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THE EU EXPERIENCE IN ECONOMIC SYSTEMS ADAPTATION TO RESOURCE FLUCTUATIONS THROUGH STIMULATION OF GREEN INNOVATIONS*

The paper analyzes the economic approaches to ecological innovations stimulation in the EU member-states. Attention is paid to the advantages and disadvantages of certain instruments with regard to the adjustment of economic systems to resource fluctuations. Pros and cons of market supply and demand mechanisms in enhancing ecological innovations are discussed. The components of reproduction mechanism to ensure the eco-balance of the economy are considered.

Keywords: ecological innovations; resource fluctuations; economic systems adjustment; ecological economy.

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ДОСВІД ЄС В АДАПТАЦІЇ ЕКОНОМІЧНИХ СИСТЕМ ДО РЕСУРСНИХ ФЛУКТУАЦІЙ ЧЕРЕЗ СТИМУЛЮВАННЯ ЕКОЛОГІЧНИХ ІННОВАЦІЙ

У статті проаналізовано економічні підходи до стимулювання екологічних інновацій в країнах-членах ЄС. Значну увагу приділено аналізу переваг та недоліків окремих інструментів адаптації економічних систем до ресурсних флуктуацій. Досліджено переваги і недоліки ринкових механізмів попиту і пропозиції щодо стимулювання екологічних інновацій. Розглянуто складові відтворувального механізму забезпечення екологізації економіки.

Ключові слова: екологічні інновації, ресурсні флуктуації, адаптація економічних систем, екологічна економіка.

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ОПЫТ ЕС В АДАПТАЦИИ ЭКОНОМИЧЕСКИХ СИСТЕМ К РЕСУРСНЫМ ФЛУКТУАЦИЯМ ЧЕРЕЗ СТИМУЛИРОВАНИЕ ЭКОЛОГИЧЕСКИХ ИННОВАЦИЙ

В статье проанализированы экономические подходы к стимулированию экологических инноваций в странах-членах ЕС. Значительное внимание уделено анализу преимуществ и недостатков отдельных инструментов адаптации экономических систем к ресурсным флуктуациям. Исследованы преимущества и недостатки рыночных механизмов спроса и предложения по стимулированию экологических инноваций. Рассмотрены составляющие воспроизводственного механизма обеспечения экологизации экономики.

Ключевые слова: экологические инновации, ресурсные флуктуации, адаптация экономических систем, экологическая экономика.

Introduction. In industrial technological society the production sector is considered to be the main point of public life. It determines current political, economic and social processes. Fluctuations in availability, prices on natural resources and objective necessity of maintaining ecological balance, force the society to bear out cost of natural parks creation, ecological monitoring, conservation of species etc.

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In a market system, people's needs are the key driving force of social development and production. The so called "demand-consumption market structure" is considered to be a powerful engine which stimulates a long chain of decisions.

Latest research and publications analysis. Environmental quality of natural surroundings and consumer requirements for goods and services represent new challenges for firms in their technology choice. Firms are forced to innovate taking into account these new environmental performance criteria. The problems of stimulation of green industries are analyzed in the papers of many foreign and national scientists among them: L. Brown (2001), J. Horbach (2008), M. Frondel (2007), H. Daly (1992), K. Rennings (2000) etc.

The research methods are represented by systematic and comparative analysis of academic literature and statistical information.

The main objective of the study is to determine the relevant economic mechanisms and instruments to stimulate green industries development and eco-innovations as a response to resource fluctuations. The structure of the paper is as following. First, we analyze greening concepts of national economies. Second, we provide methodological concept for policy and strategy of greening. Third, we compare supply and demand mechanisms to reveal a proper eco-innovations economic policy based on EU countries examples.

1. Greening the national economy. The "greening" of the economy implies a targeted process of economic transformation aimed at reduction of ecological impact on the environment. The concept of greening is realized through a system of organized measures, innovations, restructuring, technological transformations, and environmental policy activities at macro- and micro levels. Special attention in greening the economy is given to the environmental innovations, as they are profitable and environmentally friendly.

In a very broad sense, environmental innovation or eco-innovation can be defined as an innovation that includes a new or modified process, practices, systems and products which benefit the environment and contribute to environmental sustainability (Rennings, 2000). According to Eurostat (1999) eco-innovations is an industry engaged in "the production of goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and ecosystems... (including) cleaner technologies, products and services which reduce environmental risk and minimize pollution and resource use" (OECD, Eurostat, 1999). Eco-innovations are an important source of progress, for example, according to Brown (2001), potential in the solar arena is enormous. Aerial photographs show that even in the notoriously cloudy climate of the British Isles, putting solar cells on the country's existing roofs could generate 68,000 megawatts of power on a bright day, about half of Britain's peak power demand. Many firms are engaged to eco-innovation; however most of them do perform a simple improvement or the adoption of technologies developed by others.

The resource fluctuations of environmental policy instruments have a definite positive influence on eco-innovations. Thus, considering the previous severe gas crisis of 2006 and 2009, the European Union has taken many measures to respond to gas supply cuts, among them are stimulation of eco-innovations and resource saving activities.

As for the resource fluctuations, according to I. Auken (2012), Europe currently shifts to renewables. The main reason is high hidden costs of traditional energy sources, volatile resource prices, resource fluctuations (resources can come from politically unstable regions) and climate risk. It is stated that Denmark works on both short-term and long-term perspective and aims to be using 100% renewable energy by 2050.

As for the environmental policy, strictness according to Rave et al. (2011) revealed that for Germany environmental policy has an important role to play for the diffusion of firm-level eco-innovations: reliable, predictable and strict framework conditions are equally an important prerequisite for many firms to adopt more incremental and small-scale environmental innovations. Environmental taxes with slowly but steadily rising tax rates may provide the necessary incentives.

In general greening of industry and commerce might be considered as a function of a system which continuously self-reproduces its elements (figure 1):

- 1) the reproduction of green needs;
- 2) the reproduction of green technological basis;
- 3) the reproduction of green labour factors;
- 4) the reproduction of motives for "greening" production and trade.

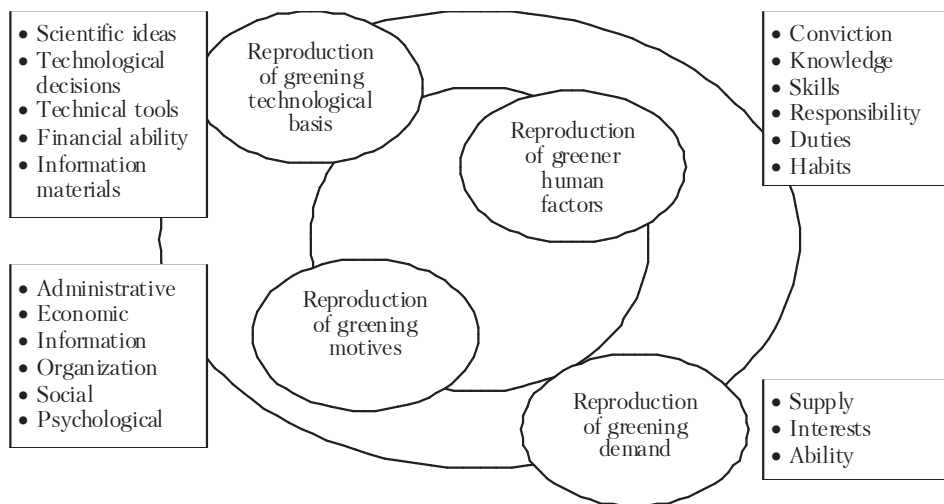


Figure 1. Mechanism of reproduction of greening economy, authors developments

Reproduction of sustainable ("green") demand is defined as a permanent process of shaping the needs for sustainable goods, as well, as the formation of financial possibilities for realization of identified needs. Sustainable goods are considered to be products and services that contribute to mitigation of integral ecological impact per unit of aggregate public product.

Furthermore, speaking about reproduction of ecological needs we have to formulate the required economic conditions for the national economy eco-balance.

Firstly, the reduction of the material-energy flows of consumed goods must not lead to the lower quality of service from the standpoint of a person's vital needs.

Secondly, refusal from the use of ecologically non-friendly products must be compensated by increase in the use of more ecologically friendly goods.

The demand for greening factors are observed mostly in relatively rich societies due to *nonhomothetic preferences* of economic agents with respect to environmental quality. Under the homothetic individual preferences, an increase in income leads to higher consumption, which causes higher pollution. Individuals with nonhomothetic preferences along with a rising income may desire less consumption and pollution, depending upon relative risk aversion between consumption and environmental safety. This approach is close to the researches on Environmental Kuznets Curve (EKC), which tries to explain bell-shaped relationships between incomes and pollution. Thus, Dasgupta and Laplante (2002) proposed to consider the following assumptions to explain the "bell-shaped" relationship between income and pollution: a) with rising income, marginal propensity to consume should decline or at least be constant; b) marginal disutility of polluted environment should increase.

Finally, demand for sustainable goods must result from three interconnected economic elements: needs, interests, and demand. *Needs* are motives for consumption of goods that have been realized by people and communities. *Needs* are transformed into *interests*. *Demand* is determined by financial capability, and the ability to pay for goods and services.

In general it is possible to identify 4 stages of sustainable needs development:

1. The first stage is associated with the means to control environmental destruction ("the end of pipe").
2. The second stage refers to environmental improvement of technology ("wasteless technology").
3. The third stage is associated with substitution of undesirable goods and service by "greener" ones ("more efficient goods").
4. The fourth stage is associated with production and consumption of goods for sustainable development ("sustainable life style").

Economists have traditionally considered nature to be infinite relative to the economy, and consequently not scarce, and therefore underpriced it. But nature is scarce and shrinking due to throughput growth. According to H. Daly (1992), the price for renewable and non-renewable energy sources should be paced at the same rate that is to make the green energy competitive with traditional and what is more important to stand on the road of sustainable development.

Motivational greening instruments imply permanent facilitation of organizational, social and economic conditions, which promote the desire to achieve goals of the economy's greening.

As to demand side determinants, it is generally assumed that market forces alone would provide insufficient innovation incentives and that consumers' willingness to pay for environmental improvements tends to be too low (Rennings, 2000). In fact, as emphasized by Taylor and al. (2006), demand pull policies do shape more the adoption and the diffusion of eco-technologies in comparison to innovative activity itself.

2. Supply or demand: which strategy is preferable for eco-innovations: the EU experience. The EU countries due to stricter environmental legislation and high dependence on natural resource fluctuations have already passed the first stages of sustain-

able needs development and currently have been working on more efficient goods and sustainable life style.

There are basically three main market strategies of greening and eco-innovations fostering:

1. Influence on demand, called "*push-strategy*". The idea of this strategy is to create a system of motivational influence (ecological standards, economic instruments, information supply) which will push the producer to manufacture "green" products.

2. Influence on supply, "*pull-strategy*" the "production-consumption train". Influencing the supply, one can pull the links of production "greening". The essence of this strategy lies in the necessity to convince a consumer both psychologically and economically to use ecologically friendly products.

3. Influence upon the communication between producers and consumers, is called "*interface-strategy*".

The demand side factors of green industries development directly depend on the per capita incomes of population. Thus, treatment of environmental protection and ecological quality as 'luxury good' means that as the incomes of economies and populations increase, they are prepared to spend more on protecting the environment. As an example, the EU countries are more effective in implementation of environmental regulations because enforcement agencies are often better funded and more transparent.

Several empirical studies stress that cost savings, reduction of resource dependence and productivity growth are key factors of eco-innovations, particularly for clean technologies. As emphasized by Frondel et al. (2007), innovation in clean technology tends to be driven by cost savings, in terms of energy and material savings, environmental management systems and by regulation. The demand side determinants are mainly seen on areas with visible effect and customer benefits such as food or baby clothes. Consequently, individuals' willingness to pay a premium for organic food or organic baby clothes is substantial. Finally, environmental process innovations create customer benefits such as less water, material or energy use.

Government intervention in green industries may be justified as a strategy to increase the supply of public goods. There are several works that tested the efficiency of different policy instruments in green industries. Hence, it is reasonable to analyze the EU countries experience of such activities.

According to Daugbjerg et al. (2011), the Danish government has intervened intensively in the wind turbine industry and organic farming sector mainly for environmental reasons but with very different impact, also it should be noted that different policy instruments were used. That is to some extent such governmental interventions can be treated as a "pure experiment" within one country green industries. While the market share of wind energy reached 20% in 2007, organic food consumption lags behind with a market share of approximately 8.5% in 2007. The reason is that government intervention in the wind turbine industry has emphasized the use of policy instruments designed to increase demand for wind energy, whereas organic farming policy has put more emphasis on instruments motivating farmers to increase supply. The simple conclusion is that demand mostly represents an engine that drives innovations in green industries.

According to Demirel et al. (2012), the amount of resources invested into the eco-innovations depend both on internal characteristics of firm and external characteristics of environment. Thus, firms less inclined to innovations in general try to meet minimum market requirements established by consumer demand. Amount of resources invested by such firms is not big because the main purpose of production mainly profit with minimum concern to eco-innovations. Forever the stringency of economic conditions and price resources fluctuations do promotes higher levels of innovations; the main explanation of such behavior is survival of the firm on the market. If the firm does not meet environmental standards it is more inclined to higher punishments and payments. More innovative firms do not necessarily need the regulatory push for eco-innovation.

J. Horbach (2008) used dataset based on the German Community Innovation Survey conducted in 2009 in order to test whether different types of eco-innovations are driven by different factors. It was used such explanatory variables for eco-innovations as supply, firm specific and demand factors, regulation, cost savings and customer benefits. J. Horbach states that fields such as material and energy savings do not need strict regulatory approaches because of their (potential) economic benefits, that is existing market motives are more than enough to stimulate such area of eco-innovations.

Considering the experience of Germany, Rave et al. (2011) econometrically proved that eco-innovators put relatively more attention to cost reduction, in particular the reduction of energy and resource costs, compared to other innovators. The latest tendencies in energy price growth prevent firms from excessively using the traditionally underpriced input factor energy. Moreover, high energy costs (and their fluctuations) provide dynamic incentives to generate eco-innovations continuously. Cost factor promotes eco-innovations and contributes to the diffusion of available technologies among firm.

Conclusions. Success in sustainable economic development greatly depends on human ability to effectively transform economic systems towards their permanent perfection and a decrease of nature intensity use. Specification of "greening" allows us to formulate local objectives for transformation of the economies as follows: restructuring of the economy, restructuring of enterprises, removal of needs with respect to not environmentally friendly products or services, change of ecologically non-friendly technological processes and lowering of the resource capacity of the products.

Among most valuable factors that promote eco-innovations are cost savings motives, productivity improvements, supply chain pressure, networking activities, environmental management systems, extended producer responsibility, R&D activities, and industrial relationships.

The demand (*push-strategy*) in eco-innovation fostering is appeared to be more effective than the supply (*pull-strategy*) as it can be seen from EU countries experience.

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