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Eco-innovation as a driver of regional smart specialization: the case of Lublin province[1]

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Abstract: According to the Europe 2020 strategy (European Commission, 2010), the development of EU countries should be based on three interrelated priorities: smart, sustainable and inclusive growth. Smart growth should be based on the increasing role of knowledge and innovation as the driving forces of future growth. In practice, this will require the improvement of both educational quality and the outcomes of research activity, the promotion of innovation and knowledge transfer within the Union, full exploitation of information and communication technologies, as well as ensuring that innovative ideas are translated into new products and services. The main purpose of this paper is to present the role of eco-innovations in a process of smart specializations identification and realization in one of the Polish regions – the Lublin province. According to the Regional Innovation Strategy for Lubelskie province (RIS), the key specialization is to become a bio-economy including selected activity areas (including sciences) related to the manufacture and processing of biological-origin resources (bio-resources) for food, energy and medical purposes. Methodology of smart specializations selection, has moreover allowed the identification of complementary specialization in the form of medical and health promoting services, supporting specialization, e.g. IT and automatics, and emerging specialization, i.e. low-emission energy generation (Zarząd Województwa Lubelskiego, 2013). The eco-innovations will play a key role in the implementation of two specializations of the region: the bio-economy and low-emission energy generation.

Keywords: region, smart specialization, eco-innovation, bio-economy, renewable energy resources, Poland, Lubelskie province
JEL codes: Q57, R11, R58

[1] The paper continues considerations presented in: Kasztelan, 2014b and Kijek, 2013b.

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1. Introduction

One can conclude that the provisions of the Europe 2020 strategy are the new paradigm of modern thinking. Expression of this is the concept of green growth (development), the bio-economy and eco-innovation. The European Union is not only changing the development paradigm, but at the same time encourages individual countries and regions to look for smart ways of development (Dziedzic, 2013: 4-14).

The specific condition is the responsibility of each region of the European Union for the preparation of the regional innovation strategy by the concept of smart specialization. The European Commission is not only encouraged, but also requires the regions to take into account the concept of sustainable development at the heart of their strategies for smart specialization (RIS3), as a multidisciplinary approach, which should use the potential of eco-innovation, but also ecosystem services and sustainable energy (Doranova et al., 2012).

Smart specialization is a new concept (Foray et al., 2009: 1-5; 2012; Foray, 2013: 54-78; Midtkandal and Sorvik, 2012: 3-6; Morgan, 2013: 102-125) designed to promote the efficient and effective use of public investment in research. The main purpose is to boost regional innovation in order to achieve economic growth and prosperity, by enabling regions to focus on their strengths. „*Smart specialization is not a planning doctrine that requires a region to specialize in a particular set of industries. Instead, it seeks robust and transparent means for nominating those new activities, at regional level, that aim at exploring and discovering new technological and market opportunities and at opening thereby new domains for constructing regional competitive advantages*" (Foray and Goenaga, 2013: 1).

This paper presents the process of smart specializations identification in the Lublin province (Poland), seeking to ask the following questions: what were the determinants of the smart specializations choice for the region and especially, what is the role of eco-innovations in this choice? Therefore, the structure of this paper is as follows. The first section explains, why eco-innovations are crucial for regions with an under-developed or traditional structure. The second part briefly reviews the socio-economic background of the Lublin province. In particular, it focuses on the barriers of economic growth mainly related to the low level of innovation. The third section presents in detail the process of the choice of smart specializations in the Lublin province. The fourth part of the paper focuses on defining the role of eco-innovations in the implementation of smart specializations in the Lublin province. The final section presents the

main conclusions of the paper.

2. Eco-innovations and regional smart specialization

The eco-innovation concept was introduced to the environmental economics literature by Fussler and James (1996: 364), who defined eco-innovations (sustainable innovations) as new products and processes creating value for enterprises and clients, and reducing (negative) environmental effects. Their approach to eco-innovations has spurred other authors and institutions on to introduce more detailed definitions of eco-innovations (see table 1).

Table 1. Definitions of eco-innovations

Authors	Definition
Kemp and Pearson (2008)	Eco-innovation is the production, assimilation or exploitation of a product, production process, service or management or business methods that is novel to the organization (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use compared to relevant alternatives
Hemmelskamp (1997)	Environmental innovation is an innovation which serves to prevent or reduce burdens on the environment, clean up damage already caused, or diagnose and monitor environmental problems.
Beise and Rennings (2003)	Environmental innovations consist of new or modified processes, techniques, practices, systems and products to avoid or reduce environmental harms.
OECD 2011	Eco-innovation is a new or substantially improved product (manufacture or service), process, organization or marketing method, which reduces negative influences on an environment and/or optimize the use of resources.

Source: Kijek, 2013b: 364.

According to the presented definitions the main feature of eco-innovations is their positive impact on an environment by the reduction of environmental risk, harms and pollution. From a social perspective, the introduction and diffusion of eco-innovations is beneficial. However, a firm's incentives for the uptake of eco-innovations may be reduced by the double externality problem. Firstly, the firm that invested in eco-innovations is often not able to exclude other firms from freely benefiting from its investment. It means that knowledge embedded in eco-innovations spills over to other firms that did not participate in the cost of its creation. Secondly, eco-innovations, by definition, cause a smaller amount of external costs as compared to competing products and technologies, but they require extra investments. Due to a problem with the full

internationalization of external costs, the eco-innovative firm may be in the unfavorable cost position when compared to firms that do not invest in environmental technologies and products. Moreover, Rennings (2000: 326) stresses the role of the regulatory push/pull effect and the increasing importance of social and institutional factors for eco-innovations. What is important the former makes eco-innovations more dependent on regulation compared to other innovations, while the latter stresses the role of networking with other firms and institutions for eco-innovation (Cainelli et al., 2011: 328-368).

Given its potential for tapping innovation to address economic and environmental challenges eco-innovation is consistent with the green growth concept articulating the need of the support of pro-growth processes, with the assumption that natural assets will still be a base of environmental resources and services forming social welfare (OECD, 2011: 10). Green growth strategies are directed at creation of premises for consumers and entrepreneurs for pro-environmental behaviors, which should result in a flow of production factors (capital, work, technology) towards more ecological activities. As such, eco-innovation is being addressed by policymakers at all levels. In case of a regional perspective, eco-innovation may be regarded as an operational element of regional innovation strategies for smart specialization – RIS3 (European Commission, 2012: 31). A central tenet of the smart specialization approach is that regional authorities should focus their knowledge investments in activities that reflect areas where a region has some comparative advantage or unexplored areas where entrepreneurs could introduce new activities (Foray, 2013: 54-78).

As already mentioned, eco-innovation has some peculiarities, but there are also possible regional conditions favoring eco-innovations. Horbach (2013: 5) shows that external knowledge sources such as the regional access to research institutions and universities are especially relevant for eco-innovations. Consequently, eco-innovation may offer possibilities for regions with an under-developed or traditional structure, since path dependencies and sunk costs are not so essential for new eco-innovation fields. Therefore, regions looking for a specialization in such fields as new energy technologies, production of renewable bio-resources etc. should support and involve different players in the development and implementation of eco-innovations. There are a few approaches to eco-innovation support that should be considered within each region's RIS3, i.e.: fostering the development and dissemination of sustainable technologies, products and

services, promoting eco-efficiency through non-technological innovations, investing in ICT and support for systemic eco-innovations (European Commission, 2012: 32).

3. Lublin province as a research subject on innovation and intelligent specializations

The Lublin province is located in the eastern part of Poland, in the area of the Vistula and Bug. The results of the 2011 National Population and Housing Census revealed that, on 31st March 2011, the Lublin province was inhabited by 2.175 million people, which represented 5.7% of the overall Polish population. This demographic situation is unfavorable, and continues to deteriorate as a result of the low number of births and migration outflow. However, in the same time the region takes part in a relatively new nationwide phenomenon which is the growing number of rural population. The new residents, mostly the working-age adults, boost economic activity and contribute to the expansion of social and technical infrastructure. The consequence of these processes is the growing competitiveness of the areas (Biegańska, 2013: 7-22; Biegańska and Szymańska, 2013: 21-30).

According to the research carried out by M. Bogdański (2012: 13-20), the Lublin province has a relatively high level of socio-economic potential of cities, despite the fact that it is accompanied by low values of GDP per inhabitant. The Lublin province is a relatively poorly developed region. In 2010, the GDP per inhabitant was 25.1 thousand zlotys, which placed the province in the penultimate position in the country (67.6% of the national average, in 2000 this value was 68.5%). On the basis of purchasing power parity, this value was estimated at 9.6 thousand euro, about 41% of the EU average.

The relatively high proportion, in national terms, of agricultural lands within the total area of the province (over 70%) provides the typical agricultural character of the region. An important issue in the development of the Lublin province is played by the food industry. This accounts for above 25% of all those employed in the industrial sector and produces nearly 24% of total production sold (Urząd Marszałkowski Województwa Lubelskiego, 2013b: 16; Zarząd Województwa Lubelskiego, 2013: 8).

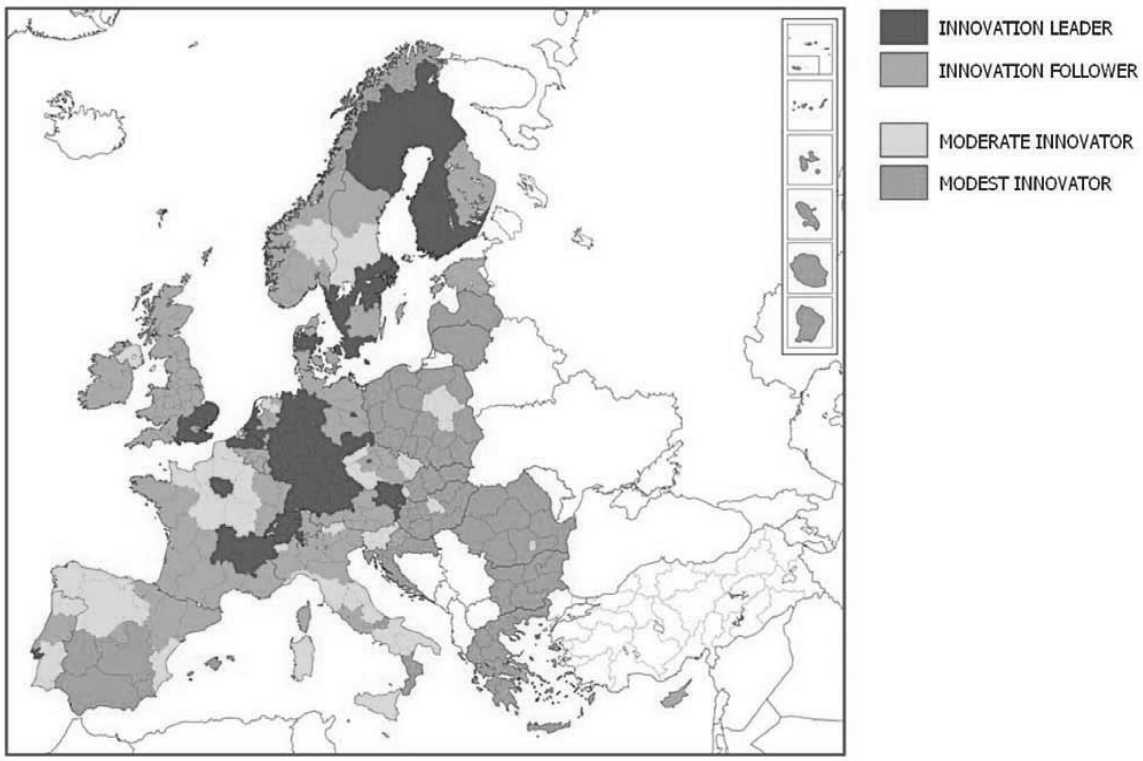
Many regional economies are based on the natural resources development. Natural resource industries are therefore subject to new societal pressures to improve environmental

performance while growing the regional or national economy and providing for the social needs of the people (Kenny et al., 2012: 8-27).

According to current research (Kasztelan, 2010: 77-86; 2013a: 637-648; 2013b: 105-122; 2014a: 87-97), the resources and values of the environment might become a key factor in developmental processes of the Lublin province. This means, in practice, that it has a relatively good environmental potential creating chances for specialization in a range of those forms of economic activity which are based on the use of natural capital. However, the main barrier to the use of this potential may be a relatively low level of innovation in the Lublin province.

In a study of regional innovative potential covering all regions of the EU-27, the Lublin province was classified to a group of regions of low innovation potential (so-called weak diffusers), which were only able to absorb innovations produced elsewhere, rather than being able to generate breakthrough innovations themselves which might start a new wave of economic development.

Figure 1. Innovation performance by EU regions in 2012



Source: European Commission, 2013: 62.

The contribution to the R & D sector of the region in the development of an innovation economy is relatively low, which in part results from the concentration on basic research, but also from the low level of the commercialization of research outcomes. Unfortunately, cooperation between companies and the R & D sector operates within a limited range (80.2% of enterprises do not undertake any such cooperation) (Urząd Marszałkowski Województwa Lubelskiego, 2013a: 6).

4. The process of the choice of smart specializations in Lubelskie province[2]

Smart specialization selection process for the Lublin region included four basic steps:

- Identification of endogenous development factors of the region
- Indication of the research and technological specialization of R & D institutions in the region (including universities)
- Identification of the main directions of personnel training at the level of higher education
- Preliminary selection of specialization areas, and their submission for a public consultation process and expert judgment.

The difficulty of data access needed to proper regional technological specialization identification as well as scientific-research determination, caused that the identification of the endogenous development potentials was based on location quotients (LQ). The location quotients were calculated using the formula:

$$LQ = \frac{x_{ij} / \sum_i x_{ij}}{\sum_j x_{ij} / \sum_i \sum_j x_{ij}}$$

where:

LQ location quotients

x_{ij} value of the selected X characteristic (eg, number of firms, employment, output, value added) in the i-th sector in the j-th province;

[2] This section is based on the text published earlier in: Kasztelan, A. (2014). The process of regional smart specializations identification in Poland – the case of Lublin Voivodeship, in Caganova, D. and de Cambal, M., Proceedings of the 6th European Conference on Intellectual Capital, Slovak University of Technology in Bratislava, Trnava, Slovac Republic, 10-11 April 2014, pp. 68-77.

$\sum_{i} x_{ij}$ value of the X variable in the j-th province;

$\sum_{j} x_{ij}$ value of the X variable in the i-th sector in the whole economy;

$\sum_{i}\sum_{j} x_{ij}$ value of the X variable in the whole economy.

Most often, the high spatial concentration is considered, when LQ exceed the value of 1.25, which indicates that the value of this feature (e.g. employment) for the particular sector in the particular region is more than 1.25 higher than the equivalent quotient for the whole country.

Complete endogenous development potentials included sectors for which at least one location quotient (LQ estimation based on the number of companies and accordingly the number of employees and the value of production sold) exceeded the level of 1.25 across the whole province. These sectors include, among others: Production of beverages (LQ = 3.07); Forestry and logging (LQ = 2.04); Crops and animal rearing, hunting, including service activities (LQ = 2.03); Production of food products (LQ = 1.74). The partial endogenous development factors included sectors for which at least one index exceeded the level of 1.25 for at least one sub-region, namely: Production of basic pharmaceutical substances and medicines, Research and development, Other professional, research and technical activity (Zarząd Województwa Lubelskiego, 2013: 15-16).

The second step in the selection of the smart specializations was the analysis aimed to indicate the research and technological specialization of R&D units operating in the Lublin province. The region is an important part of the Polish R & D sector. On a national scale, it has an average research potential but according to the most evaluation criteria, Lubelskie ranks just behind the biggest Polish research centres are located.

The R & D sector in the Lublin province is characterized by a clear specialization in fields of research related to broadly-defined agriculture, natural environment, biophysics, medicine, and materials technology. One of the criteria for assessing the scientific and research potential in Lublin province was the effectiveness in applying for research grants from public funds. In the case of project activity research institutions are characterized by an average effectiveness and specialization is easily perceptible in the broadly-defined agricultural sector; in particular, crop science, soil science, veterinary science, the science of animal breeding, and agricultural

engineering. A large number of research projects and their large-scale share on a national scale, as well as their high localization rate, are quite strong rationales for the establishment of regional specialization in this particular field. Agricultural specialization complements the specialization in environmental protection development and protection of the natural environment and environmental engineering.

The third stage of the smart specialization choice processes was to identify the main directions of personnel training in the province. For this purpose, statistical data and surveys from higher education schools were used. The analysis indicated the dominance of areas such as:

- agricultural, forestry and veterinary sciences,
- technical sciences (automation and robotics, energetics, technical physics, biomedical engineering, biotechnology and environmental protection),
- exact sciences (physics, mathematics, chemistry),
- medical sciences,
- social sciences (economics, management, computer science, etc.) (Zarząd Województwa Lubelskiego, 2013: 10, 16).

The last step was the submission of the synthesis for public consultation process. Analyzing the statements of the participants in the debate, the proposal of specializations was prepared. The proposals were analyzed by the experts and information whether to implement all of them into the RIS 2020 WL or not was included. Additionally, the reasons for that decision have been stated.

The result of the process of smart specializations identification in Lublin province is a choice of the bio-economy as the leading specialization (table 2). In turn, medical and health-oriented services were chosen as a complementary specialization, whereas IT and automatics specialization will be supporting for the development of the bio-economy, as well as medical and health-oriented services. This will also be beneficial for the comprehensive development of low-emission energy generation which has been recognized as a potential emerging specialization.

Table 2. The smart specializations for Lubelskie province

Type of specialization	Specialization	Characteristic of the specialization
Key (Leading)	Bioeconomy	The production of renewable bio-resources (i.e. resources of the world of plants, animals and micro-organisms) and the conversion of these resources as well as waste generated in the processing to value-added products such as food, feed, bio-products and bio-energy, etc. Bioeconomy covers many industries, mainly agri-food sector, as well as the associated sectors of forestry, chemical, biotechnology and energy
Complementary	Medical and health-oriented services	Medical services include health services carried out in the medical field. Health-oriented services include all services for the preservation of human health
Supporting	IT and automatics	Information technology includes such sections as: network administration, algorithmics, architecture processors, security systems, computer graphics, languages and software engineering, computer hardware, computer systems, artificial intelligence, information theory, webmastering, etc. Automatics includes industrial, buildings and transportation systems automatics, as well as biological, medical, environmental and agricultural systems automatics.
Emerging	Low-emission energy generation	This includes both the energy production from fossil fuels (e.g. natural gas, coal) and renewable energy (biomass, sun, water, wind). The specialization includes such technologies as: the development of clean fuels (e.g. clean technologies of extraction and purification of shale gas) production of renewable energy from wind, sun (photovoltaic and solar cells), water (hydro, geothermal); capture and storage of CO_2; smart grids and energy storage in the network; improving energy efficiency in buildings, etc.

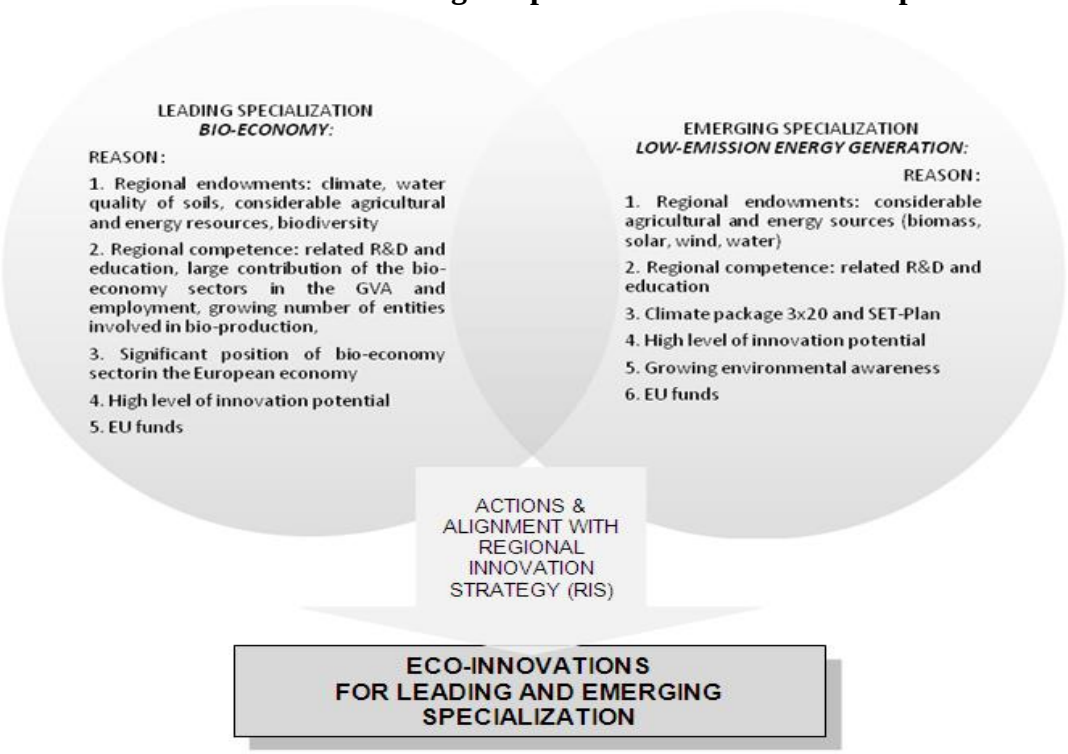
Source: Kasztelan, 2014a.

5. The importance of eco-innovations in smart specialization implementation for the Lublin province

Integration of smart and sustainable growth through smart specialization indicates two important schools of thought. First, the smart specialization itself should aim for sustainable development, inter alia, or perhaps mainly by creating corresponding eco-innovations. Second, the smart specialization should use eco-innovations contained in key enabling technologies, essential for the sustainable development of each sector or industry (Doranowa et al., 2012: 16-23).

Eco-innovations will play a key role in two of the five smart specializations adopted for the Lublin province: bio-economy, that is a leading specialization and low-emission energy generation, defined as an emerging specialization.

Figure 2. Eco-innovations for two intelligent specializations of Lubelskie province



Source: Own compilation.

The choice of the bio-economy as a key specialization for the Lublin province was based on:

- the large contribution of the bio-economy sectors in the GVA to the regional economy (about 28%) and employment in the province (about 45% of total employed in the region),
- growing number of economic entities involved in bio-production (feed, artificial fertilizers, food, pharmaceuticals, biocomponents, bio-energy, etc.),
- clear research specialization of the regional R&D sector in the field of science related to the bio-economy,
- ability to engage about 60% of research potential in the process of the creating the modern bio-economy sector in the region,

- external conditions, including significant position of bio-economy in the European space (annual revenues at the level of 2 billion euros, 22 million people employed), its high level of innovation potential and creation of added value (it is estimated that 1 euro invested in R & D can generate 10 euro of added value in bio-economy sectors) (Zarząd Województwa Lubelskiego, 2013: 17).

The bio-economy sectors and industries have strong innovation potential due to their use of a wide range of sciences, enabling and industrial technologies, along with local and tacit knowledge. Moreover, bio-economy is to be taken as the basis for smart and green growth in Europe, because, according to the assumptions, it also includes sector of energy from renewable sources. Advancements in bio-economy research and innovation uptake will allow to improve the management of renewable biological resources and to open new and diversified markets in food and bio-based products. Establishing a bio-economy holds a great potential: it can maintain and create economic growth and jobs in rural, coastal and industrial areas, reduce fossil fuel dependence and improve the economic and environmental sustainability of primary production and processing industries (COM, 2012: 2).

In relation to the key specialization of the Lublin province, which is bio-economy, eco-innovations will focus on the efficient processing of bio-resources for energy purposes. Analyzing the renewable resources it is recognized that the greatest potential for acquisition and use of biomass is in the Lublin region . It is particularly recommended the use of special-purpose plant crops (eg corn , canola, etc.) and industrial waste to obtain biogas for electricity or heat production purposes.

Biomass should be regarded as the most promising renewable energy source in Lublin province, since it reduces the dependency on fossil fuel, secure and diversify energy supply, and alleviate climate change (Cao and Pawłowski, 2013: 153-161). This is based on the easy availability of bio-resources and the possibility of organizing the supply of biomass. After overcoming technological and organizational barriers, energy from biomass can characterize a low social costs. Its proper use will be one of the most important elements of sustainable and multidirectional rural development (Biuro Planowania Przestrzennego, 2006: 58-67).

The choice of low-emission energy generation as an emerging specialization of the Lublin province is reflected in the identified potentials of energy development in the region, which are

both conventional energetics based on the rich resources of coal and shale gas, as well as renewable sources based on biomass, solar, wind and water energy utilization.

An important support in this area will be the EU and national policies in the field of the promotion of renewable energy sources in the energy and climate package 3×20 and implementation of the European Strategic Energy Technology Plan (so-called SET-Plan), assuming, i.a., the development of eighteen strategic low-emission energy generation technologies by 2020. These technologies include: wind energy, solar energy (photovoltaic and solar), hydroelectric power, geothermal energy, the energy of ocean currents, tides and waves, cogeneration and combined production, carbon sequestration energy production, advanced power generation from fossil fuels; production energy based on the method of nuclear fission, power generation based on nuclear fusion methods, smart grids, bioenergy production in combination; biofuels for the transport sector, fuel cells and hydrogen, energy storage, energy efficiency and CO_2 emission reduction methods in industry (cement, metallurgy and paper industry), energy efficiency in buildings.

Taking into account the novelty of the proposed solutions, a key role in the knowledge-based economy will play the eco-innovations that enable the replacement of property capital expenditures - capital of knowledge without depleting natural capital (Kijek and Kasztelan, 2013: 103-112; Kijek, 2013a: 659-670; 2013b: 363-369; Zarząd Województwa Lubelskiego, 2013: 19). The active policy, conducted at the regional level in the field of energy efficiency and the gradual transition to a low carbon economy, will lead to additional impulses stimulating the development of new technologies and solutions for low-carbon energy. In turn, increased demand for eco-innovations will increase scientists interest of joint research projects with the energy sector, which in the long run will result in a greater number of developed and commercialized solutions, and thus will improve the competitiveness of the regional R & D sector in the field of low-emission energy generation.

Given the importance of cluster dynamics for a smart specialization strategy and eco-innovations, the development of an eco-innovation cluster in the Lublin province has been initiated. The eco-innovation cluster is a legal entity, set up by Polish-German Foundation "New Energy" to promote sustainable innovation areas. It is active in: knowledge sharing processes, development and supporting new innovative ventures, training activities and looking for new partners in collaborative eco-innovation projects. Moreover, the eco-innovation cluster is a part

of the cluster association which is a cooperative relation of clusters and cluster initiatives from the Lublin province. It is the first such initiative in the Lublin province aiming at promoting cross-cluster co-operations.

6. Conclusion

This paper addresses issues of the regional smart specialization and eco-innovations. In spite of several common elements, eco-innovations are substantially different from other innovations. Their peculiar features that have been shown by recent works (e.g. Horbach, 2013: 5-6) suggest that they may be at the core of the smart and sustainable growth of under-developed regions.

The case study of the Lublin province shows that eco-innovations are regarded as drivers of smart specialisation of regional economy in the fields of bio-economy and low-emission energy generation. The mentioned specializations of regional science and economy results from the previously identified internal (the number of companies and employed individuals in the particular sector and the level of their integration and cooperation, and the specialization and efficiency of the research sector) and external (e.g. on-going technological and economic processes, and the prospects of the development of a particular branch on both an international and a national scale) potentials. Eco-innovations will help develop these specializations in the course of economic and environmental dimensions, since they lead, inter alia, to the growth of markets for new bio-products and reduce resource use across all aspects of the regional economy. It is worth mentioning that the research institutions and universities located in the Lublin province can provide enterprise with new knowledge related to the broadly-defined agricultural sector, i.e. crop science, soil science, veterinary science, the science of animal breeding, and agricultural engineering as well as environmental sciences and ecology. As mentioned previously, this is a chance for the Lublin province characterized as the under-developed region to follow the green and smart growth patterns based on eco-innovations. However, it should be noted that regional authorities should actively support various eco-innovations and involve different players, i.e. research, industry and the public sector (Sandström and Håkan, 2012: 144-159), in development and implementation of eco-innovative strategies.

Nevertheless, a complete understanding of the role of eco-innovations in the regional smart specialization is still far from being achieved. In particular, we believe that the next step

ahead in this direction should be monitoring the progress of the Lublin province regional smart specialization and providing cross-regional comparisons.

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Ekoinnowacje jako siła napędowa inteligentnej specjalizacji regionalnej: przypadek województwa lubelskiego

Streszczenie

Zgodnie ze strategią Europa 2020 (Komisja Europejska, 2010), rozwój krajów UE powinien opierać się na trzech powiązanych ze sobą priorytetach: inteligentnym, zrównoważonym i sprzyjającym włączeniu społecznemu wzrostowi. Inteligentny wzrost powinien być oparty na rosnącej roli wiedzy i innowacji jako sił napędowych przyszłego wzrostu. W praktyce będzie to wymagało poprawy zarówno jakości kształcenia jak i wyników działalności badawczej, promowania innowacji i transferu wiedzy w ramach Unii, pełnego wykorzystania technologii informacyjnych i komunikacyjnych, a także zapewnienia, że innowacyjne pomysły będą wykorzystane do tworzenia nowych produktów i usług. Głównym celem pracy jest przedstawienie roli innowacji ekologicznych (ekoinnowacji) w procesie identyfikacji i wdrażania inteligentnych specjalizacji w województwie lubelskim. Według Regionalnej Strategii Innowacji dla województwa lubelskiego (RIS), tzw. kluczową specjalizacją regionu będzie bio-gospodarka obejmująca te obszary działalności, które związane są z produkcją i przetwarzaniem zasobów pochodzenia biologicznego (bio-zasobów). Metodologia wyboru inteligentnych specjalizacji umożliwiła ponadto identyfikację tzw. specjalizacji uzupełniającej w formie usług medycznych i prozdrowotnych, specjalizację wspomagającą, tj. informatykę i automatykę, oraz specjalizację wyłaniającą się w postaci energetyki niskoemisyjnej (Zarząd Województwa Lubelskiego 2013). Eko-innowacje odgrywają kluczową rolę we wdrażaniu dwóch specjalności regionu: bio-gospodarki i energetyki niskoemisyjnej.

Słowa kluczowe: region, inteligentna specjalizacja, ekoinnowacje, bio-gospodarka, zasoby energii odnawialnej, Polska, województwo lubelskie