

Ecological Innovations as a Tool to Provide the Region's Sustainable Development

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Abstract

The main objective of this article is to examine the role of the ecology-oriented innovative activity in the provision of the region's sustainable development. The authors disclose the essence of the region's sustainable development and justify the necessity of the innovation paradigm implementation in its course. Along with that, according to the authors, the key element in this process is implementation of the innovations of the ecological nature. Formation of the regional ecologically innovative cluster is proposed as an institutional mechanism of the ecology-oriented innovative activity arrangement.

Keywords: sustainable development, innovations, ecologization, ecological and economic system, cluster model.

1. Introduction

The ecological imperative of the social development in the modern conditions is becoming an endogenous factor of the economic relations system functioning. However, practical building of an economic system, which would contain the ecological imperative of development, seems to be quite a complicated and controversial process combined with the reorganization of the most diverse areas of social and economic life.

In this regard, it is necessary to find such an approach to solving the problems of ecological and economic cooperation, which leads to sustainable development of the territorial units. One of the patterns of the specified problems solution is the innovative orientation of the social and economic systems, including on the regional level.

Many states consider the use of ecologically clean products and technologies, which significantly reduce the environmental risk through the application of scientific and technical achievements, extremely important for ensuring the economic and social welfare. Thus, currently, the institutional forms of arrangement of the ecologically oriented innovation processes are being actively sought for.

2. Methodology

2.1 Basic principles of the sustainable development concept from the viewpoint of its innovativeness

The "sustainable development" concept was suggested by the World Commission on Environment and Development in 1987. The Commission's idea consisted in the extension of the "development" concept interpretation through the inclusion of environment and resources preservation problems into it, as well as accounting of the interests of future generations. The report authors addressed their suggestions to both wealthy (refusal of overconsumption and extravagance) and poor countries (poverty liquidation, population pressure reduction). They expressed their confidence in the fact that the advanced technologies and the radical change of the social structures will allow to enter a new era of economic growth and ensure adequate life quality of living for each person.

In the work "New paradigm of Russia's development in the 21st century. Complex research of sustainable development problems: ideas and results," it is noted that transition to sustainable development is primarily the creation

of a new pattern of thinking, new conscience in the society, which is the most complicated and will provide transition to a new civilization together with the socioeconomic and ecological transformations (Koptiuga, Matrosov, and Levashov, 2000).

The assessment given by Moiseev to the concept of sustainable development is quite remarkable: "Today we are fairly far from the realization of what the human strategy in the conditions of the approaching crisis shall be like. Therefore, any actions of local nature are very useful and able to reduce the speed of 'run to a steep.' In this regard, the 'sustainable development' principle should be considered from this position."

Sustainable development of a region is represented by the process of continuous transformation of the qualitative and quantitative characteristics of the regional social, environmental, and economic system, aimed at the achievement of a dynamic balance between the society, economy, and environment, which ensures welfare of the current and future generations on the basis of observance of the principles of the dynamic balance, equilibrium, harmony, stability, and competitive ability, the essence of which consists in the following:

- the principle of balance—achievement of a dynamic balance of the regional social, ecological, and economic system,
- the principle of equilibrium—achievement of the optimal ratio between the qualitative and quantitative characteristics of the regional social, ecological, and economic system,
- the principle of harmony—provision of interrelationship between the social, economical and ecological areas of the region,
- the principle of stability—maintenance of the positive parameters of the region's sustainable development within the maximum longest period,
- the principle of competitive ability—implementation of the capabilities possessed by the region and connected with the realization of its competitive advantages for the provision of the territory's sustainable development.

From the viewpoint of the modern economic peculiarities of the regional development, it can be stated that sustainable development of the territorial units means the satisfaction of needs of the existing generation with the purpose to avoid any damage to the future generations (Minervin et al., 2005). Along with that, the concept of the sustainable development as the immanent position implies that ecological problems can be solved only based on innovations.

The degree of the theoretical justification of the problem of sustainable social, ecological, and economic development is determined by the strictness and consistence of the specific conceptual framework of the new forming phenomenon represented by the innovative economy. Such category is characterized by its own organizational and economic basis, which can be represented by the "5 I's" model: innovations, investments, infrastructure, institutions, and intelligence. This list provides quite a comprehensive description of the innovative economy elements, which are now perceived by many researchers as the program elements for the formation of a sustainable development mechanism (Altynbaeva, 2010). Currently, the theory of innovations continues to be formed both at the legal level and in the scientific environment, yet there is no common understanding of the process itself, and the vocabulary is contains rather controversial definitions. For the analysis of the role of the innovative component in the formation of the basis for sustainable development of the social, ecological, and economic system, it is required to outline the problem of identification of the innovations essence in the modern economy more clearly.

2.2 *The essence and forms of ecological innovations demonstration*

Innovation is a basic concept, the correct understanding of which determines the tactics and strategy of the effective innovative economy formation. Applying the system analysis to the "innovation" concept, Baev and Shugurov (1995) quite reasonably outlined five main approaches to its determination: the object-utilitarian, process-utilitarian, process-financial, object, and process approaches. The main essence of the approaches applied to the "innovation" concept implies that innovations' novelty is primarily evaluated by technological parameters and, mandatorily, by the market positions. Common features of the existing definitions of innovation are, first of all, changes (fundamental or partial); secondly, novelty; and thirdly, applicability.

A criterial characteristic of the innovation process is implementation, and its attributes that have certain specific features are the systematization, high social and economic significance, cyclical nature, high degree of risk, indefiniteness, etc. This process is a system mechanism of novelty creation, which commences from the new idea generation and ends with the sale of a certain original product, in which this idea is embodied (Sosunova and Serper, 2010).

The specific nature of the post-industrial innovative economy consists in the formation of the general innovative characteristic of each classic production factor (labor, land, and capital), and neither of them can effectively participate in the innovative social production without having any innovative property (Krasnova, 2010). In case one of them acquires such property and starts to act, it invariably "brings" other production factors to innovation state. In case it does not acquire any innovative property, then, as a rule, it does not "fit into" the new production process due to its incompatibility.

Innovations are based on the economic changes, and the enterprise's ability for innovations depends not on such factors, which were previously decisive, as the size and the age of an enterprise, but on the management effectiveness.

Various innovation types are closely interconnected and appear within the frames of a certain innovative mechanism, for example, technical innovations influencing on the production processes content also develop conditions for the management innovations, since they bring changes into the already existing production organization. Organizational innovations demonstrated as the new implemented methods of business management, in their turn, influence on social innovations.

According to the tradition of previous periods of the economic history, modern economic science is primarily oriented on the studies of the material production; therefore, the most attention is paid to the technical innovations. At that, in the conditions of recognition of the sustainable development imperatives by the society, the ecological innovations as immanently attributive to such a form of the institutions development becomes more significant.

Reid and Miedzinski (2008) provide the following definition of the ecological innovation concept—"a previously non-existing and competitively evaluated product, process, system, service, or procedure, which can meet human's demands and contribute quality of living for all people with the minimum consumption of the natural resources (including energy carriers and occupied area) during the whole life cycle for each output unit and with the minimum emission of the toxic substances." According to the statement of the Organization for Economic Cooperation and Development, this definition means a principally new commodity, service, or technology for detection, prevention, limitation, minimization, or correction of the damage of the environment, air, soil, as well as of the problems related to the emission of contaminating substances, noise, and ecosystems (OECD, 2009).

Karpishchenko and Il'iashenko (2011) classified ecological innovations depending on their implementation areas as follows:

- 1) technical (new ecologically friendly and ecologically clean products, technologies, etc.);
- 2) organizational (new methods and forms of the enterprises' activities organization, aimed at environmental hazard reduction);
- 3) social (various forms of creative activity implementation oriented at production and consumption ecologization).

From the viewpoint of the significance in the economic development, ecological innovations can be broken up into basic, improving, and pseudo innovations.

Basic innovations are represented by the large-scale inventions, and become the basis of formation of the new patterns and generations of the engineering (technology). Their peculiar feature is the significant unpredictability of ecological consequences at the modern level of science and engineering development. The ecological effect of their implementation in one of the pattern can contribute to cancellation of the negative impact in another.

Improving innovations are the most popular type of ecological innovations. In case of their implementation, it is possible not only to foresee the consequences, but also to provide economic assessment of the damage, which is prevented in the result of the ecological innovation implementation.

Pseudo-innovations are aimed at partial improvement of the outdated engineering and technology; they do not influence on the reasonable use of natural resources, development of scientific and technical progress, but only partially prevent contamination caused by the ecologically hazardous production technologies and consumption products.

In respect of the environment components, with which the innovation activity is connected, ecological innovations can be divided into single-component (atmosphere air, water, soils) and complex (air-water, water-soil, etc.).

Considering the types of the ecologically destructive processes, which can be prevented, ecological innovations can be classified as follows: landscapes destruction, mechanical, biological, and chemical contamination types.

With regard to the type of the obtained effect, ecological innovations can be classified as innovations aimed at the economic, ecological, social, budgetary, and integral effects (Andreeva and Martyniuk, 2011).

Therefore, we can speak of the diverse orientation of such phenomenon as ecological innovations. This circumstance completely and entirely allows referring them to the tools of ensuring sustainable development, the objectives of which imply the necessity of stability achievement in the economic, ecological and social aspects.

3. Results

According to expert evaluations, the annual market share of the ecological commodities exceeds USD 500 billion. Along with that, the annual increment of this market's volume exceeds 5%, and in many industrially developed states, even higher increment rates are observed. According to the forecasts, about 40% of the global production in the nearest future will be the products and technologies of the ecological and energy profile (Kovalenko and Kuznetsov, 2007).

Since such technologies are useful for the society as a whole, multi-purpose, and are at the pre-market stage (i.e. they do not represent certain types of products, technological processes, and management systems yet), they are considerably financed by the state.

Since 2010, the European Union has been publishing the so-called "eco-innovation chart", the aim of which is to detect the tendencies and evaluate achievement of the EU countries in the area of ecological innovations. This chart consists of five groups of indicators (EIO, 2013) comprising the following aspects:

- 1) eco-innovation investments (state allotments and expenses for research and development in the environmental and energy areas, the total number of involved people and researchers in the area of ecological innovations, the total cost of "green" investments);
- 2) eco-innovation activity (companies, which have implemented innovations aimed at reduction of the materials and power consumption per unit of the released product, and companies applying the ISO 14001 standard);
- 3) eco-innovation results (the number of patents in the area of the environment pollution reduction, wastes management, and effective use of energy, the number of publications in the area of ecological innovations);
- 4) consequences for the environment (productivity of raw materials use, efficiency of water resources and energy use, intensity of the greenhouse gas emissions);
- 5) socioeconomic consequences (occupancy, turnover, export of the commodities of the ecologically oriented industries).

Along with that, in accordance with the "eco-innovation chart", the EU countries are currently divided into 4 groups:

- leaders (Finland, Denmark, Sweden);
- countries with high achievements (Germany, Belgium, Spain, Slovenia, Ireland, Austria);
- countries with average achievements (Netherlands, Luxembourg, Great Britain, France, Italy, Czech);
- overtaking countries (Portugal, Bulgaria, Romania, Estonia, Cyprus, Hungary, Malta, Greece, Slovakia, Poland, and Lithuania).

Let us consider two demonstrative examples of the implementation patterns of ecological innovations, which are especially relevant to maintain sustainable development of municipal entities. Such patterns are represented by the reduction of contamination of the urban space with the municipal solid wastes (MSW) and leveling of the negative consequences of the motor transport emissions.

Since recently, the selection of the material for the package production in the industrially developed countries targets its ecological friendliness.

It is largely determined by the fact that, according to the Nielsen Company, the number of consumers concerned with the excessive package and problems of its disposal exceeded 40%. Results of the research conducted in 47 countries of the world showed that this problem worried the consumers more than the water and air pollution.

For example, 20% of respondents informed that upon foodstuff purchasing, they always pay attention to whether recyclable or ecologic package is used. Every second consumer from the "ecologically-oriented" group is even ready to reject the package offered by food manufacturers for compact storage in the household conditions (49%) and for transportation (47%), as well as the package that can be used for food warming or as a container for foodstuff storage (48%), in order to reduce the impact on the environment (Nielsen, 2008).

In this regard, manufacturers of the packaging products more frequently mark the possibility to dispose of the applied packing material or specify the share of the product, which can be extracted from the recycled material. The general criteria of the package ecological friendliness are as follows:

- multifunctional application;
- rejection of the package intended only for the product external presentation;
- rejection of the use of combined materials complicating recycling.

Currently applied active package ensures partial solution of the long-term security tasks and preservation of the guaranteed quality of the raw materials and the products. This pattern of protective means application is developing along with the development of the package with the characteristics programmed in the course of time.

Since recently, there is growing interest in biodegradable polymer materials and packages made of them, which

are destructed under the influence of various microorganisms. Currently, the global production of biodegradable plastics amounts to over 140 million tons. Along with that, a whole range of the technological approaches to biodegradable polymers creation exists (Ivanova et al., 2008), among which the following ones should be singled out:

- selection of special strains of microorganisms capable of polymers destruction;
- synthesis of biodegradable polymers by biotechnology methods;
- development of materials produced with the use of biological resources;
- copolymerization of the natural, easily destructed and synthetic compounds;
- introduction of organic fillers into the polymer matrix, which serve as a nutrient medium for the microorganisms (amylum, dextrin, cellulose, chalk, agricultural wastes, etc.).

Herewith, the ecological friendliness of package has not yet become an important factor determining the choice of food products for the majority of Russian consumers. According to the results of research conducted by Nielsen, Russia is in the list of the least ecologically oriented countries, since only 9% of respondents indicated that they chose products with consideration of such aspects as ecological friendliness and recyclability of the package (Mironova, 2008).

One more of the most important patterns of ecological innovations implementation are the measures taken to reduce the motor transport's negative impact on the environment state.

In particular, one of the innovation patterns of the improvement of ecological qualities of the transport means is the application of the electric drive in their design. Herewith, it is possible to outline two patterns of development of the machines with the electromechanical drives—invention of a clean electric car and development of an electromechanical drive with a hybrid (combined) power unit. In this regard, we can note that due to absence of effective electric energy storage units available for the mass production, clean electric vehicles have a relatively low mileage per one charge, which limits their performance.

Currently, almost all regions of the world experience an increase in the hybrid cars sales. The most saleable hybrid car on the global market is Toyota Prius. Fuel consumption of this model amounts to 3.6 liters per 100 km; the UHC and NOx emissions are reduced by 90%, and CO₂ emission—by 50% in contrast with the serial Corolla (Fil'kina, 2004).

Foreign experience shows direct interdependence between the growth of the hybrid cars sales and the stimulation of their owners by the state. For example, in the UK, owners of hybrid cars are released from payment of the annual fee in the amount of GBP 2,000.00. In Ireland, the rate of the annual registration fee for such cars is reduced by half. In Norway, owners of "hybrids" can use a one-time concessionary rate of the transport tax at purchasing them.

Therefore, ecologically oriented innovations are becoming an increasingly demanded element of the mechanism of forming the basic principles of the socioeconomic system's sustainable development.

4. Suggestions

We need to note that it seems impossible to ensure the transformation of innovation technologies into the most important factor of sustainable regional development without forming a relevant for current circumstances mechanism of integration of ecologically oriented innovation activity into the existing system of economic relations. One of the patterns of such a mechanism formation is the creation of an eco-innovation cluster on the territory of a particular region.

As for the essence of the "innovation cluster" concept, we can note that Simmie and Sennett determined it as a "group of interrelated service and industrial companies characterized by the level of cooperation based on the supply chain and functioning in equal market conditions" (Simmie and Sennett, 1999).

The clusters concept was based on the Porter's (2005) theory of competitive advantages, who defined the opportunities of obtaining a synergetic effect from creation of innovation clusters in three key lines:

1. Clusters aimed at implementation of the high-technology innovation projects and having higher development rates in contrast to the competitive environment.
2. The work within a uniform geographic zone can ensure the growth in the productivity of the enterprises that are residents of the cluster.
3. Clusters stimulate the launch of "start-ups," which subsequently become participants of such clusters, increasing their scale.

Along with that, cluster structure elements include: enterprises manufacturing final products; enterprises supplying production factors; authorities; research and development institutes and higher educational institutions; distributing enterprises; service companies; financial institutes; related industries enterprises; companies manufacturing minor products; infrastructure providers; agencies; associations.

Cluster availability allows regional authorities to move from assistance for the certain ecology-oriented innovation

projects to system assistance and stimulation of development of this innovative activity pattern. Besides, such clusters ensure harmonization of the interests of manufacturers, consumers, regional authorities, as well as reproduction of the environmental factors.

Let us remark that the main objectives of the eco-innovation cluster creation are:

- coordination of the activities of organizations within the cluster;
- establishment of a partnership network embracing all stages of the innovation projects implementation;
- formation of an innovative environment contributing to the region's sustainable development;
- promotion of products and services of ecological profile;
- assistance in attraction of investments in the projects implemented by the cluster participants.

The key provision of any cluster's activity can be the geographical localization. Highly advanced transport and information infrastructures provide reasonability of intra-cluster interactions, which include cooperation, exchange of highly qualified personnel, know-hows, ideas, and technologies. High speed of development of the communication means and logistic chains in modern conditions allows extending the cluster borders significantly.

The eco-innovation cluster can be represented as a system of economic establishments engaged in the development and distribution of the ecological profile products, and the complex of their interactions as a dynamic aggregate of quantitative and qualitative transformations of material resources and information, aimed at implementation of the aims and objectives of sustainable regional development. The mechanism of an eco-innovation cluster formation is shown in Figure 1.

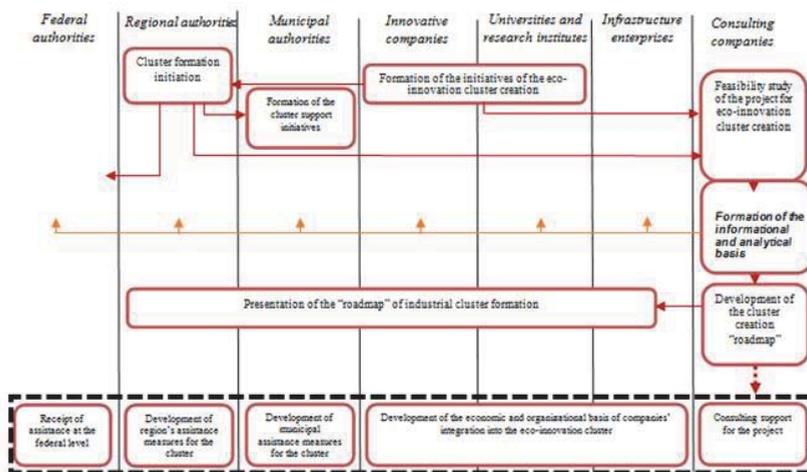


Figure 1. The organizational mechanism of formation of a territorial eco-innovation cluster

Links between economic structures at the initial stage of cluster formation are established artificially, but in the process of further development other diverse links are formed, which require monitoring and evaluation in respect of the cluster's performance. Herewith, provision of the reliable and proper information sharing between the cluster participants, which implies collection, generalization, transfer, and receipt of economical, ecological, and social data in the required volumes with the minimum cost, is one of the regulation functions of cluster development.

Formation of cluster establishments is the process of construction of a system of interrelated cluster participants and mechanisms of their interaction at the strategic, tactic, and operative regulation levels by the criteria of provision of the region's sustainable development in the whole, under limited volumes of transaction expenses arising in the cluster's external and internal environment, and providing satisfaction of the minimum level of interests of various groups of the regional development process participants.

The cluster approach is an effective tool, the application of which allows to ensure the formation of the basis for sustainable regional development, a better competitive position and investment attractiveness of the region, leading to the growth of contributions to the budgets of all levels, unemployment reduction, increase in the ecologically clean products output, etc. The policy of cluster development stimulation must be carried out by all power levels, with the

determining influence of the policy of the lower power levels on the eco-innovation cluster development.

For the development of scientifically justified proposals regarding formation of the clusters as complex systems with poorly structured problems, we suggest that the cognitive methodology of complex systems examination is applied (Gorelova et al., 2006; Gorelova, 2012; Gorelova et al., 2014). The necessity of the cognitive approach to a comprehensive study of the region's sustainable development problems was clearly specified in the work of Koptiuga, Matrosova, and Levashov (2000). The development of the cognitive methodology of complex systems examination was based on the works (Eden, 1998; Axelrod, 1976; Atkin and Casti, 1997; Atkin, 1997), and currently, it is tested on many social and economic units (Gorelova, 2012; Gorelova et al., 2014).

5. Conclusion

Understanding of the economic nature of ecological innovations having doubtless social significance as alternative expenses of the economic unit, which to a certain extent shall be compensated to it, allows formulating the general idea about the economic mechanism of eco-innovation activity arrangement within the frames of achievement of the regional sustainable development objectives.

In this mechanism's functioning, a special role is assigned to the regional and municipal authorities that are capable of creating economic conditions and pre-requisites for implementation of the ecology-oriented innovation projects. Upon that, one of the mechanisms allowing to achieve a synergetic result from the development to the implementation of ecological innovations at the regional level is the creation of eco-innovation clusters allowing to ensure achievement of the complex of positive effects of the economic, ecological, and social profile in the context of sustainable regional development.

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