

Environmental and Energy Informatics: Polish Approaches in Eco-innovation

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Abstract: The goal of this paper is to present eco-innovation implementation in Poland and in some European countries. I assess factor influencing on ecoinnovation in small medium enterprises. Both current and expected energy and material prices are particularly important for pushing firms to reduce pollution, decrease hazardous substances and increase recyclability of products. Cost savings are an important main incentive for reducing energy and material use, and for eco-innovation. Customer requirements are very important source for eco-innovations, particularly with regard to products with improved environmental performance and process innovations that increase material efficiency, reduce energy consumption and waste.

Keywords: ecoinnovation, energy, environmental regulation, Poland

1 Introduction

Definition of eco-innovation was demonstrated by Kemp and Pearson (2008). An environmental innovation, according to them, has been defined as “a new or significantly improved product (good or service), process, organizational method or marketing method that creates environmental benefits compared to alternatives. The environmental benefits can be the primary objective of the innovation or the result of other innovation objectives. The environmental benefits of an innovation can occur during the production of a good or service, or during the after sales use of a good or service by the end user” (Kemp and Pearson, 2008). In what follows is a catalog of environmental benefits that an eco-innovation could have produced either with the firm or from the after sales use of a product by the user for which surveyed companies should say whether this benefit has occurred or not. Concerning environmental product innovations, ZEW (Zentrum für Europäische Wirtschaftsforschung – Centre for European Economic Research) econometric results show that present regulations are only effective for reductions of air, water, soil and noise emissions but not suitable for energy consumption and recycling (Horbach, 2009). The companies expect a growing importance of future regulations for all product innovations. In all considered environmental innovation areas future regulations already trigger eco-innovations.

Environmental regulation and individual environmental policy instruments (specially, soft regulation) are significant drivers particularly for eco-product innovations (Cleff and Rennings, 1999, Horbach, 2008 and Rehfeld et al., 2007). Other researchers like Green

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et al. (1994) imply that firms implement environmental product innovation to obey with existing and anticipated legal requirements. Horbach (2008) finds a significant positive influence of subsidies on environmental product ecoinnovation. Kammerer (2009) demonstrate that a high level of regulatory stringency incentivises companies to implement environmental product innovations which are quite novel to the firm, but this result cannot be corroborated when these innovations are new to the market. Finally, Horbach et al. (2012) confirm a high importance of expected future regulations for all environmental product innovations.

Defining green innovation is not an easy task although several attempts have been made in the literature (Carrillo-Hermosilla et al., 2010). Klemmer et al. (1999) determined the environmental innovations as a subset of innovations that lead to an improvement of ecological equality. Chen et al. (2006, p.332) defined green innovation technologies that are involved in energy-saving, pollution-prevention, waste recycling, green product designs, or According to Halila and Rundquist (2011), the term, eco-innovation (or environmental innovation, green innovation or sustainable innovation), is often used to identify those innovations that contribute to a sustainable environment through ecological improvements. Eco-innovations are defined by Beise and Rennings (2003) as applications consist of new or modified processes, techniques, practices, systems and products to avoid or reduce environmental harms.

The current paper consist of 4 chapters, including introduction. In the second chapter I present results of ecoinnovation developments in Poland, in the third I present the topic of energy in Poland and the forth section presents the conclusions.

2 Ecoinnovation development in Poland

Poland, since its accession to the EU in 2004, enabled to utilize EU funds, reduce the backlogs in transportation infrastructure and environmental protection and at the same time builds a strong and stable economy (Kassenberg et. al, 2011). The state of the natural environment has significantly improved, while the resources productivity and energy intensity unfortunately have increased. Despite that, Polish productivity indexes per Gross Domestic Product still remain below expectations- less than average of the EU countries (Kassenberg et. al, 2011). During the last 20 years, energy consumption remained stable in spite of significant Gross Domestic Product (GDP) growth, due to energy efficiency improvement and changing the structure of economy. Nevertheless, the energy intensity index is still 2-3 times lower than the EU-27 average. In Poland, almost half (47%) of the companies surveyed by **Eurobarometer** stated that material costs represented 50% or more of their total production value. or more of their total production value (Flash EB No 315,2011). Companies in Poland were the most likely to have introduced a new or significantly improved eco-innovative product or service, production process or organisational method in the past two years (63%); companies in Hungary were the least likely to have done so (27%). Regardless of the fact that the country policy in the area of eco-innovation misses synergy, the eco-innovations have been ad-

dressed via national policy strategies on environmental protection, product policy, energy efficiency in buildings, etc. The interest of Small and Medium Enterprises (SME) in eco-innovation is slowly growing, especially in relation to cost reduction possibilities, due to notably reduction of energy consumption and decreasing expenditures related to pollutant emissions (Kassenberg et. al, 2011).

The country also has outstanding examples of eco-innovations in energy and water management, hazardous waste treatment, solar energy, green banking and coke industry and a number of eco-innovation related programs and initiatives within various clusters. On the other hand, eco-innovation does not constitute a driving force for new business opportunities in Poland. Development of eco-innovations in Poland is significantly hindered by numerous barriers. The most important is underestimation of the innovative potential as a growth driver. This innovative potential is understood here as an ability to create new technological and organizational solutions, increase labor productivity and improve resource efficiency with relation to work, capital, energy and materials. Eco-innovations in particular, remain outside the interest of decision makers policies which determine Poland's expectations towards the EU and future Structural Fund allocations for development objectives. As a consequence, Polish and some other countries' policies focus on clearing infrastructural backlog and accelerating extensive economic growth, ignoring future changes in the significance of the respective sectors and the barriers that limit the current growth model, which is based strongly on price, rather than quality, competition.

Another barrier comprises the big focus on EU funds availability and their fast utilization. The approach that money should be utilized fast, considerably limits the debate on how to optimize EU funds absorption. Poland needs stable mechanisms (similar to Finnish solutions) that will instigate the development of new, competitive structures of the Polish economy. There should be more focus on the quality of implemented ideas, their better selection and support for truly innovative economic initiatives.

The EU funds provide new possibilities for financing various initiatives at universities and colleges. Unfortunately, due to excessive formalization, more often the true aim of these activities is lost, while bureaucracy is increasing. A lot of attention is provided to the accounting side of projects, although it should be focused on how to fulfill the planned objectives and ensure durable benefits.

Lack of well-qualified and skillful specialist constitutes another large barrier to development of eco-innovations in Poland. This is result of, first and foremost, from a poor and ineffective system of education. Graduates of technological studies are in minority and staff available to work on eco-innovations is limited. There is a large difference between the business sphere, which is very innovative but still on a basic, everyday level, and administration and science. Due to insufficient information, access to eco-innovative solutions developed by the academic and science sector is limited. Providing adequate support for innovations, or eco-innovations in particular, constitutes a challenge. Poland has a serious problem with innovativeness as such, in its broad meaning.

Positive, albeit slow, changes are observed in Poland in the area of eco-innovations.

They do not immediately lead to a significant increase in the value of the eco-innovativeness scoreboard index. The Eco-Innovation Scoreboard (Eco-IS) is the first tool to assess and illustrate eco-innovation performance across the 27 EU Member States. The scoreboard aims at capturing the different aspects of eco-innovation by applying 16 indicators grouped into five thematic areas: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, environmental outcomes and socio-economic outcomes. It thereby shows how well individual Member States perform in different dimensions of eco-innovation compared to the EU average and presents their strengths and weaknesses. The Eco-IS complements other measurement approaches of innovativeness of EU countries and aims to promote a holistic view on economic, environmental and social performance. Compared with 2011 Poland rank moved from 27th to the 25th position. The increase occurred in the area of eco-innovation output. (Eco-innovation in Poland: 2012 update)

There exist several examples of eco-innovation measures in Poland:

- Successful continuation of the program GreenEvo (Green Technologies Accelerator). This initiative of the Ministry of Environment supports Polish eco-innovators, mostly small and medium enterprises (SMEs) transferring technologies all around the world. In 2011 alone, Green Evo participants revenues increased by 31% on average, and their export revenues soared by 58%. What is more 86% of companies made a trade offer to foreign customers, and 50% of them have signed distribution agreements with foreign partners (Kassenberg et. al 2011).
- Establishing a number of eco-innovation oriented clusters e.g. Silesian Cluster of Environmental Technologies, Baltic Eco-energy cluster and Clean Energy Cluster of Małopolska and Podkarpackie (Eco-innovation in Poland: 2012 update).
- Participation of Poland in the Environmental Technologies Verification (ETV) Pilot Program of the European Union – a scheme supporting market uptake of eco-innovative technologies (Kassenberg et. al, 2011).

Despite these positive trends, development of eco-innovations in Poland is still hindered by a number of barriers. Eco-innovations still are giving the impression as “end of pipe, environmental protection technologies” rather than a cross-cutting innovations (Eco-innovation observatory 2012). Transition to a low-carbon economy is perceived as a threat in companies and SMEs. Implementation of stringent environmental regulations is seen solely as a cost and not as an opportunity for building an innovative and competitive economy. Awareness on the benefits resulting from implementation of eco-innovative technologies among entrepreneurs and consumers in general is relatively low. Entrepreneurs tend to invest in cheapest technologies allowing them to achieve the commercial goal or meet the minimum legislative requirement. Many entrepreneurs and research organization fail to see benefits from cooperation.

Lack of well-qualified and experienced labor force constitutes another large barrier to development of eco-innovations in Poland. This arises from, first and foremost, from a not effective system of education. Excessive number of humanists, lawyers or sociolo-

gist graduate from Polish universities each year, but there are too little engineers, and natural scientists, mathematicians etc. Staff available to work on eco-innovations is limited. There is a large difference between the business sphere, which is very innovative but still on a basic, everyday level, and administration and science. Due to insufficient information, access to eco-innovative solutions developed by the academic and science sector is limited. Providing adequate support for innovations, or eco-innovations in particular, constitutes a challenge. Poland has a serious problem with overall innovativeness as such, in its broad meaning.

The main barrier for Polish companies is the lack of sufficient capital to invent and implement eco-innovation. Additionally, financial institutions face a significant risk connected with involvement in eco-innovative projects. This risk is related more to technological issues, i.e. the possibility to achieve expected parameters, than to financial ones. There are no sufficient funds to verify proposed solutions, either in a semi-technical form or as a pilot solution. This relates especially to a project finance situation, where a company is established only to implement a particular investment. If a project has undergone preliminary verification, banks or other financial institutions are more likely to provide a loan, as such verification reduces their risk. Venture capital funds are also lacking. The establishment of the National Centre for Research and Development and development in 2007 and clusters should improve that situation.

3 Production of energy in Poland

Production of primary energy in Poland is mainly based on fossil fuels. The main prime energy source is still hard coal and lignite, which cover 56% of the demand. Crude oil also has a significant share of 25%. Even to maintain current levels of energy generation, Poland needs to invest huge amounts into energy generation capacity (between EUR 41 billion and EUR 98,5 billion by 2020 and factually upgrade or redesign its entire energy system:

- almost 85% of electricity is produced from coal
- two thirds of the installed coal capacity is older than 30 years
- almost 20% (7 gigawatt,) of the current generation capacity have to be phased out by 2015

However, we can observe a positive trend in the growth of renewable energy sector in Poland. The most important source is wind energy. According to Energy Regulatory Office (URE), in 2012, there existed 663 wind plants in Poland of a total capacity of 2341 MW. Most wind farms are located in the north-western Poland, not far from Baltics Sea. The leader is the Zachodniopomorskie Province (closest to the German border-716.8 MW), followed by the Pomorskie Province (246.9 MW) and the Wielkopolskie Province (245.3 MW). The current share of wind energy in total renewable electricity of origin is 57.6%. It ranked first among renewable energy sources already in 2009. Currently about 50 per cent of the Polish electricity from renewable source is produced from

biomass while a third comes from co-incinerating biomass in coal-fired power plants. Adding supports for the alternative technologies will lead to new opportunities to develop projects at industrial locations that produce large amounts of biomass.

This large share results in Poland's significant biomass potential and its large share of coal power plants that generate about 90 per cent of Poland's electricity. By using this existing infrastructure, Poland was able to significantly increase its share of renewable energies in just a few years. Today, 30 of the 39 Polish coal power plants are co-incinerating biomass.

The criticism of this practice, however, is immense. Most co-incinerating coal power plants do not use the waste heat (75 per cent). As a result of the boom in co-incineration in Poland, prices for energetically used biomass have increased considerably since 2006. This has led to an enormous increase of import of biomass, like wood pellets from Russia. The Polish authorities want to create a new solution considering the new law on renewable energies. The novelty is that, different types of electricity generation will receive different compensations. The compensation for smaller mono-incinerators should, in some cases, be more than four times as high as the compensation for large coal power plants that do not utilize their waste heat. At the same time, the growth of renewable energy should once again go faster. The new Polish law on renewable energy will be an opportunity for the development of new biomass projects, for instance using waste of the wood or furniture industry. As the current policy of co-incineration support is prevailing, such locations were not important. Only 11 biomass power plants are operational at the about 450 locations that produce large amounts of biomass. The largest plants are operational at the three large Polish pulp mills and they are also co-incinerators. The eight existing mono-incinerators at industrial locations are considerably smaller and they produce less than five per cent of the Polish biomass electricity. The new legislation is debated. The large state-owned energy providers especially oppose decreasing subsidies for co-incineration. This barrier, however, will have to end soon as it is urgent to change the situation. The delay of the new law has resulted in temporarily slumping prices for renewable energies certificates. New power plants that were constructed according to the new law should become operational. Nevertheless, old co-incinerators continue to produce, even though many of them should be closed due to the announced legislative changes. This results in overcapacities and declining prices that affect the power plant operators themselves. The law on renewable energies is currently envisaged to come into force.

The Polish market for renewable energies has reached a turning point. The new Polish Act on Renewable Energy Sources entails new opportunities for developing biomass power plant projects including locations close to the wood or furniture industry. At present, mono-incinerators at such locations produce less than five per cent of the Polish electricity from biomass. Most potentially favourable locations have not yet been utilised. Instead, almost 80 per cent of the biomass electricity and more than a third of the renewable energies in Poland are generated through co-incinerating biomass in coal power plants. The new Polish Act on Renewable Energy Sources is scheduled to come into effect in the second half of 2013. According to this law, the support of co-

incinerators should decrease significantly in the future.

By contrast, smaller biomass power plants, mono-incinerators and electricity generation by using combined heat and power (CHP) technology should receive stronger support. At the same time, the goals in terms of developing and boosting renewable energies are once again increasing. In light of this development, experts have jointly analysed the market for electricity generation from solid biomass in detail. The report focuses on the identification of industrial locations that produce large amounts of biomass.

Independent variables	Dependent variables					
	ecoinn. prod.	SE	ecoinn. process	SE	ecoinn. organis.	SE
Constant	-0,63	7,88	13,7	9,71	-1,32	11,37
High material prices	0,34*	0,1	0,42	0,22	0,31*	0,15
High energy prices			-0,71*	0,29		
Expected high energy prices.			0,48*	0,22		
R2	0,42		0,32		0,15	
F (p value)	9,86(<0,001)		3,61 (<0.02)		6,36(<0,04)	

Table 1 Regression results for introduction of product, process and organisational ecoinnovation in European countries

Despite Poland's positive developments, there is room for improving Poland's energy strategy. First, a more integrated energy and climate policy is needed to put Poland firmly on a low-carbon path while enhancing energy security. Second, energy policy could put more emphasis on promoting competition to make the energy markets more efficient. Decarbonising Poland's power sector will be a particularly significant challenge requiring huge investments. Coal accounts for 55% of Polish primary energy supply and 92% of electricity generation, raising significant climate change and environmental challenges. To this end, Poland's efforts to improve energy efficiency and to diversify the country's energy mix are praiseworthy and should be pursued. The government's attention to R&D on clean coal technologies, including carbon capture and storage (CCS) is also encouraging. For further reading on the Polish energy situation, please refer to [Voigt et al. Enviroinfo 2014].

4 Analyses

In order to identify the factors influencing on introducing in companies eco-innovations in Europe, a multiple regression model was applied, and European EU enterprises data were analysed. In the model ecoinnovativeness measured as a proportion of enterprises which implemented particular kinds of environmentally-friendly innovations in 2009–2010 was chosen as a dependent variable. Independent variables used in models were factors influencing the decisions by companies as to whether they should implement eco-innovations. For the given objects of our analysis, i.e. the 27 groups of enterprises from EU countries, the values of independent variables were calculated as weighted means, where the weights were fractions of inquired respondents assessing given factors as very important and somewhat important.

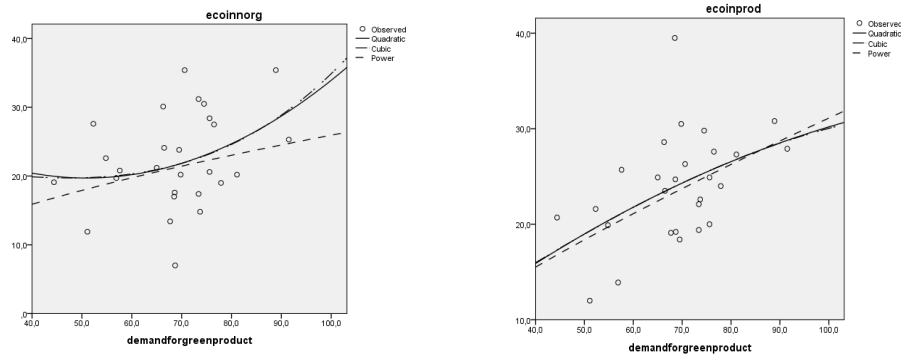


Fig. 1 Introduction of product ecoinnovation as a function of demand of green product on the market-approximation (left) Introduction of the process ecoinnovation as result of demand of green product on the market (right)

According to the results of the calculations, the only factor which positively influenced product eco-innovation implementation appeared to be an increase in high material prices (table 1). With respect to process eco-innovations it may be concluded that the current high prices of energy used in production processes and expected high energy price were only significant variables, and higher energy prices acted contrary to our theory-based expectations as a sedative to the implementation of new or significantly improved eco-innovative production processes or new methods.. Considering organizational ecoinnovation, the only significant variable was high material prices. Other factors were not significant, therefore they were not included in the model. We received positive correlation among demand for green product, process organisational ecoinnovation.

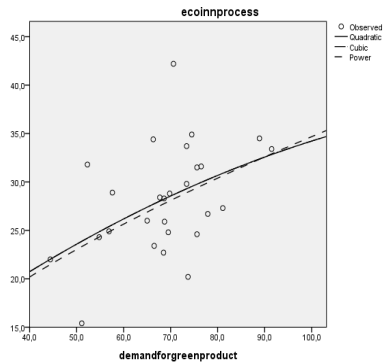


Fig. 2 Introduction of the organisational ecoinnovation as result of demand of green product on the market-approximation

7 Conclusions

There are considerable concerns related to the development of eco-innovativeness in some European countries including Poland. First, politicians do not recognize the significance of eco-innovations, or generally innovations. Strong lobby supports obsolete industries and decision makers seem to be not interested enough in development of eco-innovations. On the one hand, there is no pressure on research in new eco-innovative solutions. On the other hand, academic and R&D centers are unable to satisfy the demands of the industry. Eco-innovations are perceived as the driving factor of the third transformation in Poland and other EU members (following system transformation and the EU accession). The state should play the key role in this process – on the one hand it should inspire the demand for eco-innovations and on the other it should assure conditions for increasing interest in such solutions. Despite significant progress, the Polish economy has low productivity and high GHG emission intensity. Poland still has a lot to do to become an economy of high material and energy efficiency. This includes development of a necessary legal and institutional background. Such a transformation also requires fundamental changes in education and the behavioral patterns of citizens and companies so that we become a society of sustainable material consumption and move toward a green economy, where development is decoupled from material and energy use.

Among the factors very strongly stimulating eco-innovation implementation the respondents listed expected future increases in energy prices, current high energy prices and current high materials prices. Cooperation between research institution and companies is not satisfactory in some European countries. Poland stringent environmental regulation as main driver of eco-innovation. Those countries experience limited interest, lack of collaboration between business and research institutions, and limited budget for research at this area.

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