness and better management of the harmonisation process.

An additional element of a good harmonisation strategy is the implementing of awareness campaigns regarding new product regulations. Even though the secondary legislation has not been published yet, a dissemination campaign should be organized concerning the requirements of upcoming rules and the responsibilities of economic actors. In order to reach all stakeholders in a sector, these activities must be carried out in collaboration with governmental institutions and sector associations.

PR4: Stimulating demand for energy efficient products

The effective implementation of Ecodesign and Energy Labelling legislation also depends on the demand side of the market. The demand for efficient and sustainable products from consumer and professional buyers has a pulling effect on manufacturers.

Through awareness campaigns, customers can be enlightened of the energy and resource usage throughout the product life cycle, especially for higher energy-consuming product categories like white goods. In addition, energy analyzes can also be encouraged for products that appeal to professional users, such as electric motors, circulators and pumps. The results of these analyses can attract potential users to switch to more energy efficient products. Nonetheless, awareness-raising efforts alone are insufficient to increase the demand. For example, the users do not tend to leave inferior technology due to their economic situation even though there are more efficient products with new features in the market. Therefore, the development of financial support systems is necessary to promote energy transformation for both user groups.

PR5: Creating financial mechanisms to enhance regulatory compliance

Costs of complying with ecodesign requirements, such as conformity assessment and material technologies to be used in the design, create a burden for some manufacturers. Firstly, the manufacturer can perform conformity assessment tests in-house or use external laboratories to test and prove compliance of their products with the minimum requirements. However, laboratory infrastructure may be limited, especially for new

implementation measures. Thus, certification incentives should be made available to these manufacturers, preferably for a set period of time for the newly enacted legislation. Moreover, similar assistance can be provided to companies that open their laboratories to others in order to encourage joint laboratory use. Consequently, the duplication risk on laboratory investment can also be avoided.

Next, material technologies and critical components for energy-related products, like motors and pumps that increase the efficiency of the products, are an essential part of the R&D activities carried out to comply with ecodesign requirements. The results of these types of applied researches have intersectoral results. Hence, prioritizing this issue in financial support mechanisms will help to achieve regulatory compliance. It can also be viewed as a signal strategy, directing companies to invest in these cross-cutting areas.

PR6: Preparing the industry for Sustainable Product Initiative

EU's Sustainable Product Initiative will significantly alter the criteria for ecodesign by setting strong sustainability and durability requirements for the products. SPI include a proposal, Ecodesign for Sustainable Products Regulation, to review the existing Ecodesign Directive. Eco Design and Energy Labelling legislation intersects with policies governing the industry, the environment, energy efficiency, and EU harmonisation, all of which are under the responsibility of different public authorities. The proposal also includes new requirements and measures like mandatory green public procurement criteria, digital product passports, information requirements etc. This diversity in SPI content falls under the purview of various policymakers in Turkey.

In this regard, cooperation among policymakers is becoming increasingly important for better implementation to achieve sustainable products. In order to harmonise the legislation and take the necessary measures, intermediary committees and boards should be established with the participation of public institutions and industry. This board should inform the relevant institutions on a regular basis and analyze the sectors' needs for harmonisation.

Another recommendation to prepare the industry for SPI is to make sustainability of products a criterion for financial incentives. In this way, the awareness of manufacturers can be increased in terms of the sustainability as a technological trajectory.

Finally, training programs on sustainable product design can be organized to increase the capabilities of manufacturers. Such programs create a signal effect and increase awareness about new paradigms. Furthermore, it is recommended that courses on sustainable design, technical compliance, and certification be added to the curricula of engineering and design-related programs at universities in order to increase the number of people trained in this field.

CHAPTER 6

CONCLUSION

This chapter starts with a summary including main findings and policy recommendations and conclude with final remarks on the research limitation and discussions for further studies.

6.1. Summary and Main Findings

Circular economy is a socio-economic model that is focused on creating a sustainable system where all the elements are reused, recycled and regenerated in order to provide a healthy and balanced environment. This model differs from the linear economy in which resources are extracted, used up and discarded. Sustainable product design is an essential component of the transition to a circular economy by combining resource efficiency, innovation and competitiveness. This perspective has made the concepts like ecodesign popular for both policymakers and economic operators and has become part of the technical requirements of products. The Ecodesign Directive, Energy Labelling Framework Regulation and their secondary legislation establish the requirements of energy-related products in the EU. The technical legislation in Turkey is based on the transposition of the EU acquis on Ecodesign and Energy Labelling.

In this study, it is aimed to analyze the attitude of the Turkish industry towards Ecodesign and Energy Labeling legislation by conducting semi-structured interviews with stakeholders. In addition, market surveillance and patent application statistics were also used.

Empirical evidence on the change of patent applications shows that there is not a correlation provided between patent applications and the Ecodesign and Energy Labelling legislation. However, all interviewees agreed that these regulations have a

significant accelerating impact on R&D activities, particularly on product innovation. It was specified that technical requirements are an important trigger for companies' innovation efforts because minimum requirements are defined for products to be placed on the market. Additionally, a significant issue for SMEs was highlighted: the lack of awareness and technical incapability regarding Ecodesign and Energy Labeling legislation leads to asymmetric information, which is one of the reasons for market failure.

It is important to identify the difficulties and obstacles that manufacturers frequently encounter in complying with the regulations. One of these problems is related to the transposition process of secondary legislation. Participants criticized that sector-specific needs were not identified using scientific methods such as impact assessment during the harmonisation process of the regulations.

The compliance of the market with the legislation is one of the factors affecting the behaviour of the industry. Manufacturers are less motivated to innovate in markets where product compliance is low, resulting in the problem of underinvestment. While it is required to strengthen control mechanisms on the supply side of the market, it is also necessary to raise user awareness on the demand side.

One of the issues raised by stakeholders is the EU's Sustainable Product Initiative. This initiative aims to make products placed on the market more sustainable by revising the Ecodesign Directive and proposing additional legislative measures. Manufacturers should include the Sustainable Product Initiative in their future strategies to avoid being negatively impacted by the new requirements and losing market share. The public and private sectors must work together and take a proactive approach to manage this process.

The regulatory impact of the Ecodesign and Energy Labelling scheme has been analyzed within the framework of three dimensions, innovation, fair market and sustainability.

Following the analysis, policy recommendations were made in accordance with the three objectives and are summarized in Table 9.

Policy Goal 1: Promoting innovation by the acceleration of the knowledge diffusion
Policy Goal 2: Enhancing fair and competitive market
Policy Goal 3: Developing sustainability approach in product design

Table 9: Wrap up for Policy Recommendations

Policy Recommendations	**Policy Goal 1**	**Policy Goal 2**	**Policy Goal 3**
PR1: Reducing asymmetric information between manufacturers - Creating platforms for knowledge exchange on the regulations and standards - Encouragement of the creation of industry associations and participation of SMEs	✓	✓	
PR2: Strengthening the market surveillance mechanism - Development of test infrastructure - Cooperation with customs authorities - Participating in joint actions and sectoral inspection campaigns	✓	✓	✓
PR3: Improving the transposition process of implementation measures - Impact analysis in the transposition phase of the secondary legislation - Dissemination activities before the entry into force of regulations	✓	✓	
PR4: Stimulating demand for energy efficient products - Organizing awareness campaigns for consumers - Energy analysis for professional users - Financial mechanisms for transformation of energy-related products	✓		✓

Table 9 (Continued)

Policy Recommendations	Policy Goal 1	Policy Goal 2	Policy Goal 3
PR5: Creating financial mechanisms to enhance regulatory compliance - Providing conformity assessment incentives - Providing incentives for manufacturers in cross-cutting areas (i.e., material efficiency, motor technologies etc.)	✓	✓	
PR6: Preparing the industry for Sustainable Product Initiative - Creating a committee between public authorities and industry - Making sustainability of the products a criterion for financial incentives - Organizing training programs for the private sector as a signaling strategy		✓	✓

6.2. Limitations of the Research and Discussion for Further Studies

There are some limitations to this study. In this study, fourteen participants were interviewed to assess the general situation of the Turkish industry in terms of Ecodesign and Energy Labelling legislation. Even so most studies on the impact of regulations in the literature use semi-structured interviews, survey studies allow researchers to reach a larger number of people. Given the diversity of the sectors affected by Ecodesign and Energy Labelling, conducting surveys on a sectoral basis can be an alternative for future studies.

Another potential weakness of the study is the quantitative evaluation of patent applications. Firstly, patents are more about the inventions. It can also be associated with radical innovations. On the other hand, the impact on innovations closely related to product design, such as incremental innovation, is not properly evaluated by an analysis of patent application numbers. Secondly, sectoral classification in patent statistics is published according to NACE Rev. 1.1 codes. However, this classification does not meet with all the sectors and product groups covered by Ecodesign and Energy Labelling legislation. Therefore, from the NACE Rev. 1.1 codes specified in the patent statistics, the sectors closest to the products covered by Ecodesign and Energy Labelling legislation were chosen for the study. In future studies, a more detailed analysis can be conducted by collecting data from the field on a sectoral basis and taking into account the effective dates of secondary legislation. As an alternative to patent applications, sectoral analyses can be performed by comparing them in other IPR parameters like utility models and industrial designs.

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APPENDICES

A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE

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Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi : İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Prof.Dr. Ülkü YETİŞ

Danışmanlığını yürüttüğünüz Berker KARAGÖZ'ün "Yenilikçilik İçin Bir Tetikleyici Olarak Çevreye Duyarlı Tasarım ve Enerji Etiketi Düzenlemeleri: Türkiye Sanayisi İçin Bir Analiz" başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **0167-ODTUİAEK-2022** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

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B. INTERVIEW QUESTIONS

General Questions for Interviewees

- Introduction & background questions
- How do you define the sustainability issues in product design?
- Who are the stakeholders (persons, institutions and organizations, etc.) that you think are influential in terms of product policies in Turkey?
- What are the most appropriate mechanisms for an efficient knowledge transfer about ecodesign?
- Do you think the ecodesign and energy labelling regulations are efficient policy instruments for achieving higher resource efficiency in energy-related products?
- Do you get the impression that the Ecodesign Directive is well-accepted legislation amongst stakeholders, particularly industry and policymakers?
- How do the ecodesign and energy labelling regulations interact with other policies, legislation, schemes, measures, product policy instruments, etc.?
- Could you recommend additional experts or literature?

Target Group 1: Manufacturers, Industry Representatives

- Which of the following environmental regulations includes the most challenging requirements in your design process?
    - REACH Regulation
    - WEEE Directive
    - Ecodesign Directive
    - Energy Labelling Regulations
    - RoHS Directive
    - Other

- Who is responsible for the ecodesign process within the company?

- How do you provide the information and infrastructure needed to comply with ecodesign requirements?
  - Utilizing in-house expertise and infrastructure
  - Outsourcing of operational activities and personnel
  - Both of them

- How does your company respond to the ecodesign requirements in the legislation?
  - It sees the requirements as an opportunity for product innovation
  - It aims to be at the forefront of the ecodesign process
  - It views the requirements as a tool to stay competitive within the global market
  - It pushes for higher requirements/standards within the industry

- What is your company's approach regarding anticipated upcoming implementation measures as part of the Ecodesign Directive?

- What are the major outputs on innovation activities related to ecodesign within the company? (patents, new markets/customers, etc.)

- What are the main obstacles to better implementation of the Ecodesign and Energy Labelling requirements?
  - Lack of political support
  - Weak regulatory and implementation process
  - Unfair market conditions
  - Lack of infrastructure and competent employees
  - Lack of dissemination of knowledge (requirements, standards, etc.)
  - Other factors

- What kind of policy tools can be implemented to achieve better regulatory compliance in your sector?

Target Group 2: Trade Associations and NGOs

- Which of the following environmental regulations includes the most challenging requirements in your sector?
  - REACH Regulation
  - WEEE Directive
  - Ecodesign Directive
  - Energy Labelling Regulations
  - RoHS Directive
  - Other

- In which product group in your sector do you think compliance and awareness with ecodesign requirements are better achieved?

- What is your perception regarding the ability of the Ecodesign and Energy Labelling Regulations to foster product innovations?

- What are the main obstacles to better implementation of the Ecodesign and Energy Labelling requirements?
  - Lack of political support
  - Weak regulatory and implementation process
  - Unfair market conditions
  - Lack of infrastructure and competent employees
  - Lack of dissemination of knowledge (requirements, standards, etc.)
  - Other factors

- What should be the government's role in increasing the compliance level of the requirements?

Target Group 3: Government Officers

- What is your perception regarding the ability of the Ecodesign and Energy Labelling Regulations to foster product innovations?

- How do you think these regulations contribute to the circular economy, and do you think this could be improved? If so, how?

- Which sectors/product groups in the Turkish industry do you think compliance with ecodesign requirements is better achieved?

- What are the main obstacles inhibiting the implementation of the Ecodesign and Energy Labelling Regulations?

- What should be the government's role in increasing the compliance level of the requirements?

C. TURKISH SUMMARY / TÜRKÇE ÖZET

Günümüzde artan enerji ihtiyacının karşılanamaması, sürdürülebilir kalkınmanın önündeki en önemli tehditlerden biri olarak görülmektedir. Enerji maliyetleri ekonomik göstergeleri doğrudan etkileyen bir parametre olarak değerlendirilmekte; özellikle tasarım ve imalat aşamasından son kullanıcılara kadar geçen tüm süreçlerde kaynakların daha verimli olarak kullanılması giderek önem kazanmaktadır. Bu durum ürün geliştirme süreçlerine de yansımış olup, ürünlere ilişkin teknik düzenlemeler ve standartlar, ürün güvenliğine ilişkin hususlara ek olarak daha düşük enerji tüketimine sahip ve çevreye daha duyarlı ürünlerin tasarımına yönelik şartları da içermektedir. Ayrıca, daha az enerji tüketimine sahip ürünlerin tercih edilmesi ve tüketicilerin satın alma kararlarına yardımcı olması amacıyla ürünlerin enerji performansını ve verimliliğini tanımlayan enerji etiketleri belirli ürünler için zorunlu hale getirilmiştir.

Ülkemizde konuyla ilgili teknik mevzuat Avrupa Birliği'nde yayımlanan 2009/125/EC[10] ve (EU) 2017/1369[11] düzenlemelerinin uyumlaştırılması ile iki farklı çerçeve yönetmelik ve bu iki yönetmelik altında ürün özelinde yayımlanan uygulama tebliği adı verilen ikincil mevzuat ile ele alınmaktadır.

Bu çerçeve yönetmeliklerden ilki olan "Enerji ile İlgili Ürünlerin Çevreye Duyarlı Tasarımına İlişkin Yönetmelik"te *"Ürünün ömür döngüsü boyunca çevresel performansını artırmak amacıyla, çevresel boyutları ürün tasarımına dâhil etmek"* şeklinde tanımlanan ekotasarım kavramıyla, ikincil düzenlemelerde belirlenen

[10] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products. Official Journal of the European Union. L285/10

[11] Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017 setting a framework for energy labelling. Official Journal of the European Union, L198/1

ürünlerin tasarımında uyulması zorunlu şartların belirlenmesi ve bu şartları sağlayan ürünlerin piyasaya arz edilmesi amaçlanmaktadır.

Diğer taraftan, "Enerji Etiketlemesi Çerçeve Yönetmeliği" enerji ile ilgili ürünlerin kullanım sırasındaki enerji ve kaynak tüketimine ilişkin bilgiler ile ürün performansına ilişkin tamamlayıcı değerlerin derecelendirilerek etiketlendirilmesini ve uygun şekilde teşhir edilerek ürünler arası karşılaştırmanın sağlanabilmesini zorunlu kılmaktadır. Böylece piyasaya arz edilen ürün özellikleri hakkında tüketicilerin satın alma aşamalarında doğru ve etkili bir şekilde bilgilendirilmesi ve verimli ürünlerin tercih edilmesi amaçlanmaktadır.

Söz konusu düzenlemeler, ekotasarım ve enerji etiketlemesine ilişkin genel kuralları içermekte olup, ürünlere ilişkin asgari verimlilik şartları ve tasarım özellikleri gibi teknik konular ikincil düzenlemelerde ele alınmıştır. Uygulama tebliğleri olarak isimlendirilen bu düzenlemelerde belirtilen asgari verim sınırları ile piyasada yalnızca çevreye duyarlı tasarım şartlarını sağlayan ürünlerin yer alması amaçlanmaktadır. Diğer taraftan, belirtilen düzenlemelerin CE işaretlemesinin de bir ön şartı olarak değerlendirildiğinde, zorunlu olarak uygulanan bu düzenlemelerin üreticiler tarafından sıkı bir şekilde takip edilmesi gerekmektedir.

Ekotasarım ve enerji etiketlemesine ilişkin teknik mevzuatın üreticileri zorlayıcı etkilerinden biri asgari verim ve performans şartları nedeniyle ürünlerdeki yenilik süreçlerine ağırlık verilmesidir. Kademeli olarak yükseltilen bu şartlar üreticileri daha verimli ürün tasarımına zorlamaktadır. Diğer taraftan, enerji etiketi uygulaması da tüketicilerin ürünler arasında kıyaslamayı daha etkin bir şekilde gerçekleştirmesine imkan sağlamaktadır. Böylece piyasanın talep tarafının daha verimli ürünlere odaklanması ve artan rekabet etkisiyle piyasada yer alan ürünlere ilişkin ortalama değerlerin asgari gerekliliklerin çok daha üzerinde olması hedeflenmektedir. Düzenlemelerin bu çift yönlü etkisi birbirlerini tamamlayıcı nitelikte olup, literatürde itme ve çekme etkisi olarak tanımlanmaktadır (Bundgaard et al., 2017; European Commission, 2019).

Ekotasarım ve enerji etiketlemesine ilişkin teknik mevzuatın getirdiği kurallar ve temel gereklilikler bir kamu müdahalesi olarak piyasayı düzenlemeyi ve sürdürülebilir ürün tasarımını amaçlasa da üreticilerin bu gerekliliklere yaklaşımı ve sektörlerin uyum seviyesi, düzenlemelerin amaçlarına ulaşmasında önemli etmenlerdir. Bu bakımdan sektörlerin davranışı üzerine gerçekleştirilen çalışmalar politika yapıcılara yol göstermektedir. Literatürde sanayinin düzenlemelere bakış açısına yönelik yapılan çalışmalar incelendiğinde bu çalışmaların genel olarak mülakat ve anket sorularına esas alınarak gerçekleştirilen nitel araştırma yöntemlerine dayandığı görülmektedir. Bu araştırmalarda düzenlemelerin yenilik faaliyetlerine etkisi, piyasanın teknik mevzuata uygunluk seviyesine ilişkin değerlendirmeler ve düzenlemelerin sürdürülebilirliğe etkisi ele alınmaktadır (ECA, 2020).

Bu çalışmada Türkiye sanayisinin ekotasarım ve enerji etiketlemesi mevzuatına bakış açısının analiz edilmesi amaçlanmıştır. Çalışmada kalite, sürdürülebilirlik ve ürün yönetimi alanında görev yapan profesyoneller, sivil toplum kuruluşları temsilcileri ve kamu görevlilerinden oluşan 3 farklı hedef grupta toplam 14 katılımcı ile yarı yapılandırılmış mülakatlar gerçekleştirilmiştir.

Paydaş görüşmelerine ilave olarak çalışmada nicel verilerden de yararlanılmıştır. Sektörlerin mevzuat uyumunun değerlendirilmesi bakımından her yıl yayımlanan piyasa gözetimi ve denetimi istatistiklerinden yararlanılmıştır. Ayrıca, teknik mevzuat ve yenilik ilişkisini değerlendirebilmek adına patent başvurularına ilişkin istatistiklere de çalışmada yer verilmiştir.

Araştırma sonucunda elde edilen bulgular dört kategoride sınıflandırılmıştır:

- Bilgiye ulaşım ve düzenlemelerin yeniliğe etkisi
- İkincil düzenlemelerin uyumlaştırma süreçlerine ilişkin tespitler
- Sektörlerin mevzuat uyumu
- Ekotasarımın geleceğine ilişkin öngörüler ve Sürdürülebilir Ürün İnisiyatifi

Çalışma sonucunda elde edilen bulgular değerlendirildiğinde mülakat katılımcılarının tamamının Ekotasarım ve Enerji Etiketlemesine ilişkin düzenlemelerin yenilik faaliyetlerini doğrudan veya dolaylı olumlu olarak etkilediğini belirttikleri

görülmüştür. Sektörlere göre patent başvurularındaki değişim incelendiğinde ise Ekotasarım Direktifi'nin Türkiye'de uyumlaştırılması sonrasında incelemeye konu sektörlerdeki patent başvurularının arttığı gözlemlenmiştir. Diğer taraftan, bu artış patent başvurularının genel trendi ile kıyaslandığında belirgin bir farklılık tespit edilmemiş ve düzenlemelerin patent başvuru sayılarına etkisine yönelik doğrudan bir ilişki kurulamamıştır.

Katılımcılarla yapılan görüşmelerde, üreticilerin düzenlemelere bakış açısının ve mevzuat uyumunun sektörlere ve firma büyüklüklerine göre farklılık gösterebildiği tespit edilmiştir. Özellikle beyaz eşya ve tüketici elektroniği gibi AB piyasasına ihracat oranı yüksek sektörlerde üreticilerin düzenlemeleri yakından takip ettiği; buna ilişkin gerekli insan kaynağına ve teknik altyapıya sahip olduğu dile getirilmiştir. Diğer taraftan daha küçük ölçekteki üreticilerin bazılarında ise ancak teknik mevzuatın uyumlaştırılmasının ve Türkiye'de yürürlüğe girmesinin ardından yeni gereklilikler hakkında bilgi sahibi olduğu belirlenmiştir. Ürünlerin tasarımı ile ticarileşmesi arasında geçen süre değerlendirildiğinde düzenlemelerin henüz hazırlık aşamasında takip edilmesi oldukça önemlidir. Bu bağlamda, KOBİ'lerin mevzuat hakkında yeni yükümlülüklerinden mevzuatın uyumlaştırma aşamasında haberdar olması sağlanmalıdır. Bu konuda farkındalığın artırılması için sektör derneklerine önemli bir iş düşmektedir. Özellikle dernekleşmenin olmadığı veya sektör derneklerine katılımın düşük olduğu sektörlere bu bir problem olarak ortaya çıkmaktadır.

Ekotasarım ve Enerji Etiketlemesinin uyumlaştırma süreçleri de katılımcıların önemle vurguladığı konulardan biridir. Ürün özelinde hazırlanan ve uygulama tebliği adı verilen ikincil düzenlemelerde mevzuat uyumu sektörlere göre farklılık göstermektedir. AB tarafından yayımlanan uygulama tebliğlerinin Türkiye'de yürürlüğe girme süreci sektörlere göre değişmektedir. Yapılan paydaş görüşmelerinde uygulama tebliğlerinin getirdiği gerekliliklere uyum sağlayamayacak sektörlerin uyumlaştırma sürecine ilişkin erteleme taleplerinin olduğu belirtilmiştir. Düzenlemelere uyum sürecinin uzatılması ve uyumdaki gecikmeler, iç piyasaya yönelik üretim yapan veya AB kurallarının uygulanmadığı ülkelere ihracat yapan üreticiler için kısa vadede bir avantaj oluştursa bile orta ve uzun vadede bu firmaların yeni piyasalara girişi bakımından olumsuz bir etki oluşturabileceği değerlendirilmiştir.

Diğer taraftan, uyumlaştırmanın gecikmesinden kaynaklı olarak AB ile Türkiye piyasasındaki ürün kurallarının farklı olmasının Türk malı imajı için olumsuz bir etki yaratabileceği belirtilmiştir.

Düzenlemelerin uyumlaştırılmasının bir sonraki aşaması da üreticilerin bu düzenlemelere uygun üretim yapmasını sağlamaktır. Uygunsuz ürün dolaşımının gerçekleştirildiği piyasalarda, ürün geliştirme süreçlerine gerekli yatırım yapılmamaktadır. Bu nedenle etkin bir piyasa gözetimi mekanizmasının sağlanabilmesi oldukça önemlidir. AB piyasasında ekotasarım ve enerji etiketlemesine ilişkin teknik mevzuata uygunsuzluğun %10 ile %25 arasında değiştiği belirtilmektedir (Egenhofer vd., 2018). Piyasa gözetimi ile ilgili Türkiye istatistikleri incelendiğinde ise ekotasarım ve enerji etiketlemesine ilişkin uygunsuzluk oranının artış eğiliminde olduğu, 2020 yılında ürünlerdeki uygunsuzluk oranının %17,33'e kadar yükseldiği görülmektedir. Ancak ürün güvenliği ile ilgili temel gereklilikleri içeren teknik düzenlemelere ilişkin uygunsuzluk oranının ise çok daha düşük olduğu gözlemlenmiştir. Diğer bir deyişle üreticilerin ürün tasarımında güvenlik ile ilgili temel gereklilikleri karşılayabildiği, ürün tasarımında nitelikli değişiklikler gerektiren ekotasarım ve enerji etiketlemesi kurallarını ise aynı kolaylıkta sağlayamadıkları görülmektedir.

Mülakatlarda üreticiler tarafından dile getirilen konulardan biri de AB'nin 2022 yılı içerisinde açıkladığı Sürdürülebilir Ürün İnisiyatifidir. AB Yeşil Mutabakatı'nı destekleyici yaklaşımlardan biri olan Sürdürülebilir Ürün İnisiyatifi AB tek pazarının döngüselliğini artırmayı amaçlayan bir dizi mevzuat paketinden oluşan bir çerçeve düzenlemedir. Döngüsel ekonominin geleneksel önlemlerinin aksine tasarım aşamasından başlayarak ürünlerin yaşam döngüsü boyunca sürdürülebilirlik oluşturmayı amaçlamaktadır. Bu amaç doğrultusunda Ekotasarım Direktifi'nin kapsamında bulunan sektör ve ürün gruplarının artırılması ve ürün gerekliliklerinin yeniden belirlenmesi hedeflenmektedir. Bu nedenle, Sürdürülebilir Ürün İnisiyatifi ile devreye alınması planlanan dijital ürün pasaportu, yeşil kamu alımı uygulamaları ve ürünlere ilişkin ilave bilgi gereklilikleri gibi yeni yükümlülüklerin henüz hazırlık aşamasında takip edilmesi ve bu alanda farkındalığın oluşması gerektiği belirtilmiştir.

Çalışma sonucunda yukarıda elde edilen bulgular doğrultusunda geliştirilen öneriler üç ayrı politika hedefi ile ilişkilendirilmiş ve aşağıda kısaca özetlenmiştir:

Politika Hedefleri	**Öneriler**
Hedef 1: Teknik mevzuata ilişkin bilginin yayılımı ile yeniliğin artırılması	1,2,3,4,5
Hedef 2: Adil ve rekabetçi piyasa koşullarının oluşturulması	1,2,3,5,6
Hedef 3: Ürün tasarımında sürdürülebilirliğin teşvik edilmesi	2,4,6

1) Üreticilerin teknik düzenlemelere ilişkin bilgiye erişimi kolaylaştırılarak asimetrik bilgi nedeni ile oluşabilecek piyasa aksaklıklarının önüne geçilmelidir. Ekotasarım ve Enerji Etiketlemesi mevzuatının Ar-Ge ve inovasyon için tetikleyici etkisi göz önünde bulundurulduğunda özellikle KOBİ'lerin bilgiye erişimini hızlandırıcı mekanizmaların geliştirilmesine ihtiyaç duyulmaktadır. Bu bakımdan söz konusu faaliyetlere yeterli kaynak ayıramayan KOBİ'lerin sektörel birlikler vasıtasıyla bu açıklarını kapatabilecekleri değerlendirilmektedir. Özellikle KOBİ'lerin sektör derneklerine katılımının teşvik edilmesinin, dernekleşmenin bulunmadığı veya zayıf olduğu sektörlerde ise teknik gerekliliklere ilişkin bilginin paylaşılması ve yaygınlaştırılması amacıyla aracı platformlar ve çalışma gruplarının oluşturulmasının faydalı olacağı değerlendirilmektedir.

2) Ekotasarım ve enerji etiketlemesi kapsamındaki ürünlere yönelik piyasa gözetimi ve denetimi mekanizmasının güçlendirilerek adil ve rekabetçi piyasa koşullarının oluşumuna katkı sağlanmalıdır. Bu bakımdan hâlihazırda yürütülen piyasa gözetimi faaliyetlerinin etkinliğinin artırılması amacıyla ürünlere ilişkin doğrulama testlerinin yapılabileceği laboratuvar sayısının ve niteliğinin artırılması oldukça önemlidir. Diğer taraftan, iç piyasada gerçekleştirilen denetimlere ilave olarak ithal ürünlerin gümrük aşamasında denetimi ile uyum sağlanabilmesi adına sorumlu kuruluşlar arasında işbirliği gerçekleştirilerek uygulama birliğinin sağlanmasının faydalı olacağı değerlendirilmektedir.

3) İkincil düzenlemelerin uyumlaştırılmasına ilişkin prosedürlerin iyileştirilmesi amacıyla Ekotasarım ve Enerji Etiketlemesine ilişkin uygulama tebliğlerinin uyumlaştırılması sürecinde ilgili kuruluşlar tarafından etki analizi yapılmalıdır. Böylece mevzuat uyumu konusunda sektörlerin karşılaşabilecekleri sorunlar tespit edilecek ve ilave önleyici tedbirler alınabilecektir.

4) Piyasanın uygunluk seviyesinin artışına katkıda bulunacak tedbirlerden biri de piyasanın talep tarafında enerji verimliliğine ilişkin farkındalığın artırılmasıdır. Verimli ve teknik düzenlemelere uygun ürünlerin talep edilmesi amacıyla Ekotasarım ve Enerji Etiketlemesi mevzuatı kapsamında yer alan ürün grupları için gerek bireysel tüketiciler gerekse profesyonel kullanıcılara yönelik farkındalık artırıcı çalışmalar yürütülmelidir. Enerji verimliliğine ilişkin genel farkındalık faaliyetlerinin yanı sıra profesyonel kullanıcılar için enerji tüketim analizleri gerçekleştirilmelidir. Ayrıca ürün değişimini teşvik edebilmek için finansal destek programları oluşturulmalıdır.

5) Uygunluk değerlendirmesi ve malzeme teknolojileri gibi eko tasarım gerekliliklerine uyum maliyetleri bazı üreticiler için yük oluşturmaktadır. Bu kapsamda tercihen yeni çıkarılan mevzuat için üreticilere süreli belgelendirme teşvikleri sağlanabilir. Ayrıca ortak laboratuvar kullanımını teşvik etmek amacıyla laboratuvarlarını ortak kullanıma açan firmalara da benzer yardımlar yapılabilir. Bu sayede, laboratuvar yatırımındaki tekrarlama riskinden de kaçınılabilir. Mali teşvikler sektörler arasında kesişen ürünlerin verimliliğini artıran malzeme teknolojileri ve kritik bileşenler geliştirilmesi için de sağlanması yararlı olacaktır. Şirketleri bu kesişen alanlara yatırım yapmaya yönlendirilmesi aynı zamanda bir sinyal stratejisi olabilecektir.

6) Avrupa Birliği tarafından yürütülen Sürdürülebilir Ürün İnisiyatifi kapsamında yeni uygulamaların takibi ve ulusal politikaların şekillendirilmesi amacıyla ilgili kamu kuruluşları ve özel sektör temsilcilerinin yer aldığı komiteler oluşturulmalıdır. Sürdürülebilir ürün yaklaşımının sektörlerin tümünde benimsenmesi ve işletmelerde farkındalık oluşturulması amacıyla eğitim programlarının düzenlenmesi faydalı olacaktır. Ayrıca bu alanda yetişmiş insan gücünün artırılması amacıyla üniversitelerin mühendislik ve tasarım ile ilgili programların müfredatına sürdürülebilir tasarım,

teknik gerekliliklere uyum ve sertifikasyon ile ilgili derslerin eklenmesi tavsiye edilmektedir. Diğer taraftan sürdürülebilirlik konusunun imalat sanayine ilişkin hazırlanan finansal teşvik programlarının başvuru ve değerlendirme aşamalarında bir parametre olarak ele alınabileceği düşünülmektedir.

Sonuç olarak, ekotasarım ve enerji etiketlemesi ile ilgili mevzuatın uyum seviyesinin artırılmasıyla firmaların ARGE ve inovasyon faaliyetlerine yönelmesi, piyasada adil ve rekabetçi bir yapının oluşturulması ve sürdürülebilirlik yaklaşımının firmalara kazandırılması amaçlanmaktadır. Uygulamaya ilişkin sorunların giderilmesi ve beklenen etkinin sağlanması amacıyla geliştirilecek politikaların uygulamaya geçirilmesi ve izlenmesi oldukça önem taşımaktadır.

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