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Eco-innovation of enterprises operating in Poland against the background of EU countries

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ABSTRACT

Eco-innovation is any innovation that leads to sustainable development by limiting the negative impact of production activities on the environment, increasing the resilience of nature to loads or ensuring greater efficiency and responsibility in the use of natural resources. Eco-innovations are opportunity for enterprises. Their introduction contributes to reduce the costs of doing business, allows you to take advantage of new opportunities development and positively affects the company's image. The main goal of the research is to recognize the situation and the level of eco-innovation in Poland, including the micro, small and medium enterprises sector and to compare the obtained results with the ones from EU countries. The result of the research is indicating the barriers and opportunities to support the development of eco-innovation in the micro, small and medium enterprises sector in Poland. Lack of financial resources for eco-innovation was indicated as the largest barrier by MSMEs in Poland. The most significant barriers to eco-innovation in Poland are mainly of an economic nature, including high cost of implementation, difficult access to capital, uncertain return on investment and the weak system of economic and fiscal incentives encouraging eco-innovation.

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INTRODUCTION

The Micro, small and medium enterprises sector (*MSME)* plays an important role in all economies around the world. There are 1.84 million non-financial companies in Poland, defined as active enterprises, including 99.8% of companies of the MSME sector (according to the data for 2014, following the publication the activity of non-financial enterprises in 2014 (CSO, 2016) When assessing the number of companies operating in Poland in absolute terms, it must be concluded that it is high, however, when using the indicator of the number of enterprises in relation to the size of the population, Poland occupies only the 22nd position among EU countries (Wielgórka, 2018). Large enterprises was in Poland only 3.5 thousand in 2016. The sector of MSMEs is a main stimulator of economic development while generating 50.2% of GDP of the whole sector of enterprises and employing 69.8% of people employed in enterprises (CSO, 2016). Growing expectations of the environment, taking into account environmental management in social (Borghesi *et al.,* 2013) and environmental terms (including reduction in micro-pollutants) affect the decision of enterprises concerning the implementation of the concept of corporate social responsibility (CSR) (Wielgórka, 2018). The need for the implementation of the concept of sustainable development (SDE), by means of an increase in eco-innovation, is an essential development goal (Eryigit, Özcüre, 2015; Moore and Manring, 2009), which is reflected among others in the Europe 2020 strategy, adopted by the European Commission. The position of the sector of enterprises in Poland in terms of total innovation as well as eco-innovation is low. The introduction of eco-innovation by companies is mainly the result of adjustments to legal regulations imposed by the State in Poland. Most of eco-innovation concerns the solutions aimed at reducing environmental pollution by the main industrial sector. A long-term improvement in the field of eco-innovation requires an increase in financial outlays on this type of investments and greater awareness of MSMEs enterprises. Development determines the use of ecofriendly technologies, which requires investments in eco-innovation, more effective use of resources and reduction in pollution. The introduction of modern technologies compliant with the concept of sustainable development is becoming an important challenge for modern economies (Kuo and Smith, 2018). Unfortunately a large share in economy belongs to traditional energy intensive industrial sectors in Poland. Therefore, it becomes necessary to take actions directed at rational use of resources, raising awareness and investments of MSMEs in the field of eco-innovation. The main goal of the research is to recognize the situation and the level of eco-innovation in Poland in 2010-2017, indicating the barriers and opportunities to support the development of eco-innovation in the MSME sector in Poland. The vision of the further development of the European Union, adopted in the Europe 2020 strategy, includes three interrelated priorities (Europe 2020):

- smart development: economic development based on knowledge and innovation;
- sustainable development: supporting a more resource efficient, greener and more competitive economy;
- inclusive growth: fostering a high-employment economy delivering social and territorial cohesion.

At the end of the 20th century occurred the concept of eco-innovation as a result of responsibility for the environment and the growing awareness of risks associated with the natural environment. The concept of eco-innovation in theory is defined multidimensionally. In general terms eco-innovation applies to innovation bringing the effects for the environment (Marchi, 2012). The eco-innovation (classic definition) means a new product which provides value to the customer and business and at the same time significantly reduces the negative impact on the environment (Nowak and Szewczyk, 2016). Eco-innovation is technological, service, production processes which reduce the negative impact on the environment (Flis, 2010). The essence of eco-innovation is an integrated approach to the use of the created concepts in the field of environmental protection and the economy (Ziółkowski and Woźniak, 2010). These are processes (production, technological, service) that reduce the negative impact on the natural environment (Wolski, Zawieja, 2014). Eco-innovation is an opportunity for the implementation of sustainable solutions that will allow for more effective use of natural resources and reduction in the harmful impact on the environment while simultaneously maintaining a high level of innovation (Foltynowicz, 2008). The concept of eco-innovation is also understood as creating new and

competitively assessed goods, systems, services (Cainelli and Mazzanti, 2013) and procedures, processes, which may satisfy human needs and provide the quality of life to all people along with the minimum use of natural resources per production unit and minimum emission of toxic substances (Schmidt-Bleek, 2000). Insufficient level of knowledge on development of eco-innovation in Poland was adopted as the main research problem. This allowed to define main research objectives of this study, which were to identify situation and the level of eco-innovation in Poland, including the MSME sector, and to compare the results with results from EU countries in 2010-2017. In order to achieve assumed goals of the study, the following research hypothesis was verified: "Eco-innovation level of Polish enterprises is very low but has a large growth potential". In order to resolve identified research problem and also to verify the hypothesis, literature and empirical studies were carried out. As part of literature research, global and national literature has been reviewed. As part of empirical research carried out in order to verify the research hypothesis set out in the paper, statistical data regarding the level of eco-innovation in the EU countries was analyzed and a survey was conducted on a randomly selected group of 300 MSMEs with their headquarters in Poland.

MATERIALS AND METHODS

Identification of barriers and sources of eco-innovation financing of MSMEs

A modern company should be managed in terms of strategy, market and innovation (De Marchi, 2012; Tylec and Ostraszewska, 2015). It must cooperate with its environment (Nulkar, 2014), take care of the market and modernity of its products but, most of all, it must be open to changes. The use of environmentally friendly processes (eco-innovation) (Demirel and Kesidou, 2019) is more and more frequently recognized, appreciated and demanded by customers. The most important barriers to development and the acceleration of dissemination of eco-innovation are:

- uncertain market demand, uncertain return on investment or too much long payback period for eco-innovation;
- lack of funds in the MSMEs;
- insufficient access to the financial incentives and existing subsidies;
- applicable provisions and structures not providing sufficient incentives for eco-innovation;
- lack of external funding (CCEP, 2011; Polzin *et al.,* 2016).

In the subject literature, an important position is occupied by the problem of barriers to the implementation of eco-innovation in enterprises, including MSMEs (Marin *et al.,* 2015; Rossi *et al.,* 2016). Among them, there can be identified:

- legal barriers (e.g. non-transparent regulations, too detailed technical requirements limiting the potential of eco-innovative activity, unpredictable changes in provisions bringing about uncertainty of the market and discouraging from investments, , incorrectly established standards);
- demand barriers (e.g. the market dominated by the existing companies, market prices reflecting only economic costs, uncertain demand in the market, lack of possibility to distinguish the product in terms of its eco- preferentiality in connection with deficit of reliable information);
- economic barriers (e.g. lack of external funding, lack of funds in the company, uncertainty of benefits by the pioneers in the market, high risk and uncertain return on investment) (Scarpellini *et al.,* 2016);
- research and development barriers (e.g. maladjustment of the activity of research and development institutions to innovation needs, underfunding of research and development projects, lack of support for cooperation between science and industry);
- technological barriers (e.g. the solutions dominating in the market creating the input barriers to new technologies, technological potential and limited availability of technology, long period of replacement of the existing infrastructure);
- cooperation barriers (e.g. lack of suitable business partners, lack of suitable suppliers, weak interactions between the actors of the innovation system, lack of cooperation between enterprises and research and development institutions, limited access to external information,)
- staff barriers (e.g. lack of experienced and qualified staff, lack of proper managerial skills and technical expertise, resistance to changes, inability to manage tasks associated with the eco-innovation process, inability to absorb the solutions developed

outside the company) (Ryszko, 2014).

The main barriers to the implementation of eco-innovation in MSMEs include, most of all, the lack of funds. The sources of the financing of eco-innovation may include many financial instruments (Scarpellini *et al.,* 2018) depending on the criteria:

- ownership right: own capital, foreign capital for example bank credit, loan;
- sources of capital: external, internal;
- time of disposal of specific capital, including short-term capital, long-term capital (Wielgórka, 2011).

The major sources of the financing of eco-innovation of MSMEs is own capital. It's increasing, creating may be internal (self-financing) and external, this may consist in increasing own capital. Foreign capital is the capital acquired from the outside from the environment in which the company operates and must be returned. Foreign capital is to finance the activity of the company and its development, it is too used in the financing of eco-innovation. The main division of this capital due to the time of disposal of specific capital is into: short-term capital and long-term capital. The instruments supporting the development of the economies of EU countries, belonging to Structural Policy, are Structural Funds - directed to different sectors of economies that need help to catch up with others, more developed ones (Bień and Wójcik-Mazur, 2014). Micro, small and medium enterprises can receive grants from various funds for eco-innovation provided they meet certain requirements (Colombo *et al.,* 2019). Poland has the strategy which is aimed at creating the conditions for growth in innovation and competitiveness of the economy and entrepreneurship ensuring employment growth and an increase in the level of economic, social and spatial cohesion. The funds for this strategy come from the following UE funds: the European Social Fund (ESF), the European Regional Development Fund (ERDF), the European Agricultural Fund for Rural Development, the Cohesion Fund (CF) and the European Fisheries Fund. In Poland the prospect for years 2014-2020 is implemented by means sixteen regional programs managed by Marshall Offices and six national operational programs managed by the Ministry of Development. MSMEs will be able to use to finance eco-innovation:

- Infrastructure and Environment Operational Program;
- Smart Growth Operational Program;
- Regional Operational Programs (16 in Poland);
- Knowledge-Education-Development Operational Program.

Micro, small and medium enterprises that want to develop the eco-innovation project at the local or regional level should focus on the monitoring of the provisions of Regional Operational Programs 16 in Poland). ROP are adopted for each voivodeship individually. The main objectives of ROP are the activities associated with the improvement in competitiveness and promotion of polish regions. The Regional Operational Programs supports for example: preventing and combating environmental and technological threats, the environment, investments in health care infrastructure and in social infrastructure, energy investments. A main problem in the case of the national operational programs is a weak link of environmental issues with innovation, eco-innovation. Infrastructure and Environment Operational Program were allocated most of the funds. The priorities in financing of project of this program are: environmental protection, low-carbon economy, energy security, development of technical infrastructure of the country. The second largest program (in Poland) in terms of the amount of funds is Smart Growth Operational Program - is also the largest program in the EU financing research, development and innovation due to which the support, among others, for research and development projects will be received by scientists and entrepreneurs and the results of Research and Development will be practically applied in the economy. The main assumption of this program is "from ideas to market". It means the support for the emergence of innovation from creation of concepts of unique technologies, products, services, through preparation of prototypes to their commercialization. The objective of Knowledge Education Development Operational Program is professional activation of young people under 30 who are unemployed, support for higher education, development of social innovation, mobility and transnational cooperation.

The analysis of eco-innovation of MSMEs operating in Poland against the background of Eco-IS indices of EU countries in 2017

The measurement of eco-innovation of economies is a difficult task since it is necessary to take into account the effects of the implementation of

innovative pro-environmental solutions. Due to the increasing role of eco-innovation, particularly in the context of the Europe 2020 strategy, the European Commission appointed the Eco-Innovation Observatory (EIO) which, on the basis of the system of indicators, created the first tool for evaluation of eco-innovation - Eco-Innovation Scoreboard – Eco-IS). EIO is a new research area of international statistics only being developed, among others, by OECD and the European Union. The main task of EIO is collecting data associated with eco-innovation in European Union countries. On the basis of these indicators, there was created the ranking of Eco-Innovation Scoreboard. In 2017 Poland occupied the second-to-last - 26th positions among 28 Member States of the EU (O'Brien *et al.,* 2018). Eco-IS index is calculated on the basis of 16 sub-indices concerning five thematic areas. The construction of Eco-IS index includes the total of five areas three of which directly relate to eco-innovation. These are: eco-innovation inputs (green investments of PE/VC funds, government expenditure on environmental, total number of researchers and energy R+D), eco-innovation activities (enterprises introducing eco-innovation improving material and energy efficiency and possessing ISO 14001) and eco-innovation outputs (publications, information on eco-innovation in media, patents). The other two groups of indices are the ones showing the effects of the implementation of eco-innovation such as resource efficiency (water efficiency, energy efficiency and emissivity) and socio-economic outcomes (development of "eco-industries" of economies). It should be noted that the indicators on the side of effects are relatively

Table 1: Eco-innovation Scoreboard (Eco-IS) in EU countries in 2017

	EU countries	Eco-innovation inputs	Eco-innovation activities	Eco-innovation outputs	indicator Eco-IS
I	Sweden	166	148	182	144
	Finland	200	155	202	141
	Germany	178	151	130	139
	Luxemburg	104	124	220	139
	Denmark	178	58	154	120
	Slovenia	141	124	153	117
II	Italy	66	111	112	113
	Austria	91	142	115	113
	Spain	75	106	139	112
	Portugal	104	134	100	105
	United Kingdom	102	87	65	105
	Ireland	113	58	69	99
	France	118	10	107	99
	Netherlands	88	38	91	88
	Malta	23	116	77	86
III	Belgium	94	11	93	83
	Lithuania	29	94	93	82
	Czech Republic	81	126	49	82
	Greece	57	96	142	77
	Croatia	25	93	61	75
	Slovakia	27	90	33	74
	Latvia	41	41	105	73
	Romania	53	37	55	65
	Hungary	39	47	13	63
	Estonia	50	76	90	62
	Poland	43	17	53	59
	Cyprus	4	39	113	45
	Bulgaria	30	37	33	38
	Min	4	10	13	38
	Max	200	155	220	144
	Average	197	145	207	106
I		El leaders			
II		Average EI performers			
III		Countries catching up in EI			

poorly correlated with the indices of intensity of development and implementation of eco-innovation. Environmental effects are measured with statistical indicators which still mainly depend on the historical paths and not eco-innovation implemented in recent years. On the other hand, the definition of eco-industries adopted by Eurostat and Ecorys (2009), on which socio-economic indicators are based, refers to a wide range of activities (renewable energy sources, recycling, among others, treatment plants), however competitiveness and the level of employment of some of them does not have to directly depend on innovative solutions e.g. energy of photovoltaic. At the same time, an essential part of economic effects of eco-innovation appears in enterprises of other industries for which they are e.g. a way to improve productivity. Therefore, the indicators of effects do not differ between the countries of UE28 as much as the ones directly referring to eco-innovation, which is evident also in the case of Poland in 2017. When analyzing the results concerning eco-innovation inputs (Table 1), they were generally above the average for all the countries of the EU. The specific cases are Finland, Denmark, Germany and Sweden where the performance in this component of the Scoreboard was significantly higher than for the other countries. Due to the outstanding performance of Denmark and Ireland, this component is also by far the highest range of ratings (the difference of 196 points between the highest and the lowest point) and the highest standard deviation in the result set.

In the second element of the actions associated with eco-innovation (activities) – the country of the highest efficiency is Finland too. In terms of eco-innovative outcomes the leader is Luxembourg with the result of 220, and the lowest result of Hungary amounting to 13. Poland, in the period considered, was included in the group of "the countries catching up in eco-innovation", unfortunately occupying the second-to-last position ahead of Bulgaria with Eco-IS index result of 59. Eco-IS index in the analyzed years placed the economy of Poland in the fourth position from the end in 2010, in 2011 in the last position and in 2012 – in the second-to-last. The position of Poland in this ranking is low. However, there can be observed a slight increase in points – from 53 to 59 in 2015. If taken into account only the first three areas referring directly to eco-innovation, Poland occupies the last position, however its distance to the EU average is growing (1/3 of the average in relation to 1/2 for the general index). However, this is mainly due to general weakness of Poland in the area of innovation. Low public and private expenditure on green R+D result from the low level of expenditure on the total of R+D activity in Poland.

It is the same in the case of patents where there is noticeable a high share of technologies associated with environmental protection among few patent applications. In turn, Polish companies introduce not only little eco-innovation but innovation in general, moreover, larger enterprises and the ones belonging to the public sector are more eco-innovative. Decomposition of Eco-Innovation Scoreboard index may indicate which areas of eco-innovative activity are well developed and which require specific actions. The achievements of Poland in five thematic areas are taken into account in Eco-SI in years 2010-2017 (Fig. 1). In Poland, all the areas require the intensification of activities (Tylec *et al.* (2015). The most disturbing is the worsening of the position of Poland in relation to the

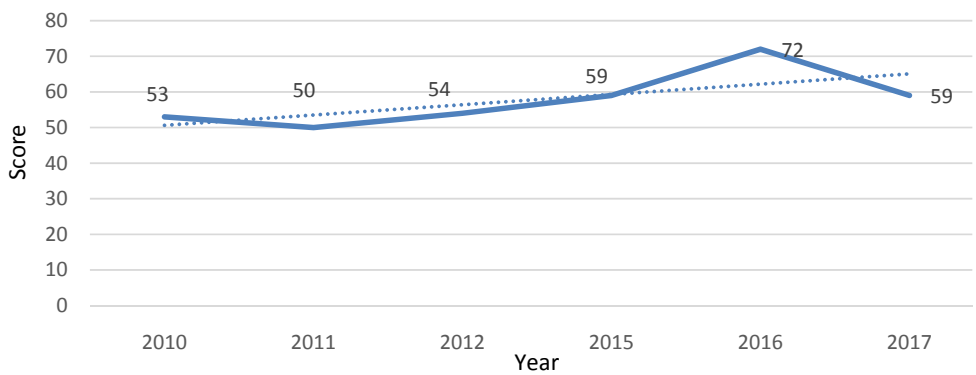


Fig. 1: Eco-IS index for Poland in selected years

average for the EU (28) in the area of eco-innovation inputs. Poland is characterized by unsustainable potential of eco-innovation mainly based on socio-economic outcomes, with very low expenditure on eco-innovation and poor results in the area of eco-innovation activity. The low position of Poland in the rankings of eco-innovation, there was conducted the statistical survey aimed at the identification of the scope of the barriers to and opportunities for the development of eco-innovation in terms of sustainable development of MSMEs. The research was carried out in 2017 on a randomly selected group of three hundred MSMEs with headquarters in the area of Poland. There were received 224 questionnaires suitable for further analysis, which gives a rate of return of 74.7%. The questionnaire results indicate that the main motivation for undertaking activities for the benefit of the environment is the willingness to reduce costs of the business activity (82% of the surveyed MSMEs). The next reason (second) indicated by the entities in question is modernization of technology (73%), followed by improvement in the image by the implementation of Corporate Social Responsibility (58%). 34% of those questioned consider the introduction of eco-innovation in their company e.g. in the form of photovoltaic, renewable energy, energy-saving technology etc. This indicates that Polish entrepreneurs perceive high-efficiency dimension of eco-innovation and economic benefits coming from its implementation, which reflects growing environmental awareness of entrepreneurs. The eco-innovation of MSMEs is most often financed from equity (92%), credit bank (63%) and EU funds (56%). Lack of financial resources for eco-innovation was indicated as the largest barrier by MSMEs in Poland (86%).The most significant barriers to eco-innovation in Poland are mainly of an economic nature, including high cost of implementation (78%), difficult access to capital (76%), uncertain return on investment (62%) and the weak system of economic and fiscal incentives encouraging eco-innovation (58%). Other problems include administrative barriers (46%) as well as insufficient knowledge on potential economic benefits from the implementation of an eco-innovation (43%).

CONCLUSION

Eco-innovation very rarely constitutes an activity of MSMEs isolated by the funders in Poland. Innovative projects developed in the area of ecology are assessed according to the same criteria as other investments, including innovative ones. Taking into account the fact that they are often less focused directly on economic effects, when using the same evaluation criteria, they may get worse overall ratings. The problem is significant funds for environmental protection provided for the local government units, which carry out projects typical of a specific area, i.e. they focus on construction of sewerage, sewage treatment and dissemination of more eco-friendly sources of energy. This results in limiting the possibilities to obtain funds for investments by MSMEs. There has been too little emphasis placed on the connection in the cases of a single investment in innovativeness and environmental protection in the current programming period. It has been probably due to the fact that one of the serious problems is generally low competitiveness and innovativeness of Polish enterprises. It seems that low public and private expenditure on eco-innovation is the consequence of generally very low level of expenditure on research and development activity in Poland. However, on the other hand, in years 2010-2017, there was an increase in public expenditure on R+D but the effects of those actions are only to a limited extent noticeable in the presented data of Eco-Innovation Scoreboard. It can be expected that the position of Poland in terms of Eco-IS in subsequent editions of the research will improve, of course, provided there is an increase in expenditure on eco-innovation. The need for implementation of the principles of sustainable development through dissemination of eco-innovation is a vital goal of the present and future generations, which is reflected, among others, in the Europe 2020 strategy, adopted by the European Commission. Unfortunately, a relatively weak position of Poland in terms of total innovation as well as innovation contributing to the benefits for the environment is reflected in the results of the research commissioned by the European Commission. Polish economy lags far behind not only the leaders of eco-innovation but also the countries which like Poland are included in the group of the countries catching up in the field of eco-innovation. An improvement in the indicators in the field of eco-innovation in Poland requires a substantial increase in expenditure on innovation, construction of appropriate support instruments and greater awareness of MSMEs in the field of benefits

from eco-innovation. It should be emphasized that enterprises that successfully financed eco-innovation most of all used own capital, loans and structural funds, which contributed to an increase in their competitiveness and innovativeness. The Polish green technology market is in the early phase of development and is considered to have sizable growth potential.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

ABBREVIATIONS

%	Percentage
CF	Cohesion fund
CSR	Corporate social responsibility
Eco-IS	*Eco-Innovation scoreboard*
EI-AP	Eco-innovation action plan
EIO	Eco-Innovation observatory
ERDF	European regional development fund
ESF	European social fund
EU	European Union
MSME	Micro, small and medium enterprises
ROP	Regional operational programs

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