EFFECTS OF TECHNOLOGY TRANSFER PROJECTS: REGIONAL CASE OF ENERGY SAVING TECHNOLOGIES

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ABSTRACT

The purpose of this study is to develop a methodological basis for determining the effects of technology transfer projects on example of regional case of energy saving technologies. This will supplement the methodology of innovation policy formation with new scientific ideas about the peculiarities of transformation of innovation processes and combine within innovation policy both technological trends and the potential impact of government regulation on factors determining innovation behavior of economic entities in the context of energy saving technologies. The analysis of the greening of technologies has shown that due to the significant differentiation of the product life cycle depending on the stage of innovation and technological development (technological cycles of development, production and operation) the most effective is the concept of resource efficient and clean production. The key idea of this concept is that industrial processes and functions should be improved so as not only to reduce waste and reduce pollution, but also to preserve and (or) generate additional income by conserving resources. The approach should be implemented in the following areas: production efficiency: optimization of efficient use of natural resources (material resources, energy and water); minimization of negative impact on the environment by reducing waste and emissions in places of their formation; reduction of harmful effects of products on the environment during its life cycle; minimization of risks to public health. Based on these ideas the main areas of technology transfer projects are presented. Based on the analysis of the world experience of innovation systems management, it is proposed to consider the groups of effects of technology transfer that have a positive impact on the development of the regional economy.

Keyword: *Technology transfer, Effect, Region, Approach, and Energy saving technologies.*

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1. INTRODUCTION

Increasing the role of resource conservation and environmental security is due to both the pace of development of the innovation economy (actively developing new technologies, expanding the range of tasks addressed by government and commercial programs), and environmental function.

Based on the large scale, the task of product life cycle management and full project implementation cycle arises.

Without the analysis of the resource component of the project can not be implemented due to the fact that the tasks of development are constantly complicated in nature and resource intensity of these projects. The issue of rational use of allocated resources becomes a priority also based on their scarcity. Therefore, the issue of resource provision and environmental and economic effects of innovation is becoming increasingly important.

Study of institutional features of development of priority sectors of the national economy [1; 2] is based on the dynamic effectiveness of innovation policy [3], sustainable development goals [4] and modern innovation trends [5; 6] complements existing approaches with analytical tools for assessing the compliance of enterprises with technological trends and allows solving problems of technology transfer projects management.

This approach allowed to develop an innovative project of energy saving technologies in accordance with the principles of active innovation network, which provides for the creation of a regional cross-sectoral platform that

will enable productive interaction of participants in the innovation process within the network strategy at all stages of the value chain with the participation of agents and institutions.
The purpose of this study is to develop a methodological basis for determining the effects of technology transfer projects on example of regional case of energy saving technologies. This will supplement the methodology of innovation policy formation with new scientific ideas about the peculiarities of transformation of innovation processes and combine within innovation policy both technological trends and the potential impact of government regulation on factors determining innovation economic behavior in energy saving technologies context.

2. TECHNOLOGY TRANSFER PROJECTS

The analysis of the greening of technologies has shown that due to the significant differentiation of the product life cycle depending on the stage of innovation and technological development (technological cycles of development, production and operation) the most effective is the concept of resource efficient and clean production.
The key idea of this concept is that industrial processes and functions should be improved so as not only to reduce waste and reduce pollution, but also to preserve and (or) generate additional income by conserving resources.
Based on these ideas and authors approach [7] in table the main areas of technology transfer projects are shown.

Table -1: Directions of the main measures included in the portfolios of energy saving projects

Classification feature	Projects
Project types	- modernization of industry and energy at individual facilities; - production of equipment to reduce pollution, measurement, increase energy efficiency, etc., invest capital in enterprises for such production; - service aimed at environmental protection: destruction and disposal of waste, treatment of water and wastewater; - design and consulting services; investing in consulting and engineering firms.
Energy efficiency in industry	- replacement or modernization of energy-intensive production equipment; - combined heat and power generation.
Resource supply systems (networks)	- power supply (ACS, new constructions, reduction of losses in electric networks); - heat supply (new constructions of thermal networks); - water supply (comprehensive programs to reduce water consumption, comprehensive modernization of water supply systems); - energy sources for own needs.
Energy efficiency in commercial buildings	- wall insulation, etc.; - installation of new heating and ventilation systems; - installation of energy-saving lighting; - other areas of modernization.
Improving energy sources and their structure	- comprehensive optimization of the structure of energy sources of cities and regions; - small energy on traditional energy resources; - fuel preparation and combustion technologies; - water treatment technologies (coolant); - secondary energy resources; - renewable and non-traditional energy sources.
Type of technology by field of implementation	- general industrial technologies; - specialized technologies; - best branch enterprises.
Implementation of quality system	- mass goods; - manufactured goods and technologies.
Incentive mechanisms	- funds; - sale of released capacity; - public activity.
Level of the projects	- complex international projects; - complex national projects; - complex regional projects; - complex municipal projects; - complex branch projects.
Training and advocacy	- education in schools; - professional training and advanced training; - visual propaganda.

The approach should be implemented in the following areas:
- production efficiency: optimization of efficient use of natural resources (material resources, energy and water);
- minimization of negative impact on the environment by reducing waste and emissions in places of their formation;
- reduction of harmful effects of products on the environment during its life cycle;
- minimization of risks to public health.

We can note that the most effective are complex projects [8; 9], which include measures that affect all or some directly independent areas of energy conservation: electricity, heat, water, gas and other fuels.

Such measures are relevant in the implementation of relevant energy saving projects for regions, municipalities or large and medium-sized industrial enterprises.

We also propose to use this approach in the development of a system of intersectoral technology transfer, which provides bringing to other areas of indirect technological results of innovation.

Thus, the development of the industry on the basis of resource conservation implies that increasing the level of innovation should be considered in the innovation and technological cycle, based on the contradiction between the growth rate of product quality and the cost of its creation.

To find a balance in this contradiction, it is necessary to use the analysis of the technological life cycle of goods, which is a set of stages and stages, as well as methods used to consistently perform certain operations, ranging from identifying requests, their satisfaction and ending with consumer satisfaction. The cycle includes four stages: pre-commodity, commodity, post-sale and disposal. Each stage is characterized by certain stages, in which all the characteristics of the product are formed first, and then some of them are preserved on the basis of modifying innovations.

At most stages of the life cycle, from suppliers of raw materials and components to product sales, supply chain management system services are required. The supply chain is usually defined as a set of stages of increasing the value added of products as it moves from suppliers to consumer companies. Supply chain management involves promoting material flow at minimal cost.

We propose to implement this task of the approach on the basis of the concept of the energy production cycle, which is not only the main technological process, but a wide range of production links of the main process. This concept characterizes the complex interdependence of enterprises, their basics on one leading type of raw material or energy, territorial features of location, and so on.

Therefore, it is possible to move to the analysis of the energy component of the production cycle (cycles), which is a set of production and technological processes that are consistently deployed on the basis of combining this type of energy and raw materials, from primary forms of production and processing to finished products. types that can be produced on site, based on the approach of production to sources of raw materials and energy, as well as the rational use of all components of raw materials and energy resources.

3. ENERGY VALUE OF THE LIFE CYCLE APPROACH

In modern conditions, the task of minimizing the energy value of the life cycle (life-cycle cost). This approach should influence the design, planning of assortment policy, economic analysis, as well as the distribution, marketing and provision of services. Based on this, it is necessary to create a new cycle of energy saving based on the principle of complexity, which provides for multi-purpose use of resources, development of low-waste and zero-waste production, deep processing of raw materials, use of secondary resources.

Material and energy input throughout the life cycle and individual stages can be calculated per unit of output, services using the indicator MIPS (Material Input Per Service Unit):

$$MIPS = MI / S, \quad (1)$$

MI – material input or the sum of all input material flows, including those materials that require energy for their production;

S – products or services; dimension S can be different depending on the type of product or service.

This indicator characterizes the material input per unit of product or service. MIPS is used to assess the environmental impact of the material input required for the production of a product or service, because it shows the total amount of material resources. Consideration of the product life cycle is necessary when performing MIPS analysis, because the environmental loss of production or consumption is not always obvious, because according to the MIPS concept, any product carries an invisible "environmental backpack", defined as the difference between total material flows throughout product life cycles and the useful weight of this product and are relevant.

Energy consumption requirements are divided into three classification groups.
1) criteria for energy consumption of products, which determine the perfection of the product design in terms of composition and quantity of energy resources concentrated in it, as well as in terms of energy quality;
2) criteria for energy consumption of the product, determining the perfection of its design and organization of technological processes to achieve optimal costs of energy resources in the manufacture, maintenance and technological maintenance during operation, repair and technological support of product disposal processes;
3) energy efficiency criteria of the product, which are determined by the energy resources spent during operation and disposal of the product.
Requirements for the three classification groups are presented to the product at the following stages of its life cycle:
- during product development, design requirements are set for its energy consumption, energy intensity, energy efficiency and utilization;
- in the manufacture of the product set and specify the requirements for energy consumption of its production;
- during operation of the product the requirements to its energy consumption, energy efficiency, energy consumption at technical and technological maintenance of service (if there is a need) are established;
- when disposing of the product, the requirements of energy consumption of recycling are implemented.
These tools are mainly used in the design of a new technological cycle. In the current cycles, it is advisable to implement tools for energy saving projects, optimal management of which is carried out through appropriate selection at the stages of design and implementation of energy saving measures and energy efficient technologies, which are a set of methods and operations.
Generally the life cycle of an energy saving project consists of the following stages:
- energy audit, the purpose of which is to examine the current state of the analyzed energy system and the potential for possible improvement of its energy efficiency;
- development and planning, as a result of which measures and technologies are formed taking into account their energy efficiency in order to achieve the set targets for energy saving;
- project implementation (evaluation of the effectiveness of selected measures);
- completion of the project (adjustment and / or supplementation of selected groups of measures in order to achieve the targets during the implementation of energy-saving industrial project).
Thus, in the conditions of innovative development of space technologies the formula of a technological component demands addition in part of expansion of a production cycle to power production.

4. APPROACH FOR TECHNOLOGY IMPACT EVALUATION

Understanding technology as a set of knowledge that can be used to produce goods and services from economic resources, or scientific methods of achieving practical goals of economic activity, makes it possible to determine new criteria for analyzing the technology transfer.
According to the basic scientific and methodological approach, knowledge is a «flow», and therefore it can not be transmitted as an object, because in the process of knowledge formation plays a significant role in the transfer process, because knowledge in this case is the result of interpreting information context. Therefore, when optimizing complex technological systems based on transfer, evolutionary models should be used in compliance with the principles of dialectics and systems approach.
By analogy with the principle of environmental complementarity in the innovation system, all components included in it are interdependent and functionally consistent with each other. The exclusion of one part of the system leads to the exclusion of a number of closely related elements and functional changes in the system as a whole. Adding a new element to the system changes the state of related elements and leads to a reduction in the number and disappearance of less competitive elements.
In general, there are two main approaches to the analysis of the «overflow» of knowledge and technology:
1) based on the absorption capacity of the regional economy, i.e. the ability of countries to adapt technology. This approach is based on the basic tenets of neo-technological theories and the idea that there is a common global knowledge fund that can be used by all countries, so the diffusion of new technologies is limited to the ability to perceive and use this knowledge;
2) based on a set of bilateral trade, economic and scientific-technical ties. Countries have different reserves of knowledge in certain areas, and therefore their diffusion occurs through various channels of technology transfer, including through mutual trade and foreign direct investment.
It should be noted that in modern conditions, these approaches complement each other, as the effectiveness of cooperation in the field of technology is greatly influenced by the potential of the innovation system and the available resource of technology.

The processes of globalization have intensified the exchange of material, financial and intellectual resources between countries, which necessitates the development of a knowledge management system at various levels. «Spillover» of results of research, development and innovation becomes a necessary condition for the formation of new interdisciplinary directions.

5. TECHNOLOGY TRANSFER PROJECTS EFFECTS

Based on the analysis of the world experience of innovation systems management, it is proposed to consider the following groups of effects of technology transfer that have a positive impact on the development of the regional economy:

1) «synergetic effect» of interaction, which is a combination of other effects and strengthening of domestic developments through international innovation and technological cooperation. In the combination of domestic research base and foreign technologies there is an opportunity to implement a synergistic synthesis of technologies based on a combination of local research base, current and potential demand for innovation and the potential of foreign achievements.

2) the effect of optimization of innovation priorities based on the problems of sustainable development, technological forecasts (foresight) and relevant regional priorities, taking into account industry specifics and strategies of socio-economic development;

3) the effect of scale (the effect of expanding technology support networks) – the development and transfer of fundamental technologies is more efficient in global, national and regional networks;

4) import efficiency (the effect of «catching up» development) – the introduction of the most effective developments to reduce the technological gap in certain areas of the economy, the introduction of international standards in R&D and production, effective management practices;

5) the effect of innovation momentum for the national economy: foreign technology (its principles of operation, ideas), especially high technology, can be the basis for further development of new modifications based on it and the development of technologies in related industries;

6) the effect of competitive incentives – the emergence of new technologies stimulates competition mechanisms that promote the growth of economic potential of the country;

7) the advantage of technological capitalization – technology in the case of effective management can become a factor of production and may have common properties of goods, expressed by technological rent in the export of technology and attract investment in innovation;

8) the effect of innovation and investment image – the idea of the region as a reliable partner in cooperation, able to implement the most ambitious projects. The role of image is important for TNCs, the transfer of technology through which can not only give impetus to the development of scientific and technological potential of individual industries, but also ensure in the medium and long term effective functioning of related industries by increasing innovation potential of the economy [10];

9) the effect of optimizing resources by abandoning some R&D and directing the released resources to new projects that are characterized by higher priority and potential;

10) the effect of increasing export efficiency through the export of technology as a way to circumvent the problem of exporting the product or establishing control over a foreign company through the terms of the license agreement (production volume, profit sharing). If previously most of the investment was directed to the company receiving the technology, and the transfer of technology within the firm, including through joint ventures, commercial transactions, including the sale of licenses, and cross-licensing chains have now become predominant;

11) the effect of skills import through the system of engineering services and through unorganized transfer with the participation of scientific personnel in research projects and programs;

12) the effect of innovation and investment image as a factor in attracting relevant technological investments and human capital in the region, marketing of innovation potential, which simplifies communication and the process of establishing cooperation;

13) effects of improving the quality of life and HIGH-HUME-effects are based on the potential use of technology in everyday life. Fresco J., author of the term «resource-oriented economy» argues that «all the delights of science and technology, all the wonders of electronics and mechanics are simply useless mountains of garbage, if they are not aimed at improving human life».

14) the effects of the development of the regional innovation system, which are its ability to generate its own technologies and implement foreign ones.

The presented list of effects is useful for analyzing technology transfer projects at different levels, but the most accurate estimates can be obtained at the local level.

6. CONCLUSIONS

Understanding technology as a set of knowledge that can be used to produce goods and services from economic resources, or scientific methods of achieving practical goals of economic activity, makes it possible to determine new criteria for analyzing the projects of energy saving technologies transfer. Increasing the role of resource conservation and environmental security deals both with the pace of development of the innovation economy (actively developing new technologies, expanding the range of tasks addressed by government and commercial programs), and environmental function. The analysis of the greening of technologies has shown that due to the significant differentiation of the product life cycle depending on the stage of innovation and technological development (technological cycles of development, production and operation) the most effective is the concept of resource efficient and clean production. In the area of energy saving technologies transfer the complex projects are the most effective. They include measures that affect all or some directly independent areas of energy conservation: electricity, heat, water, gas and other fuels. Such measures are relevant in the implementation of relevant energy saving projects for regions, municipalities or large and medium-sized industrial enterprises.

Based on the obtained results, a set of improvements of organizational and institutional support for the development of innovation policy through the implementation of scientific and methodological recommendations for strategic directions of its formation, as well as innovation policy in terms of improving technology transfer mechanisms; resource management; development of new models of innovation communications, which allows to improve the quality of formation and implementation of regional innovation policy, will help solve the problem of lack of strategic orientation of regional innovation development.

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