DOI: 10.56652/ejmss2020.2.4

Artykuł oryginalny / Original article

Paweł Bartoszczuk (ORCID 0000-0002-2208-5960)
Warsaw School of Economics, Enterprise Institute,
al. Niepodległości 162, 02-554 Warszawa, e-mail: pbarto1@sgh.waw.pl, tel. +48 22 564 86 71

Eco-innovations in examples of Polish enterprises

Ekoinnowacje na przykładzie polskich przedsiębiorstw

ABSTRACT

The goal of the research was to determine the impact of eco-innovations on environmental and financial performance in CEE countries, particularly Poland. There exist several types of them and they can result therefore in a new or significantly improved product (good or service), process, a new type of marketing or new organizational methods. Some authors have proposed a narrowing of this concept. According to these researchers, the reason for eco-innovation introduction is the deliberate pursuit of a lower environmental burden, as well as the achievement of a specific environmental effect. Eco-innovation should be seen as an integral part of innovation efforts across all the economy's sectors. We give three examples of eco-innovative projects in Poland. While large companies are more willing to cooperate with universities and are thus more likely to innovate, SMEs are reluctant to do so and to co-operate among themselves due to a lack of trust, as well as no incentives to innovate.

Keywords: eco-innovation; environment; Central European Countries; economy; enterprise; environment

STRESZCZENIE

Istnieje kilka typów ekoinnowacji. Mogą one skutkować powstaniem nowego lub istotnie ulepszonego produktu (dobra lub usługi), procesu, nowych metod marketingowych lub organizacyjnych. Niektórzy autorzy zaproponowali zawężenie tej koncepcji. Zgodnie z wynikami ich badań, powodem wprowadzania ekoinnowacji jest dążenie do ograniczenia degradacji środowiska, a także osiągnięcie szczególnego wpływu na środowisko Ekoinnowacje powinny być postrzegane jako integralna część wysiłków na rzecz innowacji we wszystkich sektorach gospodarki. Celem badań było określenie wpływu ekoinnowacji na wyniki środowiskowe i finansowe w krajach Europy Środkowej i Wschodniej, w szczególności w Polsce. Podano trzy przykłady projektów ekoinnowacyjnych w Polsce. Zauważono też, że podczas gdy duże przedsiębiorstwa są skłonne do współpracy z uniwersytetami, a zatem są skłonne do wprowadzania innowacji, małe i średnie firmy niechętnie wprowadzają innowacje i współpracują ze sobą z powodu braku zachęt i zaufania, a także braku motywacji do innowacyjnych rozwiązań.

Słowa kluczowe: ekoinnowacje, środowisko, kraje Europy Środkowej, gospodarka, przedsiębiorczość, środowisko.

1. DEFINITION OF ECOINNOVATION

In the literature, there is a general division into two main groups defining how eco-innovation is defined. In the case of the first, eco-innovation is treated as a subclass of innovation that improves both economic, prosperity and the state of the natural environment. According to Fussler and other scholars (Fussler & James, 1996, p. 346; Huppes et al., 2008; Hemmelskamp, 1997), they benefit both the entrepreneur and the consumer while significantly reducing the negative impact on the environment'. Similarly others (Arundel & Kemp, 2007; Bukowski, Szpor i Śniegocki, 2012; Ehrenfeld, 2008; James, 1997; Kanerva, Arundel, & Kemp , 2009; Kemp & Pearson, 2007; Lee & Min, 2015; Norberg-Bohm, 2000) agreed that, in order to establish the ecological nature of the innovation in question, 'it is sufficient to demonstrate that, as a result of their implementation, there is an ecological effect of reducing the negative impact of the com-

otrzymano / received: 07.11.2020 | poprawiono / corrected: 25.11.2020 | zaakceptowano / accepted: 08.12.2020

DOI: 10.56652/ejmss2020.2.4

pany on the natural environment'. Actions to reduce this impact include both technological changes to improve the efficiency of products and services and how they are made to improve the environment (Kemp & Pearson, 2007). However, it should be noted that innovations that are not eco-innovations can also contribute to improving the environment.

The second group, on the other hand, contains definitions that are based on broad concept of eco-innovation, according to which eco-innovation is not a type of innovation, but consists of environmental dimensions in companies' economic strategies, including process eco-innovations, product innovations and organisational changes in business management, and changes in social and political aspects (Beliën & Forcé, 2012; Carrillo-Hermosilla, Del Río González, & Könnöla, 2009; Ghisetti & Pontoni, 2015; Hellström, 2007; Huber, 2008; Oltra, 2008; Porter & Linde, 1995; Rennings, 2000). Some authors have proposed narrowing this concept. According to these researchers, the reason (Sinclair-Desgagné, Feigenbaum, & Pawlak, 2003) for the introduction of eco-innovation is the deliberate pursuit of a lower environmental burden, as well as the achievement of specific environmental effect. The authors also stress the positive ecological effect associated with the use of the product, but at the same time emphasize the lower importance of the intended introduction of environmental innovations (Arundel & Kemp, 2007; Oksanen & Hautamäki, 2015; Roscoe, Cousins, & Lamming, 2016; Xavier, Naveiro, Aoussat, & Reyes, 2017).

Eco-innovation can be divided into: product, process, organizational or marketing, as well as ordinary innovations (OECD, 2009):

1) pollution management,
2) cleaner technologies and products,
3) management of resources and products preferred for ecology.

Innovation, depending on some of the criteria adopted, can be divided into (Białoń, 2010):

1) **Product– new** product or upgraded product,
2) **Technological** – a complete or partial change in the factors or characteristics of manufacturing processes and the proportions between them,
3) **Organizational –** e.g. *lean management, kaizen, reengineering,* quality management,
4) **From the** name of incentive systems, organizational culture.

Due to the environmental impact of innovation, eco--innovations can be:

1) **Environmental protection (eco-innovation)** – leading to savings in the consumption of materials; in the marketing of organic products.
2) **Indifferent – not** affecting natural and human environments.
3) **They have a negative impact** on elements of the natural environment and on man.

Particular attention should be paid to the criterion of the relation to the natural environment, according to which eco-innovations can be distinguished: ecological, ecological and neutral. It is important that eco-innovation should be seen at different levels: manufacturing companies as well as services; (municipalities, cities, provinces, regions of all sizes, up to a global scale) and consumers (individual and institutional).

According to the novelty criterion, innovations that are new at the level of the world, country or industry and only on an enterprise scale are distinguished. on the other hand, in relation to the impact criterion, it is proposed to divide the company into innovations within the company and in its external environment.

The literature indicates that most **innovations and eco-innovations are incremental** (Barczak, 1995). This category means increasing ecological efficiency in existing processes by introducing environmentally friendly materials into the production cycle, improving technology and focusing on reducing production waste generated. The typology of eco-innovation, (Hellström, 2007) including eco-innovation and increment and marketing, is illustrated in Figure 1.

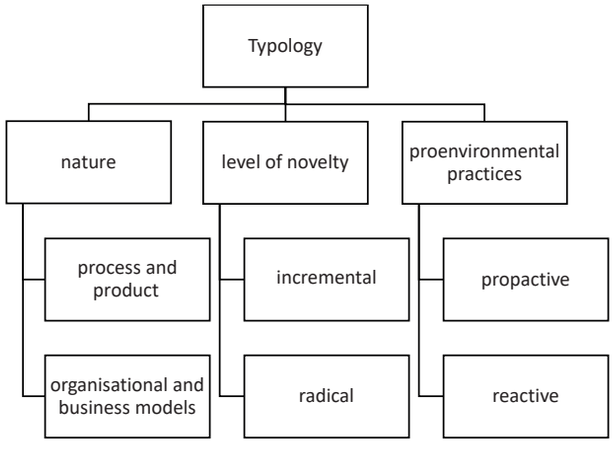

Figure 1. Typology of eco-innovation
Source: Xavier et al. (2017).

Yet another division of eco-innovation developed on the basis of the literature studies proposed L.C. Basso with colleagues (Table 1).

In a slightly different way he shared the ecoinnovations of L. Woźniak and his colleagues (Woźniak, Strojny, & Wojnicka, 2010) distinguishing in this case the following important groups:

1. Ecoproduct innovation – the need to apply them is due to shortening product life cycles and the appearance of new models; ecodesign, the product can be improved by using more environmentally friendly materials (organic, recycled, high durability, low energy consumption) while developing environmental technologies (e.g. renewable energy sources); they are completely new products (Hart, 1995; van Hemel & Cramer, 2002).

Table 1. Classification of certain types of eco-innovation, their definitions and authors

Lp.	Type of eco-innovation	Definition	Author
1	Eco-innovations in the life cycle	Well-established in both the new product and significant changes at any stage of the life cycle of this product. This taxonomy provides for both a reduction in the use of raw materials and the level of waste at any stage of the product life cycle, i.e. from the production phase up to the consumption phase.	J. Huber (2008) ; A. Reid & M. Miedziński (2008)
2	Product eco-innovation	It refers to new or improved products whose environmental impact is minimized.	
3	Process eco-innovation	Processes based on new or improved production systems to meet certain sustainability principles, such as reducing water, energy, raw materials, gas and waste emissions, waste of materials.	
4	Organisational eco-innovations	incorporating environmental management tools, such as ISO 14000 family standards or voluntary agreements (e.g. gri global reporting initiative).	
5	Marketing eco-innovations	Introduction of a new marketing method, embodying significant changes in product design, packaging, product promotion, markets, product consumption education.	
6	Incremental eco-innovations	Based on catalyzing existing technologies to improve them and make them more resource efficient.	M. Kanerva, A. Arundel, & R. Kemp (2009), OECD (2012)
7	Eco-innovation disturbing	It refers to a change in the way processes or products are carried out without having to change the technological paradigm, e.g. by changing the way in which they are carried out. E.g. replacement of traditional light bulbs with fluorescent.	M. Kanerva, A. Arundel, & R. Kemp (2009), OECD (2012)
8	Radical eco-innovation	Founded as a result of changes in the paradigm of technology, including economic change or creation in consumption and supply chain.	OECD (2012)

Source: Basso, Santos, Kimura, & Braga (2013).

2. Eco-process innovation – eco-friendly innovation activities are safe for the consumer from the perspective of dominant manufacturing innovation processes; These are used for the production of goods and services, often to increase eco-efficiency (Huber, 2008).
3. Eco-innovation of business models – related to the creation of new markets through the ecological image of the company and the product; one example of this type of innovation is cooperation with local producers, being socially responsible and creating new outlets.
4. Organizational innovations – require adaptation of structures and procedures in the company and modern environmental management (OECD/Eurostat, 2005; Klewitz, Zeyen, & Hansen, 2012; Rennings, Ziegler, Ankele, & Hoffmann, 2006) standards; solutions are used in the form of end-of-pipe strategies and cleaner production technologies; in this case, companies are heavily involved in a cleaner production strategy in order to change the way resources are used, to manage the product through closed circuits or industrial symbiosis and to improve the overall ecological efficiency of economic activities (Altham, 2007).

2. ECO-INNOVATION CASE STUDIES

One of the examples of Polish eco innovative companies, SEEDiA, provides smart ecological furniture that is powered by renewable energy. This Polish start-up 2 places electric sockets in public urban places such as benches, trash, kiosk, bus shelters, etc. Their mission is to design for Smart Cities modern and innovative usable objects of small architecture powered by solar energy. Their initiative has received recognition in the shape of many awards, including the Orange Fab Best Startup 2018 and was a finalist in the Urban Environment no 8 contest Smart City Expo in Barcelona.

The first solar benches were installed by SEEDiA, which, in addition to the seat function, give you the opportunity to charge your phone or use a WiFi hotspot. With mounted photovoltaic panels, SEEDiA smart furniture also reduces CO_2 emissions into the environment (SEEDiA, 2020). Another example is Pronosis's remote energy meter reading system, which uses wireless technology to provide customers with up-to-date, exhaustive data from their electricity meters in the form of easy-to-read charts and reports. They check and monitor their energy consumption 24 hours a day via an online application accessible from any web browser and portable devices. The system sends customers immediate e-mail or SMS alerts regarding optimal tariffs and enables them to adjust their contracted electricity capacity to avoid fines for exceeding it. Prognosis offers comprehensive energy management diagnostics and audits and can quickly pinpoint the most energy-intensive aspects of an organization's activity. This can support customers in making upgrades to their electricity infrastructure, leading to further savings of up to 15%. Finally, as well as benefiting customers, the technology has allowed Prognosis to achieve sales revenues of over approximately EUR 330 000 (PLN 1.4 million) and create seven

DOI: 10.56652/ejmss2020.2.4

full-time equivalent jobs. EU funding supported its creation and helped Prognosis implement a business model to commercialize the product and related services in domestic and international markets.

A sustainable and circular fashion business, LPP is another example of a Polish clothing manufacturer that has been adapting to the environmental challenge of the clothing industry. The philosophy of LPP is local thinking and global action in an eco-innovative manner. Since 2017, they have been implementing the Sustainable Development Strategy LPP based on 4 pillars: product, employees, environment and principles. The Polish clothing manufacturer has committed itself by 2025 to using plastic packaging that meets one of the following criteria: 100% reusable, recyclable or compostable. According to the president of LPP: 'Joining the global agreement for rational plastic management and elimination of plastic waste means taking radical actions in a relatively short time. At the same time, it is a signal of upcoming changes in all LPP brands. New commitments to environmental protection will become the foundation of our development strategy for the coming years

3. BARRIERS TO ECO-INNOVATION

There are some significant barriers to eco-innovations in Poland - lack of knowledge about sustainable solutions and insufficient qualified specialists to advise business on access to sustainable investment and the relatively high cost of eco-innovative technologies, including testing new technologies. The most significant barriers faced by companies that implement eco-innovation were of an economic nature: low research effort, weak industry-science links, as well as insufficient participation of the higher education system in enhancing innovation and eco-innovation. The greatest challenge for improving the innovation level of Poland is to improve cooperation between universities and business, in particular SMEs. While large companies are more willing to cooperate with universities and are thus more likely to innovate, SMEs are reluctant to do so or to co-operate among themselves due to mission trust, as well as no incentives to innovate. Additionally, we observe insufficient awareness of companies about benefits (including financial benefits) from implementing eco-innovative solutions and reluctance to take the risk of adopting eco-innovations. Insufficient awareness of customers about benefits from eco-innovative technologies also has an effect.

Companies would be interested in implementing eco-innovations; however, the demand is limited, and customers often do not consider environmental benefits when making purchasing decisions. Public procurement law and practices in Poland do not prioritise innovation in the selection criteria. The requirements set out in the new National GPP Action Plan (2017) for sustainable public procurement 2017-2020 are not binding. The business sector in Poland is increasingly driven by SMEs that cannot afford significant R&D expenditures, but they can be very flexible in terms of market offer. Increasing innovation and competitiveness in sectors with low added value requires intensive cross-sector cooperation between the companies and the promotion of an environment conducive to the diffusion of knowledge at the national level. An important element would be the implementation of an innovation support program, based largely on EU funds, targeting SMEs in particular as they often lack the resources to cope with the submission of applications for co-financing.

REFERENCES

Altham, W. (2007). Benchmarking to trigger cleaner production in small businesses: Drycleaning case study. *Journal of Cleaner Production*, 15(8–9), 798–813.

Arundel, A. & Kemp, R. (2007). *Measuring Eco-Innovation. Results from the MEI project.* Retrieved from https://www.researchgate.net/publication/254405708_Measuring_Eco-Innovation

Barczak, G. (1995). New product strategy, structure, process, and performance in the telecommunications industry. *Journal of Product Innovation Management*, 12(3), 224–234.

Basso, L. C., Santos, D. F. L., Kimura, H., & Braga, C. S. (2013). Eco-innovation in Brazil: The creation of an index. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.2284336

Beliën, J. & Forcé, H. (2012). Supply chain management of blood products: A literature review. *European Journal of Operational Research*, 217(1), 1–16.

Białoń, L. (2010). *Zarządzanie działalnością innowacyjną*. Warszawa: Placet.

Bukowski., S., Szpor, A. i Śniegocki, A. (2012). Ekoinnowacje w Polsce. Stan obecny, bariery rozwoju, możliwości wsparcia. Instytut Badań Strukturalnych. Pobrane z https://ibs.org.pl/publications/potencjal-i-bariery-polskiej-innowacyjnosci-2/

Carrillo-Hermosilla, J., Del Río González, P., & Könnöla, T. (2009). *Eco-innovation: When sustainability and competitiveness shake hands*. Palgrave: Macmillan.

OECD (2005). *Oslo manual: Guidelines for collecting and interpreting innovation data* (3rd ed.). The Measurement of Scientific and Technological Activities, OECD Publishing, Paris. https://doi.org/10.1787/9789264013100-en...

Ehrenfeld, J. R. (2008). *Sustainability by design. A subversive strategy for transforming our consumer culture*. Yale University Press.

Fussler, C. & James, P. (1996). *Driving eco-innovation: A breakthrough discipline for innovation and sustainability*. London: Pitman Publishing.

Ghisetti, C. & Pontoni, F. (2015). Investigating policy and R&D effects on environmental innovation: A meta-analysis. *Ecological Economics*, 118, (C) 57–66.

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, 20(4), 986–1014.

Hellström, T. (2007). Dimensions of environmentally sustainable innovation: The structure of eco-innovation concepts. *Sustainable Development*, 15(3), 148–159.

Hemel, C. van & Cramer, J. (2002). Barriers and stimuli for eco-design in SMEs. *Journal of Cleaner Production*, 10(5), 439–453.

Hemmelskamp, J. (1997). Environmental policy instruments and their effects on innovation. *European Planning Studies*, 5(2), 177–194. https://doi.org/10.1080/09654319708720392

Huber, J. (2008). Technological environmental innovations (TEIs) in a chain-analytical and life-cycle-analytical perspective. *Journal of Cleaner Production*, 16(18), 1980–1986.

Huppes, G., Kleijn, R., Huele, R., Ekins, P., Shaw, B., Esders, M., & Schaltegger, S. (2008). Measuring eco-innovation: Framework

and typology of indicators based on causal chains. Final report of the ECODRIVE Project. Leiden, London, Lüneburg ECODRIVE Report to the European Commission.

James, P. (1997). The sustainability circle: A new tool for product development and design. *The Journal of Sustainable Product Design*, 2, 52–57.

Kanerva, M. M., Arundel, A. V., & Kemp, R. P. M. (2009). Environmental innovation: Using qualitative models to identify indicators for policy. UNU-MERIT, Maastricht Economic and Social Research and Training Centre on Innovation and Technology. UNU-MERIT Working Papers No. 047.

Kemp, R. & Pearson, P. (2007). *Final report MEI project about measuring eco-innovation*. Maastricht: UM Merit.

Klewitz, J., Zeyen, A., & Hansen, E. G. (2012). Intermediaries driving eco-innovation in SMEs: A qualitative investigation. *European Journal of Innovation Management*, 15(4), 442–467.

Lee, K.-H. & Min, B. (2015). Green R&D for eco-innovation and its impact on carbon emissions and firm performance. *Journal of Cleaner Production*, 108, 534–542. https://doi.org/10.1016/j.jclepro.2015.05.114

National GPP Action Plans (policies and guidelines). (2017). Retrieved from https://ec.europa.eu/environment/gpp/pdf/200311_GPP_NAPs_March_2020.pdf

Norberg-Bohm, V. (2000). Creating incentives for environmentally enhancing technological change. Lessons from 30 years of U.S. energy technology policy. *Technological Forecasting and Social Change*, 65(2), 125–148. https://doi.org/10.1016/S0040-1625(00)00076-7

OECD. (2009). *Eco-innovation in industry: Enabling green growth*. OECD.

OECD. (2012). *The future of eco-innovation: The role of business models in green transformation*. Copenhagen.

Oksanen, K. & Hautamäki, A. (2015). Sustainable innovation: A competitive advantage for innovation ecosystems. *Technology Innovation Management Review*, 5(10), 24–30.

Oltra, V. (2008). *Environmental innovation and industrial dynamics: The contributions of evolutionary economics*. Post-Print. https://ideas.repec.org/p/hal/journl/hal-00391485.html

Porter, M. & Linde van der, C. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, 9(4), 97–118.

Reid, A. & Miedziński, M. (2008). Eco-innovation. Final Report for Sectoral Innovation Watch. EUROPE INNOVA, Technopolis Group. DOI: 10.13140/RG.2.1.1748.0089.

Rennings, K. (2000). Redefining innovation – Eco-innovation research and the contribution from ecological economics. *Ecological Economics*, 32(2), 319–332.

Rennings, K., Ziegler, A., Ankele, K., & Hoffmann, E. (2006). The influence of different characteristics of the EU environmental management and auditing scheme on technical environmental innovations and economic performance. *Ecological Economics*, 57(1), 45–59. https://doi.org/10.1016/j.ecolecon.2005.03.013

Roscoe, S., Cousins, P. D., & Lamming, R. C. (2016). Developing eco-innovations: A three-stage typology of supply networks. *Journal of Cleaner Production*, 112, 1948–1959.

SEEDiA. (2020, October 20). Mała architektura SEEDiA w parku sensorycznym w Mielcu. Retrieved from https://seedia.city/pl/mala-architektura-seedia-parku-sensorycznym-mielcu/

Sinclair-Desgagné, B., Feigenbaum, D., & Pawlak, E. (2003). *The integrated product policy and the innovation process: An overview*, Scientific Series. Montréal: CIRANO.

Woźniak, L., Strojny, J., & Wojnicka, E. (Red.) (2010). *Ekoinnowacje w praktyce funkcjonowania MŚP*. Warszawa: Polska Agencja Rozwoju Przedsiębiorczości.

Xavier, A. F., Naveiro, R. M., Aoussat, A., & Reyes, T. (2017). Systematic literature review of eco-innovation models: Opportunities and recommendations for future research. *Journal of Cleaner Production*, 149, 1278–1302.