

Factors Affecting Eco-Innovations in the European Union

MARCIN RELICH

Faculty of Economics and Management,
University of Zielona Gora,
Licealna 9, 65-417 Zielona Gora,
POLAND

Abstract: - Environmental concerns and challenges are constantly increasing in recent years. These challenges affect the national economies of many countries and business strategies in companies. Environmental regulations and greater awareness of consumers in the aspect of environmental concerns force companies to develop products that can reduce harmful environmental effects. This paper is concerned with investigating the importance of factors affecting environmental innovation in the European Union (EU), and the environmental benefits obtained during the consumption or use of innovative products. Moreover, this study presents the difference in assessing the importance of factors related to introducing environmental innovations by the EU innovative and non-innovative enterprises.

Key-Words: - circular economy, environmental innovation, environmental benefits, innovative enterprises, product innovation, costs and input prices, customer demand.

Received: March 9, 2023. Revised: October 21, 2023. Accepted: November 7, 2023. Published: November 17, 2023.

1 Introduction

Economic development was closely linked to negative effects on the natural environment over the past decades. However, the increase in ecological attitudes among citizens and consumers has resulted in changing environmental regulations and business strategies toward incorporating the concept of sustainable development and a circular economy. As a result, companies are presently drifting from the strategy of gaining the maximum economic profit towards paying attention to social and ecological issues. The number of companies that have decided to develop eco-products, including eco-innovations, is increasing from year to year.

Eco-innovations can be defined as innovations that provide benefits to both the entrepreneur and consumer by the limitation of the detrimental impact of the economy on the environment, [1]. An eco-innovation can also be seen as a merge of innovation (in the sense of novelty and creativity) and ecological awareness or environmental sensitivity, [2]. Eco-innovations can be classified into four categories: environmental technologies, organizational innovations, product and service innovations, and green system innovations, [1]. In this study, eco-innovations are considered only from the perspective of product innovations.

Financing eco-innovations can be based on internal and external sources of capital. Environmental policy, including public grants,

subsidies, or other financial incentives, can significantly support enterprises in developing innovative eco-products. The possibility of using national and EU funds to support the design of eco-innovation and its placing on the market can be seen as one of the factors driving environmental innovations. Other factors can refer to increasing customer demand for environmental products or increasing costs and input prices. The latter can result from reducing the amount of energy or materials needed for production or eliminating harmful materials by pro-environmental substitutes. This is particularly significant from the perspective of the circular economy, where the value of products, materials, and resources is maintained in the economy as long as possible, and the generation of waste is minimized, [3], [4]. The concept of resource-efficient eco-innovations for a circular economy in the EU companies was presented in, [5], [6].

Drivers and barriers to introducing eco-innovations are widely considered in the literature. From the perspective of their implementation into a circular economy, they can be classified into technical, economic/market, institutional/regulatory, and social/cultural dimensions, [7]. Another classification of drivers groups them into political system (legislation, incentives, market structures), social system, and educational system, [8], or production, consumption, and waste management areas, [9], or public administration, networking, and

technological factors, [10]. It is noteworthy that in the last twenty years, the literature relating to sustainable product development has significantly increased, [11]. In recent years, there were also published studies related to eco-innovations in the EU countries, [12], [13], [14], [15], [16]. Beltrán-Esteve and Picazo-Tadeo assessed environmental performance in the European Union in 2001-2013 from the perspective of eco-innovation and catching, [12]. The results of research conducted by Cecere and Mazzanti indicated that green products and service innovations support the creation of green jobs in European small and medium enterprises (SMEs), [13]. Analytically, [13], indicated, using the Community Innovation Survey 2012-2014, that public financial subsidies and a company's environment (e.g., existing environmental regulations and taxes) are the crucial factors in the process of creation of eco-innovation with environmental benefits, [14]. Koszarek-Cyra verified the hypothesis in selected EU countries that citizens' high environmental awareness increases the number of pro-ecological initiatives undertaken in SMEs, [15]. In turn, Hajdukiewicz and Pera investigated eco-innovations in the European Union in the context of key areas for improvement that include the total R&D personnel, eco-innovation patents, energy productivity, and implementation of sustainable products among SMEs, [16]. The literature review indicated that there is no current research devoted to the importance of factors affecting environmental innovation in the EU, and environmental benefits obtained during the consumption or use of innovative products. The lack of studies devoted to the above-mentioned field was the motivation to carry out relevant research for the latest Community Innovation Survey that refers to the year 2020. Moreover, this research investigates the difference in assessing the importance of factors related to the development of eco-innovations by the EU innovative and non-innovative enterprises.

The paper is organized as follows: Section 2 presents materials and methods, including a description of the database search. Section 3 presents the results of data analysis and discussion. Section 4 presents the conclusion and further research.

2 Materials and Methods

The data was collected from European Statistical System (Eurostat) datasets, namely the Community Innovation Survey (CIS) 2020. This survey includes data related to innovation and environment (data code: inn_cis12_ienv), which is something new

compared to the previous surveys (CIS 2018, 2016, etc.). CISs are prepared by national statistical offices across the EU and can serve as the data source for measuring innovation in the EU. CISs collect data on the innovativeness of various types of enterprises, sectors, countries, innovation types, and economic activity. Moreover, CISs gather data related to innovation in products and processes, innovation activity and expenditure, innovation effects, innovation collaboration, public innovation research, and the source of information for innovation patents. Every two years, Eurostat publishes a successive survey, [17]. At the moment of preparing this study (August 2023), Eurostat provides data sets related to CIS12 that refer to the year 2020, [18].

The second survey prepared for the European Commission in 2020 refers to attitudes of European citizens regarding the environment, [19]. The report called "Special Eurobarometer 501" covers issues related to general attitudes toward the environment and sources of information, ways of acting to tackle environmental issues, and the role of the EU in environmental protection.

In this study, the following data was collected for investigation:

- enterprises by type and importance of factors related to climate change, activity, and size class (data code: inn_cis12_clim);
- enterprises by type and importance of factors driving environmental innovations, activity, and size class (data code: inn_cis12_envf);
- enterprises by type and importance of environmental benefits obtained during the consumption or use of an innovative product of the enterprise, activity, and size class (data code: inn_cis12_envu);
- national expenditure on environmental protection by institutional sector (data code: env_ac_epneis1);
- inflation rate (data code: tec00118);
- greenhouse gas emissions from production activities (data code: cei_gsr011).

The study aims to verify the four following hypotheses:

H1: there is a significant positive dependence between national expenditure on environmental protection and the high level of importance of factors related to government policies in the EU countries;

H2: there is a significant positive dependence between the level of inflation rate and the high level of importance of factors related to increasing costs or input prices;

H3: there is a significant positive dependence between the level of awareness of EU citizens (national expenditure on environmental protection in households) and the high level of importance of factors related to increasing customer demand;

H4: there is a significant positive dependence between greenhouse gas emissions from production activities and the level of the high level of importance of factors related to the impacts of extreme weather conditions.

The verification of the above hypotheses is carried out using regression analysis.

3 Data Analysis and Findings

This section is divided into three areas of data analysis: 1) the level of importance of factors related to introducing environmental innovations in the EU innovative enterprises, non-innovative enterprises, and all enterprises; 2) factors driving environmental innovations and benefits obtained during their consumption or use; 3) regression analysis for verifying research hypotheses.

3.1 Importance of Factors Related to Eco Innovations

The level of importance of factors related to environmental innovations is presented for the EU innovative, non-innovative, and all enterprises. These factors refer to government policies or measures, increasing customer demand, increasing costs or input prices, and impacts of extreme weather conditions (data code: inn_cis12_clim).

Figure 1 illustrates the level of importance of the factor regarding government policies. The EU innovative enterprises have indicated the high level of importance of government policies in 11%, whereas non-innovative enterprises in 6%. The medium level of importance has reached 22% and 17% in innovative and non-innovative enterprises, whereas the low level is 29% and 24%, respectively. In turn, no importance of government policies was indicated by 38% and 53% of innovative and non-innovative enterprises, respectively.

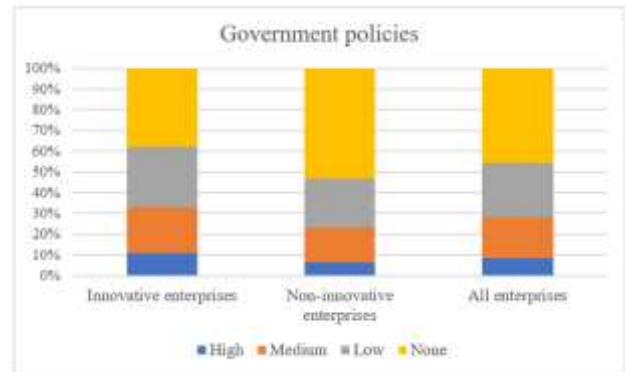


Fig. 1: The importance level of government policies

Figure 2 presents the importance level of the factor related to increasing customer demand. The structure of importance of this factor is very similar to the previous one. The EU innovative enterprises have indicated the high level of importance of increasing customer demand in 11%, whereas non-innovative enterprises in 5%. In turn, the importance of increasing customer demand was indicated by 39% and 56% of innovative and non-innovative enterprises, respectively.

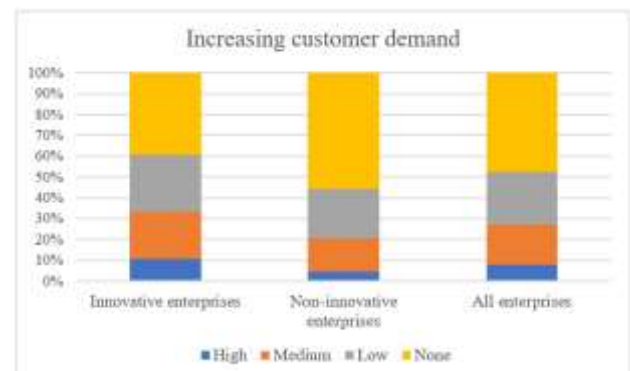


Fig. 2: The importance level of increasing customer demand

Figure 3 illustrates the importance level of increasing costs or input prices. Again, this factor has a similar structure of importance as the previous ones. The EU innovative enterprises have indicated greater values of high, medium, and low importance for costs or input prices, whereas non-innovative enterprises have indicated a greater level of no importance.

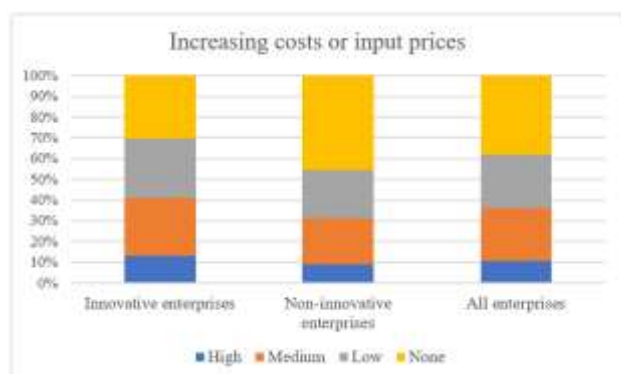


Fig. 3: The importance level of increasing costs or input prices

Figure 4 presents the importance level of the factor related to the impacts of extreme weather conditions. The biggest difference in the assessment among the EU innovative and non-innovative enterprises is in the low level of importance (33% vs. 26%) and no importance of these impacts (43% vs. 54%).

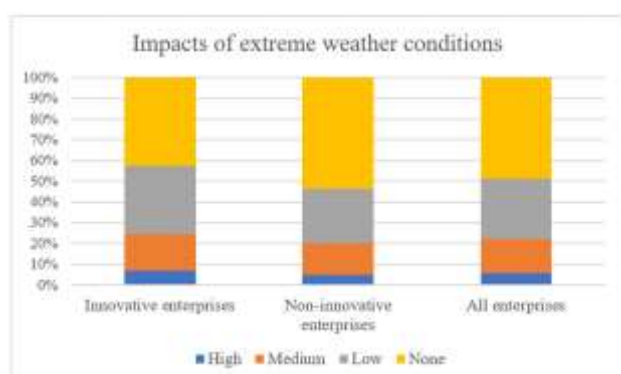


Fig. 4: The importance level of factors related to the impacts of extreme weather conditions

The structure of importance is very similar for different factors related to environmental innovations. The EU innovative enterprises have indicated that the considered factors have a greater impact on eco-innovations compared to non-innovative enterprises. In turn, non-innovative enterprises have mostly chosen the option of “no importance” for factors related to eco-innovations.

3.2 Factors Driving Eco-Innovations and Environmental Benefits

Data analysis in this subsection contains data related to the EU innovative enterprises that have indicated the high level of importance factors related to environmental innovations. Moreover, this data analysis is divided into two areas: the importance of factors related to introducing environmental innovations by the EU enterprises, and

environmental benefits obtained during the consumption or use of innovative products.

Figure 5 presents the importance of factors related to introducing eco-innovations by the EU enterprises in 2020 (data code: inn_cis12_clim). Increasing costs or input prices are the factors of the greatest importance for developing environmental innovations by EU enterprises. On average 13% of enterprises declared the greatest importance for this factor, before government policies (10.7%), increasing customer demand (10.7%), and impacts of extreme weather conditions (6.8%). The factor of increasing costs or input prices had the greatest value in Slovenia (21.8%), Germany (21.3%), Hungary (20.4%), and Poland (17.4%). Hungarian enterprises have indicated the greatest importance of factors regarding government policies (20.8%), increasing customer demand (18.5%), and impacts of extreme weather conditions (12.8%).

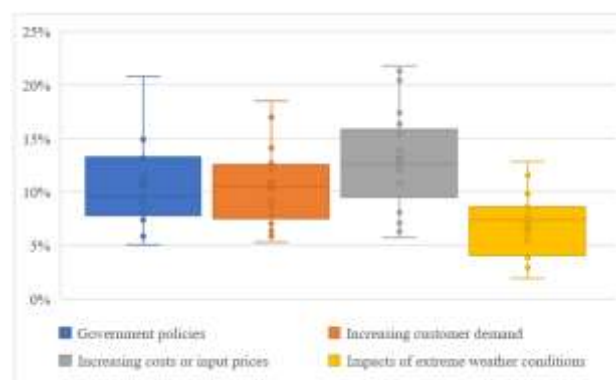


Fig. 5: Factors related to introducing eco-innovations

The further analysis is the detailed version of the previous one. For example, the factor related to government policies is reflected in the following factors: existing regulations, existing taxes, regulations and taxes expected in the future, and government grants, subsidies, or other financial incentives (data code: inn_cis12_envf). The greatest important factors regarding environmental innovations refer to improving the enterprise’s reputation (on average 15.7%) and the high cost of energy, water, or materials (on average 12.7%). The greatest importance of the factor linked to improving an enterprise’s reputation is consistent with expectations. In turn, the significant level of importance for the factor regarding the high cost of energy, water, or materials can be referred to as the increase in resource prices that took place in the last years. On the other hand, the EU enterprises have indicated the least importance for the need to meet requirements for public procurement (on average 5.5%). This can result from the low level of

environmental requirements induced by governments of the EU countries in the aspect of public procurement. Figure 6 presents the importance of nine factors driving environmental innovations.

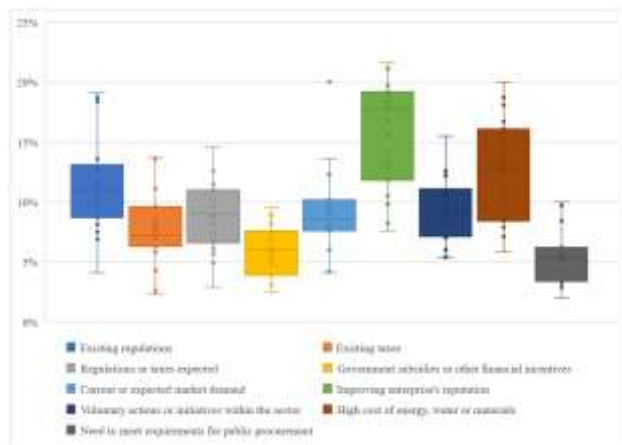


Fig. 6: Factors driving eco-innovations

Existing regulations are the important factor driving environmental innovations in Slovakia (19.1%), Romania (18.7%), and Germany (18.4%). Existing taxes, charges, or fees are mainly considered in Romania (13.7%) and Slovakia (13.6%). Regulations and taxes expected in the future are the significant factor affecting environmental innovations in Slovakia (14.6%) and Slovenia (12.6%). Government grants, subsidies, or other financial incentives are the important factors driving environmental innovations in Lithuania (9.5%), Latvia (8.9%), and Slovenia (8.9%). The greatest value of the factor regarding current or expected market demand was observed in Denmark (20.0%). Improving the enterprise's reputation is the significant factor driving eco-innovations in Denmark (21.6%) and Romania (21.1%). In turn, the high cost of energy, water, or materials is the important factor affecting environmental innovations in Slovenia (20.0%), Germany (18.7%), and Slovakia (18.1%).

The next data analysis refers to environmental benefits obtained during the consumption or use of innovative products (data code: inn_cis12_envu). The results of this analysis are illustrated in Figure 7.

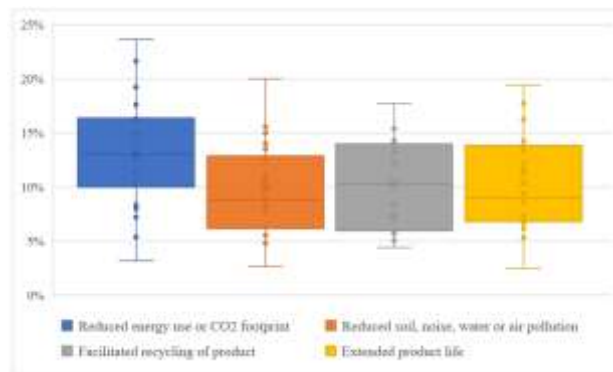


Fig. 7: Environmental benefits related to eco-innovations

The greatest environmental benefit of consumption or use of innovative products indicated by the EU enterprises is the reduction of energy use or CO2 footprint (on average 13.0%). This benefit was indicated the most frequent in Latvia (23.6%), Estonia (21.6%), and Austria (19.2%). Another environmental benefit related to the reduction of soil, noise, water, or air pollution was mostly indicated in Latvia (20.0%), Estonia (15.6%), and Italy (15.0%). Facilitated recycling of products is the successive environmental benefit mainly indicated in Portugal (17.7%), Estonia (15.4%), and Romania (15.4%). In turn, extended product life was mostly indicated in Estonia (19.4%), Latvia (17.7%), and Romania (16.4%).

It is noteworthy that the range of all environmental benefits regarding eco-innovations is very similar. Moreover, the benefit related to reduced energy use or CO2 footprint can result from the high cost of energy that rapidly increased in the EU countries in the last years.

3.3 Verifying Research Hypotheses

The first hypothesis refers to the dependence between national expenditure on environmental protection and the high level of importance of factors related to government policies in EU countries. Figure 8 presents the trend on a scatter plot. This hypothesis was not positively verified.

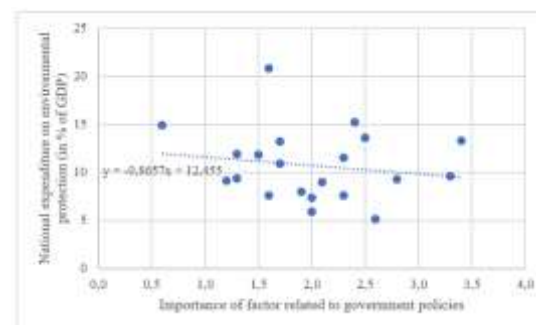


Fig. 8: A scatter plot for H1

The second hypothesis refers to the dependence between the level of inflation rate and the high level of importance of factors related to increasing costs or input prices. Figure 9 illustrates the identified trend on a scatter plot. This hypothesis was also not positively verified.

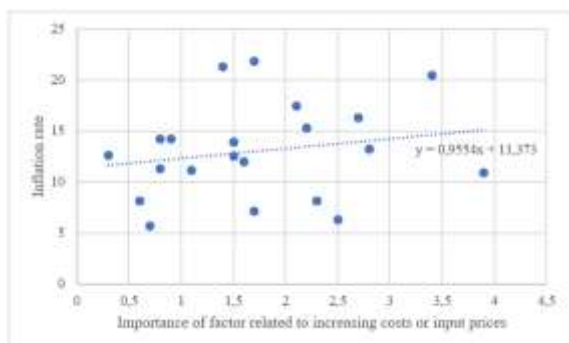


Fig. 9: A scatter plot for H2

The third hypothesis refers to the dependence between national expenditure on environmental protection in households and the high level of importance of factors related to increasing customer demand. Figure 10 illustrates the identified trend on a scatter plot, and hypothesis H3 was not positively verified.

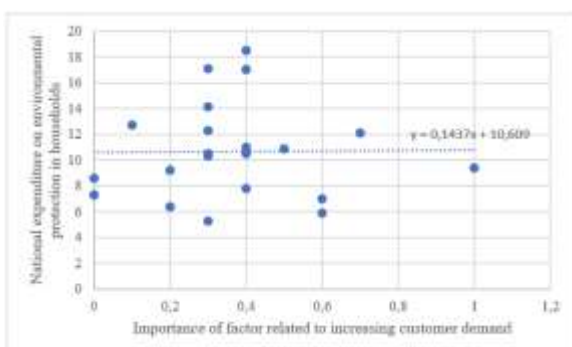


Fig. 10: A scatter plot for H3

The fourth hypothesis refers to the dependence between greenhouse gas emissions from production activities and the level of importance of factors related to the impacts of extreme weather conditions. Figure 11 presents the trend and its parameters on a scatter plot. Also, the hypothesis H4 was not positively verified.

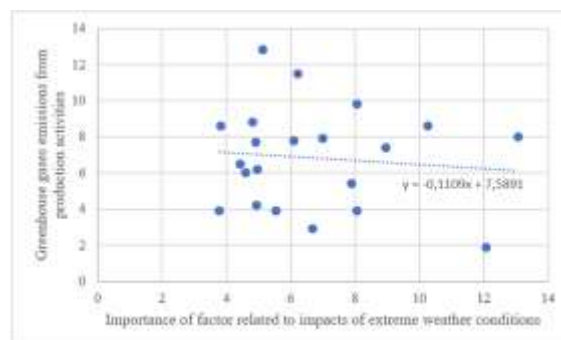


Fig. 11: A scatter plot for H4

4 Discussion and Conclusion

The contribution of this research is the presentation of current trends within eco-innovation in the EU enterprises, and environmental benefits obtained during the consumption or use of innovative products. The results were obtained using data related to the last survey (CIS) that was conducted in 2020. This survey included data regarding innovation and the environment, which was not included in the previous surveys (CIS 2018, CIS 2016, etc.). Consequently, the results presented in this study are wider and more up-to-date compared to the results presented in [12], [14]. Moreover, data analysis conducted in this study indicates that the most important factor driving eco-innovations is related to improving an enterprise's reputation and the high cost of energy, water, or materials. This is in contrast to the results presented in [14], which are based on CIS 2012-2014, and indicated that public financial subsidies and the company's environment are crucial factors in the process of creating eco-innovation with environmental benefits.

Since a company is intended to increase its market position, the greatest importance of the factor related to improving the enterprise's reputation is consistent with expectations. In turn, the high level of importance for the factor regarding the high cost of energy, water, or materials can be referred to as the increase in resource prices that took place in recent years in the EU countries. On the other hand, the EU enterprises have indicated the least importance related to meeting requirements for public procurement. This can result from the low level of environmental requirements induced by governments of the EU countries in the aspect of public procurement.

The aim of the presented work was two-fold. Firstly, the presentation of the importance of factors affecting environmental innovation in the EU, and environmental benefits obtained during the consumption or use of innovative products.

Secondly, the presentation of the difference in assessing the importance of factors related to introducing environmental innovations by the EU innovative and non-innovative enterprises. The results have indicated a significant difference between innovative enterprises and non-innovative enterprises. Innovative enterprises have indicated the higher level of importance of government policies and other factors, whereas non-innovative enterprises have not indicated the importance of considered factors. Moreover, the results of data analysis indicated that increasing costs or input prices is the most important factor for developing environmental innovations by the EU enterprises, whereas the impact of extreme weather conditions is the least important factor. Another result of the presented study indicated that the greatest environmental benefit of consumption or use of innovative products is the reduction of energy use or CO2 footprint. Furthermore, this study also includes the verification of four hypotheses regarding, for example, the aspect of the effectiveness of national expenditure on environmental protection and its impact on increasing customer demand. In addition to this, the results can support policymakers in identifying what factors related to government policies (existing regulations, existing taxes, regulations and taxes expected in the future, government grants, subsidies, or other financial incentives) are the most and least important for innovative and non-innovative enterprises.

References:

- [1] Ociepa-Kubicka, A., & Pachura, P., Eco-innovations in the functioning of companies. *Environmental Research*, Vol.156, 2017, pp. 284-290.
- [2] Karakaya, E., Hidalgo, A., & Nuur, C., Diffusion of eco-innovations: A review. *Renewable and Sustainable Energy Reviews*, Vol.33, 2014, pp. 392-399.
- [3] EC, Communication from the commission to the European parliament, the European council, the council, the European economic and social committee and the committee of the regions on a monitoring framework for the circular economy. *European Commission: Strasbourg* 2018.
- [4] Relich, M., A data-driven approach for improving sustainable product development. *Sustainability*, Vol.15, No.8, 2023, 6736.
- [5] Cainelli, G., D'Amato, A., & Mazzanti, M., Resource efficient eco-innovations for a circular economy: Evidence from EU firms. *Research Policy*, Vol.49, No.1, 2020, 103827.
- [6] Relich, M., Predictive and prescriptive analytics in identifying opportunities for improving sustainable manufacturing. *Sustainability*, Vol.15, No.9, 2023, 7667.
- [7] De Jesus, A., & Mendonça, S., Lost in transition? Drivers and barriers in the eco-innovation road to the circular economy. *Ecological Economics*, Vol.145, 2018, pp. 75-89.
- [8] Durán-Romero, G., López, A. M., Beliaeva, T., Ferasso, M., Garonne, C., & Jones, P., Bridging the gap between circular economy and climate change mitigation policies through eco-innovations and Quintuple Helix Model. *Technological Forecasting and Social Change*, Vol.160, 2020, 120246.
- [9] Aldieri, L., Brahmī, M., Bruno, B., & Vinci, C. P., Circular economy business models: the complementarities with sharing economy and eco-innovations investments. *Sustainability*, Vol.13, No. 22, 2021, 12438.
- [10] Passaro, R., Quinto, I., Scandurra, G., & Thomas, A., The drivers of eco-innovations in small and medium-sized enterprises: A systematic literature review and research directions. *Business Strategy and the Environment*, Vol.32, No.4, 2023, pp. 1432-1450.
- [11] Relich, M., Knowledge dissemination of sustainable product development. In *24th European Conference on Knowledge Management*, 2023, pp. 1106-1115.
- [12] Beltrán-Esteve, M., & Picazo-Tadeo, A. J., Assessing environmental performance in the European Union: Eco-innovation versus catching-up. *Energy Policy*, Vol.104, 2017, pp. 240-252.
- [13] Cecere, G., & Mazzanti, M., Green jobs and eco-innovations in European SMEs. *Resource and Energy Economics*, Vol.49, 2017, pp. 86-98.
- [14] Prokop, V., Stejskal, J., Hajek, P., & Kuba, O., Creating eco-innovations for sustainable entrepreneurship and development within european countries. *European Journal of Sustainable Development*, Vol.8, No.3, 2019, pp. 183-183.
- [15] Koszarek-Cyra, A., Eco-innovations in the SME sector in recent years—the perspective of selected EU countries. In *37th International Business Information Management Association Conference*, 2021, pp. 7694-7702.

- [16] Hajdukiewicz, A., & Pera, B., Eco-innovation in the European Union: Challenges for catching-up economies. *Entrepreneurial Business & Economics Review*, Vol.11, No.1, 2023, pp. 145-164.
- [17] Hamam, M., D'Amico, M., Zarbà, C., Chinnici, G., & Tóth, J., Eco-Innovations transition of agri-food enterprises into a circular economy. *Frontiers in Sustainable Food Systems*, Vol.6, 2022, 845420.
- [18] Community Innovation Survey (CIS) 2020, [Online].
<https://ec.europa.eu/eurostat/web/main/data/database> (Accessed Date: August 20, 2023).
- [19] Special Eurobarometer 501, [Online].
http://data.europa.eu/euodp/en/data/dataset/S257_92_4_501_ENG, (Accessed Date: August 20, 2023).

Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

The author contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

No funding was received for conducting this study.

Conflict of Interest

The author has no conflicts of interest to declare.

Creative Commons Attribution License 4.0 (Attribution 4.0 International, CC BY 4.0)

This article is published under the terms of the Creative Commons Attribution License 4.0

https://creativecommons.org/licenses/by/4.0/deed.en_US