

## **INDUSTRIAL CLUSTERS AS A DEVICE OF STIMULATION OF COOPERATION AND INNOVATION OF SMALL AND MEDIUM-SIZED ENTERPRISES IN THE AREA OF BIO-ECONOMY**

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### **ABSTRACT**

The elaboration discusses the possibilities of the usage of industrial clusters to invigorate cooperation and innovative character of enterprises from the area of industry. Its purpose is to explain why clusters are appropriate structure to increase the innovative activity of cluster members, belonging to the bio-economy sector. Increasing the innovativeness of these entities is possible due to cooperation, resource synergy and the exchange of knowledge as well as technology transfer. In addition to the theoretical approach to this issue, the article contains examples of two clusters functioning in the area of the bio-economy. The elaboration has a theoretical and overview character. There were used union and national strategically and policy papers, research studies and other information deriving from observations and conversations with the chairman of an industrial cluster the Zachodniopomorski Klaster Chemiczny Zielona Chemia.

**Key words:** bio-economy, industrial clusters, cooperation, companies, innovativeness

### **INTRODUCTION**

In 21st century, the world and the European Union countries have to face developmental challenges which require striving for maintenance of balanced, long-term industrial development including husbandry of biological resources. In 2010 the concept was presenting innovative approach towards solving problems of the egress of the European countries from recession after a worldwide crisis. Those funds add up as fundaments of bio-economy. These countries needed a new direction of development, based on more and more sound knowledge and innovation. There will be new products and services, new marketplaces of food and bioproducts in various branches of industry (agriculture, forestry, food industry, energy production and chemical, cosmetic, pharmaceutical, biotechnological sectors) in bio-economy. The creation of new branches

of industry is anticipated [Chyłek and Rzepecka 2011, Adamowicz 2016]. On the other hand, bio-economy is considered to be an answer from science to many numerous challenges of environment, economy, and society, which determine the future of following generations. Every country in the world, as well as in Europe, have to deal with them [*The European Bioeconomy...* 2011, Adamowicz 2014]. Industries need new solutions to those problems – it requires the effects of cooperation of scientists, entrepreneurs, and society. The European Commission suggested to encompass this kind of operations in developmental strategies in macro, meso and micro scale and supporting them by national authorities and self-government.

The bandwidth of knowledge and diffusion of innovation goes well in industrial clusters; it means geographical aggregations of functional objects (companies, units of research and development sector, institu-

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tions of business environment) appearing in the same or affined industries. There are interactions and horizontal links between them, cooperation and competition (coopetition), the flow of knowledge and innovation. Industrial clusters, because of their sharp features affect functioning and development of a region.

The elaboration aims to show industrial clusters as an appropriate structure for stimulation and organization of cooperation and innovative activities of companies in the bio-economy area. The article includes the explanation of the bio-economy concept. It focuses on the possibilities of utilization of membership in an industrial cluster to a collaboration of different objects in various extent, primarily the flow of knowledge and the creation of new solutions in sectors which use renewable biological resources or industries chained with their value.

It has presupposed that industrial cluster creates a useful net of cooperation between companies and scientific units what enables the increase of the innovation and industrial entities, especially of small and medium-sized enterprises.

## MATERIAL AND METHODS

The article has a theoretical and overview character. Its primary sources were strategical documents of the European Union and Poland, voivodeships, policy papers, scientific papers and other information attained from the chairman of Zachodniopomorski Klaster Chemiczny Zielona Chemia (translator's note: West Pomeranian Chemical Industrial Cluster Green Chemistry). The identification of real effects of participation in clusters' structure was enabled by the analysis of documents, results of surveys of different authors conducted on industrial clusters which function in the area of bio-economy and observations; as well as conclusions from the conversation with the representative of the management of chemical cluster.

## THE IDEA OF BIO-ECONOMY IN STRATEGICAL DOCUMENTS

The realization of the Lisbon Strategy by members of the European Union did not bring the assumed effects. What is more, worldwide crisis enfaced a necessity to

find a new, sound developmental urge of the European Union countries. In 2010 the European Commission acknowledged that it might be pursuing to achieve balanced growth. It was notified in the strategy Europa 2020 [2010]. A strategical direction of development (so-called smart specialization) of members of the European Union should become bio-economy, concerning the need for the sensible use of biological resources [*Innovating for...* 2012]. It is connected with the usage and remold of marine and terrestrial production processes used for the production of food, fodder, bio-products, and bio-energy, as well as processing and creating products arisen in methods of bio-waste [Chyłek 2012, Gołębiewski 2013]. With the passing of time, the definition of bio-economy and its conception has evolved theoretically. Recently scientists tend to broaden of this idea, in example, by examining it in the concept of public goods theory, external effects or from the perspective of industrialization of agriculture, social innovation, the role of farmers in the creation, social processes, and the scale of bio-economy development. As Adamowicz [2014] leads, bio-economy became one of the greatest ideas of "analytical-cognitive and dynamic sector of the European industry, being one of the biggest bidders of employment, which has great potential and real fundaments of development".

The rational use of biological resources while using knowledge from the area of biotechnology, genetics, chemistry, physics, mathematics, IT, materials science, medicine, environmental and economic science and other, enables creating innovative technologies, products, and services. They are supposed to help in solving global economic and ecological challenges of the contemporary world. They include, in example, universal nutritional safety, a well-balanced industry of natural resources, limitation of social dependency from non-renewable resources, protection of biodiversity, mitigation of changes and results of climatic changes, solving the problem of rubbish.

The European Commission precisely described the directions of exploitation of strategies in favor of using renewable biological resources in the document *Innovating for Sustainable Growth: A bio-economy for Europe* [2012]. On its basis, individual members of the European Union, including Poland, described

their strategic operations. According to the European's Commission recommendations, Polish government tried to solve of the program of bio-economy with other strategic and program assumptions: *Strategia Rozwoju Kraju do 2020 roku* [2012], *Dynamiczna Polska 2020 [Uchwała Nr 7... 2013]* (translator's note: The Strategy of Country's Development, Dynamic Poland) concerning in advance environmental, manufacturing, energetic policy, innovative policy, industrial cluster policy. In the official document *Krajowe inteligentne specjalizacje* [2016] (translator's note: National Intelligent Strategies), bio-economy includes these specializations:

- innovative technologies, processes, and products of agricultural-nutritional and timber sectors;
- food of the best quality;
- biotechnological processes and outcomes of specialistic chemistry and environmental engineering.

The choice of this "smart specialization" in this case resulted not only because of politics of the European Union and planned directions of financing pro-developmental enterprises in years 2014–2020. It was justified mainly:

- by the potential of bioresources available in Poland and previous stock of development in the areas of bio-economy (that is to say: agriculture, forestering, fishing, aquaculture, food processing, chemical and biotechnological industry, energy sector and other);
- by abilities of knowledge and research-and-development sector which may be inspiring to habituate innovation in the area of bio-economy and to improve competitiveness for industries;
- by offering new chances of development for regions with significant potential of natural resources, i.e., Lubelskie Voivodeship and West Pomeranian Voivodeship.

Bio-economy as a way of a smart specialization entered into regional strategies of voivodeships innovation (or their amendment) which could have possibility to the usage of potential resources in this area, i.e. *Regionalna Strategia Inteligentnych Specjalizacji Województwa Zachodniopomorskiego 2020+* [2016] (translator's note: Regional Strategy of Smart Specializations of West Pomeranian Voivodeship). These kinds of documents have become fundamental for

making out specific activities on the meso and micro levels. A side from above, they were used for preparing programs of reinforcement the innovative abilities of enterprises, between entities, development of the research-and-development sector functioning in the area of bio-economy, directing scientific and researching units onto practical usage of the results of their surveys. The process of bio-economy development imposes initiation and support of modern and permanent types of cooperation between entrepreneurs and units of the research-and-development sector, institutions of business surrounding and social area. They are being created by quadruple helix [Carayannis et al. 2012]. As Gralak [2015] leads, the support of institutional surrounding of the bio-economy sector is crucial, what pertains to different organizations, in example, innovation centers, technological transfer, industrial cluster initiatives and technological incubators. It gives preferential treatment to creation and development of multilateral connections of objects from the bio-economy area (members of the industrial cluster) and innovative activity [Komor 2016].

## **INDUSTRIAL CLUSTER AS AN ORGANISATIONAL STRUCTURE BASED ON COOPERATION**

An industrial cluster is considered to be a network of organizations, relying on strategical cooperation during the realization of reciprocal aims by all members, what ensures them of the higher efficiency of husbandry [Rundo 2013]. The conception of an industrial cluster has been introduced into economic branches at the turn of the 1980s and 1990s by Porter, but the phenomena of cooperation between industrial entities from various branches concentrated in particular geographical area has been seen even in ancient times. It confirms by the structure of Sumerian cities in 4th century BC with dedicated districts specialized in a particular craft. They created a network of mutual relations. Marshall considered this problem before Porter; he formed a conception of an industrial district and benefits of agglomeration [1920], but also Perroux created the theory of the growth of centers [1964].

Many definitions of an industrial cluster appeared in the literature of economy. Along with the development of surveys in this area, there have been created

new interpretations and extended their meanings. The promotion of innovative activities as part of industrial cluster's policy has disposed the creators to develop following definitions to emphasize the role of industrial clusters while cooperating knowledge and industry, knowledge transfer and commercialization of innovation. The table presents some of the descriptions.

Modern structures of an industrial cluster perform in many developed and developing countries, and they constitute elements of local and trade innovation systems. As Weresa et al. [2017] point, individual industrial clusters divide between each other by size, level of development, a degree of innovation and technological sophistication of their members, a degree of internationality and influence on the sector and sector in which they function. However, they have interactive features such as geographical concentration, sectoral concentration and sound bounds and interactions between the members of an industrial cluster in the form of coopetition so the amalgamation of cooperation and concurrency.

Now and again, the cluster's initiative connects with an industrial cluster. However, it is not the same.

A cluster's initiative means "an organized activity to intensify growth and concurrency of clusters in a region, involving industrial cluster's companies, government and/or research environment. They are less or more formalized and institutionalized forms of cooperation of groups of a local object to initiate functioning or solving substantial problems of an already existing industrial cluster" [Kowalski 2013].

Cluster's initiatives are supposed to support the growth and concurrency of previously organized industrial clusters. What is more, they are an essential elements of industrial, local and innovative policy. They attend upon initiating and promoting new branches, using the achievements of science. Despite, an industrial cluster and cluster's initiative are not the same, the second is often called as an industrial cluster in Poland. It occurs in cases of functioning cluster's initiatives in ICT (information and communications technology) sector, bio-economy, creativity sectors and in healthcare. The creation of them in recent years was because of the initiative of scientific centers, government or Polska Agencja Rozwoju

**Table.** Exemplary definitions of an industrial cluster

| Author and source                             | Industrial cluster   |
|---|--|
| M.E. Porter [1990]                            | a geographical center of mutually related industries, specialized suppliers, units providing services, companies functioning in affined sectors and institutions associated with them (i.e. universities, standardization units and industrial associations) in each branch, competing with each other but also cooperating  |
| S.A. Rosenfeld [1997]                         | a geographical center of companies functioning in related sectors, cooperating or related with each other in different ways or providing services complementary to each other and making use of the same infrastructure, as well as specialized suppliers. They function on the same (local) labor market, facing similar changes and dangers  |
| P. Den Herig, S. Malta [1999]                 | a manufacturing net of rigidly connected companies (including specialized suppliers), objects which create knowledge (universities, research institutes, engineering companies), bridging institutions (brokers, consultants) and clients connected with each other in production chain create the added value   |
| M. Fromhold-Eisebith,<br>G. Eisebith [2005]   | a regional agglomeration of companies and other organizations (universities, centers of research-and-development, national agencies) connected by sectors or by the chain of added value, achieving competitive ascendancy due to colocation and cooperation   |
| <i>Clusters for Competitiveness</i><br>[2009] | an agglomeration of companies, suppliers, contractors and various institutions in the particular branch, connected with each other and located nearby, experiencing external benefits and effects of synergy resulting from, i.e. accessibility to specialized human resources, the dispersion of knowledge and higher work efficiency concerning the increased level of competition |

Source: Own elaboration based on Kowalski [2013].

Przedsiębiorczości [translator's note: Polish Agency of an Entrepreneurship Development] as part of regional innovation strategy and projects of supporting this kind of organizations.

Industrial clusters and cluster's initiatives are structures which enable cooperation in the form of a network. They form by numerous organizations, characterized by unique skills of creating value (i.e. knowledge resources, accessibility to stock, research-and-development potential, unique accomplishments of human resources), the exchange of privity and experience, simultaneously with preparedness to cooperation (even with rivals). As Weresa et al. [2017] lead, this kind of network collaboration of objects located in proximal or subsequent distance (it is possible in 21st century due to high-tech means of communication) advantages synergy and brings benefits to individual objects in an industrial cluster. As well it is used in region and sector, in which a group and the whole husbandry function. The results of surveys conducted on industrial cluster's structures in various areas show that they have a sound influence on the dispersion of knowledge, diffusion of innovation, improvement of change and concurrency [Kowalski 2013, Fundeanu and Badele 2014, Grzegorzewska et al. 2014]. The impingement of industrial cluster's structures results from the effects of dispersion. They appear when activities undertaken by industrial entities create benefits for other objects located in the habitat. It contributes to achieving a so-called environmental efficiency in the economic, social, technical and ecological dimension [Kowalski 2013].

## BENEFITS OF COOPERATION BETWEEN ENTITIES AS PART OF INDUSTRIAL CLUSTERS

Cooperation based on industrial cluster's structure is becoming more popular in the worldwide industry. In Polish sector in the years 2013–2015 about 19% of small-sized, 17.7% of medium-sized and 21% of large companies took part in the innovative activity as part of industrial clusters [*Działalność innowacyjna przedsiębiorstw...* 2016] [translator's note: Enterprises innovative activity]. Nowadays, these indicators are higher because of the progression. That is the result of supporting this kind of cooperation by national, re-

gional and local authorities, because of significant innovative and concurrency potential of industrial clusters and cluster's initiatives [Haberla 2016]. However, not every of the existing structure, although called an industrial cluster, function amicably to the assumptions of this conception – some of them are only rehearsals of industrial clusters' structure.

An industrial cluster enhances the strength of a single entity in activities on the market, enables a transfer of knowledge for units from the science sector, exchange of experiences, the realization of innovative projects responsible for the demands of companies. It leads that membership in an industrial cluster forcefully determines the innovation of a company. Participation in this form of cooperation ensures more comfortable access to potential resources of information about the change, missing specialist resources crucial for the improvement of innovation (i.e. knowledge, skills, financial capital, human capital). It is easier to identify trends, undertake and habituate innovations, influence the technological improvement in the sector, create intersectoral change, achieve greater dynamics of development due to an industrial cluster. According to Anderson et al. [2004] – the faster growth of companies results from easier access to seed and venture capital, advanced tools of risk management, higher strength of the whole industrial cluster. On the other hand, it results from the lower significance of interest groups (which may be a barrier while making decisions), inspected access to the network of sources of financing and complementary skills, improvement of effectiveness (as a result of specialization and rivalry) and access to specialized resources. Benefits of presence in an industrial cluster mentioned earlier are significantly crucial for small and medium-sized enterprises which come across numerous barriers to innovation and are not always able to overcome them independently.

Functioning in an industrial cluster resists on cooperation, sometimes even on concurrency, and it enables the entities to achieve following benefits confirmed by results of empirical surveys [Kowalski 2013, Grzegorzewska et al. 2014].

- improvement of agencies' productivity;
- achieving benefits of scale and specialization;
- reduction of transaction, transport, technical infrastructure and market activities costs;

- achieving greater specialization within a range of acquiring human resources, conducted research-and-development works, sources, and mechanisms of financing;
- easier access to information about conditions and changes in technology, stock, and determinants of running a business; in the result – easier adjustment and reaction to changes in the habitat;
- ability to impact the technological progress in branch and sector; gaining a technological pioneer's pension;
- acquiring access to the qualified labor force;
- exploitation of sharing knowledge, the synergy of sources to obtain skills of learning, cooperation while solving problems and creating innovations.

Surveys conducted by varied authors on the exploitation of an industrial cluster's conception in different industrial and service sectors in Poland affirm that it is possible to achieve mentioned benefits by companies or other members of an industrial cluster. Cooperation based on synergy and trust improves their innovativeness and concurrency. It also supports the development of a region [Nasalski 2008, Łącka 2013, Kacprzak 2014].

### **INDUSTRIAL CLUSTERS IN BIO-ECONOMY – A SHIFT OF THE THEORY TO PRACTICE IN POLAND**

National concept papers emphasize that bio-economy is a smart specialization. Its development requires organizing a net of cooperation (i.e. as an industrial cluster) of various objects within a sector and inter-sectoral cooperating to solve problems associated with the wise husbandry of biological resources. The collaboration of members of an industrial cluster enables reducing difficulties while financing undertakings in the area of bio-economy (i.a. using public support) and looking for new markets for hitherto or new proposals of companies. It facilitates promoting the flow of existing or innovative solutions in or between sectors. Scientists support entrepreneurs while diagnosing needs of purchasers and exploiting this knowledge to prepare new solutions. They initiate the research-and-development works and create innovations which will conform prospective

needs of acquirers. As Komar [2016] leads, the most significant meaning for the development of industry has a creation of an effectual, proficient "system of gaining, keeping and sharing knowledge, and commercialization of the results of scientific surveys". Industrial clusters offer these opportunities. Two, undermentioned examples describe, how it realizes practically. Prime, agricultural and food industrial cluster connects with producing ecological food, and it is called Dolina Ekologicznej Żywności [translator's note: Valley of Ecological Food]; further, called Zachodniopomorski Klaster Chemiczny Zielona Chemia [translator's note: West Pomeranian Chemical Industrial Cluster Green Chemistry] with a widely comprehend bio-economy. Initially, it was directed towards chemical sector (chemical and rubbery industry), but with the passing of time it spread its range of activity into other areas of bio-economy such as waste farming and the power industry.

#### **Klaster Dolina Ekologicznej Żywności**

An industrial cluster functioning as an association lies in Lubelskie Voivodeship, but its influence embraces Podkarpackie Voivodeship, Świętokrzyskie Voivodeship, Podlaskie Voivodeship and Warmińsko-Mazurskie Voivodeship. It has existed since 2010 and was created within the project "Rozwój klastra Dolina Ekologicznej Żywności" [translator's note: The development of an industrial cluster Valley of Ecological Food] accomplished in years 2010–2013. A concept of this net structure was prepared to needs of Program Operacyjny Rozwój Polski Wschodniej 2007–2013 [translator's note: Operative Program of Development of Southern Poland]. Axis 1: Modern industry, functioning. 1.4 Promotion and cooperation. It states as a cluster's initiative organized within the regional development policy and supports innovation in the area of a region with significant potential of biological resources, and specialization of productivity factors. PLN 2.5 million was set for this, and 90% of funds (PLN 2.25 million) derived from the European Fund of Regional Development. The Instytut Uprawy, Nawożenia i Gleboznawstwa w Puławach research center [translator's note: The Institute of Cultivation, Fertilizing and Soil Science in Puławy] has become a coordinator of this project. The cluster's initiative,

primarily having six participants (recently – more than 20) was supposed to lead to [Kacprzak 2014]:

- the creation of a supra-regional platform of cooperation in the area of development and promotion of the ecological food in the region of southern Poland;
- the improvement of competitiveness and innovativeness of members;
- the augmentation of production scale of environmental food and the number of workplaces in the sector of green products (within netted cooperation and mutual promotion offer of products and clusters' services);
- the improvement of accessibility to complex information and knowledge about production; processing, marketing of ecological outcomes for members of an industrial cluster;
- the increase in demand for eco-friendly products among consumers and gaining new markets.

The structure of this industrial cluster relies on the integration of individual elements of production and distribution of biological and agricultural products. The circle begins with creators, within organizations and institutions supporting and controlling economic, agrarian activities (consultants, certifying units, producer associations), processing companies, research-and-surveying institutes, agricultural school system, and organizations focused on promotion and development of the stock of ecological food.

After seven years of functioning of this net of cooperation, it can be easily alleged that it has brought anticipated results. To needs of this activity of the cluster's structure and its members, surveys and analysis concerning production, processing, and marketing of ecological products have been created. There appeared 13 new environmental products and used 26 innovative methods of manufacturing and selling bio food. Essential effects of the existence of the industrial cluster are the formation of sound cooperative connections between its members and the attraction of subsequent members. Another result is the creation of permanent relations between the members of this cluster in the regulative surrounding on the local, regional and national standards. Dolina Ekologicznej Żywności has promoted a distinguishable brand and entrepreneurs acquired the increase of production scale. Activities connected with sharing knowledge and teach-

ing the members of this cluster were also successful (i.e. training courses, conferences, promotional and informative materials).

### **Zachodniopomorski Klaster Chemiczny Zielona Chemia**

The association Zachodniopomorski Klaster Zielona Chemia was created in June 2007 and registered in KRS [translator's note: National Court Register] on 18 September 2007. It is one of the most extended existing structure in Poland. Before this time, there were informal cooperative bounds between entrepreneurs of chemical sector and between Szczecin universities in Poland. Works over the Regional Strategy of Innovation in 2006, noted a need to create formalized cluster structure which will have higher chances of acquiring support for activities. These connect with forming a platform of knowledge exchange, the technology transfer as a result of the cooperation of science and industry, and innovative operation of companies. The prime movers of this net structure were scientists of Politechnika Szczecińska [translator's note: Szczecin Polytechnic Institute], Akademia Rolnicza w Szczecinie [translator's note: Szczecin Agriculture University] which in 2009 created Zachodniopomorski Uniwersytet Technologiczny w Szczecinie [translator's note: West Pomeranian University of Technology, Szczecin], and self-government. The entrepreneurs of the chemistry sector have attended works over creating the industrial cluster from scratch. Primarily, the structure kept a count of about 20 members, including companies from the chemistry sector (chemical and rubber industry), universities and objects of the business surrounding. After the reform of higher education in Poland in 2010, the industrial cluster started to overgrow. In 2017 it focalizes 120 members, including 20 large companies, 55 small and medium-sized, numerous business support organizations, scientific units, and institutions of local government. The range of the industrial cluster has transgressed over a region of West Pomerania - recently, its members localize in 10 voivodeships. It cooperates with units abroad – in Germany, the Netherlands, Belgium, Sweden, Denmark, Finland, Spain, Italy, Greece and the United States of America. Recently, objects from Ukraine and Belarus have joined.

The activity of the industrial cluster consists of organizing platforms of cooperation of business environment with representatives of the research-and-development sector and latest achievements of science. There are three such platforms: bio-economy, packaging and the power Industry and the recovery of materials. Polish and foreign counterparts demonstrate great interest in the results of commercialization of the cluster's innovation what causes a consistent development of research-and-development background and joining the net of cooperation by following members. Since autumn in 2015, the Zachodniopomorski Klaster Zielona Chemia states as Krajowy Klaster Kluczowy [translator's note: National Fundamental Industrial Cluster]. It was entered by Ministerstwo Gospodarki [translator's note: The Ministry of Industry] what attests an acknowledgment of its achievements and the strength of a structure, and executed strategy.

Following facts prove the strength and efficiency of the industrial cluster in years 2010–2017: the organization of 230 meetings, including eight editions of Międzynarodowe Forum Naukowo-Gospodarcze Chemika EXPO [translator's note: International Scientific and Economic Meeting of Chemika EXPO]. It organizes courses and other events for companies of the industrial cluster (i.e. mutual industrial assignments, studio appointments, attendance at fairs, cooperative market). The communication between the members and promotion of the cluster's activities facilitates since 2014 by a fortnightly dispensation of a Newsletter in the electronic version. What is more, the industrial cluster implemented 12 national and international projects (including initiatives CORNET, 7 FP, H2020). Projects such as SUBWEX (2013–2014), SmartFlower-Pack (2013–2014), FreshCoat (2013–2015), Extrumi (2013–2015), ProgRess (2014–2015), ActiPoly (2015–2017) appeared among them. Due to those projects, the industrial cluster claimed PLN 7.5 million on Zachodniopomorski Uniwersytet Technologiczny w Szczecinie account. However, companies which cooperate in this cluster claimed a support of PLN 23.5 million. Concerning limited framework of this article, it is impossible to describe each and individual projects in details, however, each fit in the range of bio-economy. The Klaster Zielona Chemia took part in the Natureef project (European Cluster Partnership). The aims of this project were

the creation and implementation of a similar strategy which promotes cooperation between various branches of industry. It also simplifies an internationalization of small and medium-sized enterprises by mentoring and popularization of their innovative technologies (in the area of natural resources). The project was financed by a programme Horizon 2020 of the COSME initiative [translator's note: Programme for the competitiveness of enterprises and small and medium-sized enterprises]. Thanks to this initiative, the Klaster Zielona Chemia supports its three members from South Africa, China, and the Philippines.

Apart from that, the industrial cluster supported the development and preparatory works of new products from members of the cluster, in example, innovative, organo-mineral fertilizer Or Cal (covered by the patent) as well as hobby and professional fertilizers for agriculture SUPROFOS and SUPROFOSKA. What is more, the industrial cluster supports surveys within PhD thesis directed on bio-economy and uses the results of these studies to needs of members of the industrial cluster.

## CONCLUSIONS

Modern, innovative processes demand interaction and cooperation between the units of science and industry. Experts lead that the most beneficial expanse of creating and implementing the innovation is a region in which a connection of knowledge, skills, and functioning of companies is possible. Environments especially favorable for cooperation and innovative processes are industrial clusters. They efficiently impact the creation of connections and organization of collaboration of universities, research institutes, companies, institutions of the business surrounding, social groups, representatives of consumers, and units of the labor government. Cooperation inside of an industrial cluster contributes to the exchange of knowledge and information, transfer of technology, their flow from the science sector and the developments of qualified workforce in companies. Thanks to above-mentioned, clusters acquire new chances of development – they intensify the research-and-development activity, involve innovative technological solutions into production processes. It favorably impacts the growth of in-

novations and concurrency of companies and a region in which a cluster locates. Experts lead that essential factors of an industrial cluster's success are: sound scientific substructure in the form of fundamental and applied surveys, good scientific hinterland, the high culture of industry in the academic environment, accessibility to business support services, and the presence of large industrial objects in affined industrials. They singled out sectoral specialization in a region, the intensive cooperation of members of an industrial cluster in a local, interregional and international environment, as well as positive effect of this collaboration – the mutual trust of objects.

Abovementioned annotations also pertain industrial clusters in the range of bio-economy. Portrayed examples of two Polish industrial clusters functioning in this sector denote that such structure approves the flow of knowledge and know-how, acquiring new skills, and implementing mutual research-and-development works. It facilitates communication and creation of an atmosphere of trust, even among rivals. It reassures more straightforward access to expert services and interactive marketing activities. The presence of companies from the bio-economy sector in an industrial cluster supports their innovativeness, commercialization of surveys results, and the diffusion of knowledge and innovation. It enables the growth of the number of workplaces and improves the quality of work power among cluster's members, what improves developmental conditions of a region. Outnumbered benefits lead that industrial clusters in Poland should be used to a greater extent while enhancing innovativeness of companies from the bio-economy sector.

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## KLASTRY JAKO NARZĘDZIE STYMULOWANIA WSPÓŁPRACY I INNOWACYJNOŚCI MAŁYCH I ŚREDNICH PRZEDSIĘBIORSTW W SFERZE BIOGOSPODARKI

### STRESZCZENIE

W opracowaniu omówiono możliwości wykorzystania klastrów do pobudzenia współpracy i innowacyjności przedsiębiorstw z obszaru biogospodarki. Celem artykułu jest wyjaśnienie, dlaczego klastry są właściwą strukturą do zwiększenia aktywności innowacyjnej członków klastra należących do sektora biogospodarki. Zwiększenie innowacyjności tych podmiotów jest możliwe dzięki współpracy, synergii zasobów i wymianie wiedzy oraz transferowi technologii. Poza teoretycznym ujęciem tego zagadnienia artykuł prezentuje charakterystykę dwóch klastrów funkcjonujących w obszarze biogospodarki. Opracowanie ma charakter teoretyczno-przeglądowy. Do jego przygotowania wykorzystano unijne i krajowe dokumenty strategiczne oraz programowe, opracowania naukowe, a także informacje pochodzące z obserwacji i rozmów z prezesem Zachodniopomorskiego Klastra Chemicznego Zielona Chemia.

**Słowa kluczowe:** biogospodarka, klastry, współpraca, przedsiębiorstwa, innowacyjność