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SOCIOECONOMIC INDICATORS OF ENERGY-EFFICIENT DEVELOPMENT OF THE REGION

Abstract. The article presents the results of the research concerning the development of the socio-economic indicators characterizing the energy efficiency of the region. The experience of using the system of the indicators in the EU countries is analyzed. The role of the energy efficiency indicators in conducting the effective regional policy of the energy supply is defined. The author introduces the block diagram of the innovative energy balance of the energy provision and energy consumption of the region. The essence of the implementation of the core social and economic indicators is determined.

The normative-methodical interpretation of the developed indicators and their consumption to assess the level of the energy-efficient development of the region in the most energy intensive sectors is offered: industrial, transport and housing. It is defined the dependence of the level of the productive energy and the unproductive losses from the consumptiond energy generation and the sources of energy. The indicators of the energy efficiency in the fields of the economy are calculated. The reasonable economic feasibility of the gradual transition of the regional public transport to the electrical energy is grounded.

The method of calculating the indicator of the dependence of the energy generation of the region from the energy resources is developed. It is defined the social component of energy efficiency for the regions of Ukraine.

Keywords: socio-economic indicators, energy efficiency, renewable resources, a regional energy policy, energy saving measures

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Introduction. Among the problems of the socioeconomic development of the regions of Ukraine it is the most urgent the problem of the efficient energy provision. For many countries that have the high degree of the dependence from the imported energy resources this problem appears between the strategies of the national security and is the obligatory requirement of the socio-economic development, modernization of the economy and clean environment.

Literature review and the problem statement. Problems efficiency of wind, geothermal and solar energy for socio-ecological-economic development in the regions studied M. Afanas'yev [Afanas'yev, 2008], , H. Dźwigoł [Dźwigoł 2014; Dźwigoł 2014], O. Lapko [Lapko 2009], O. Malyarenko [Malyarenko 2011], M. Kulik [Kulik 2007], A. Meshkov, I. Bondaryeva, O. Kvilinskyi, V. Lyashenko, A. Tolmachova, K. Pająk, S. Zwierzchlewski [Meshkov, Bondaryeva, Kvilinskyi 2016; Lyashenko, Tolmachova, Kvilinskyi 2016; Pająk, Zwierzchlewski, Kvilinskyi 2016].

International experience with key program elements of industrial energy efficiency of greenhouse gas and emissions reduction target-setting programs studied L. Price [Price 2010], C. Forbes [Forbes 2011], N. Stern [Stern 2007].

Will we have enough affordable energy in the near future? What will we do for the long term?

Research results. There may be a lot to assume. Energy prices and availability aren't solely determined by the size of the supply. They're also affected by the economy, possible new laws and regulations governing energy choices (such as emissions of carbon

dioxide and other gases), worldwide demand, theъ policies and political stability of petroleum-rich nations, lifestyle choices and business decisions, climate change, and the pace of developments in science and engineering. Any of these factors can be changed in a very short period of time.

Under the energy efficient development of the region, let us understand the development of the measures concerning the change of the qualitative economic, social and environmental characteristics of the region, where the most important elements are the search for the technological innovations and improving the management of the energy provision of the region.

In the EU countries, the socioeconomic indicators are the necessary components of the governmental programs and the norm acts, such as the EU Directives. The developed by the International energy agency system comprises 24 indicators for the different spheres of the economy. This methodology of the calculation of the energy consumption for the sectors of the economy has been taken as a base to create the base of the data of the indicators of ODDYSEE – the common European project where there are the participants 28 countries of the EU and Norway [Dodonov B. 2015, c. 5].. In accordance with the Directive of the EU [2012/27/EU] the consumption of the indicators of the energy efficiency in the regions there are foreseen the following steps:

- The countries are to present the annual reports on the fulfillment of the given objectives of the Directive.
- Starting from 2014, every country is a time during 3 years to report concerning the fulfillment of the National plan of the actions as to the energy efficiency.
- The indicators of the energy efficiency are to be quantitative and to be expressed in the form of the primary provision of the energy resources and the finishing energy consumption.

The construction of the system of the indicators has to give a holistic view of the quantitative and qualitative characteristics of the sources of the energy provision and the level of the energy consumption of the region, their structure and the degree of the balance (Figure 1).

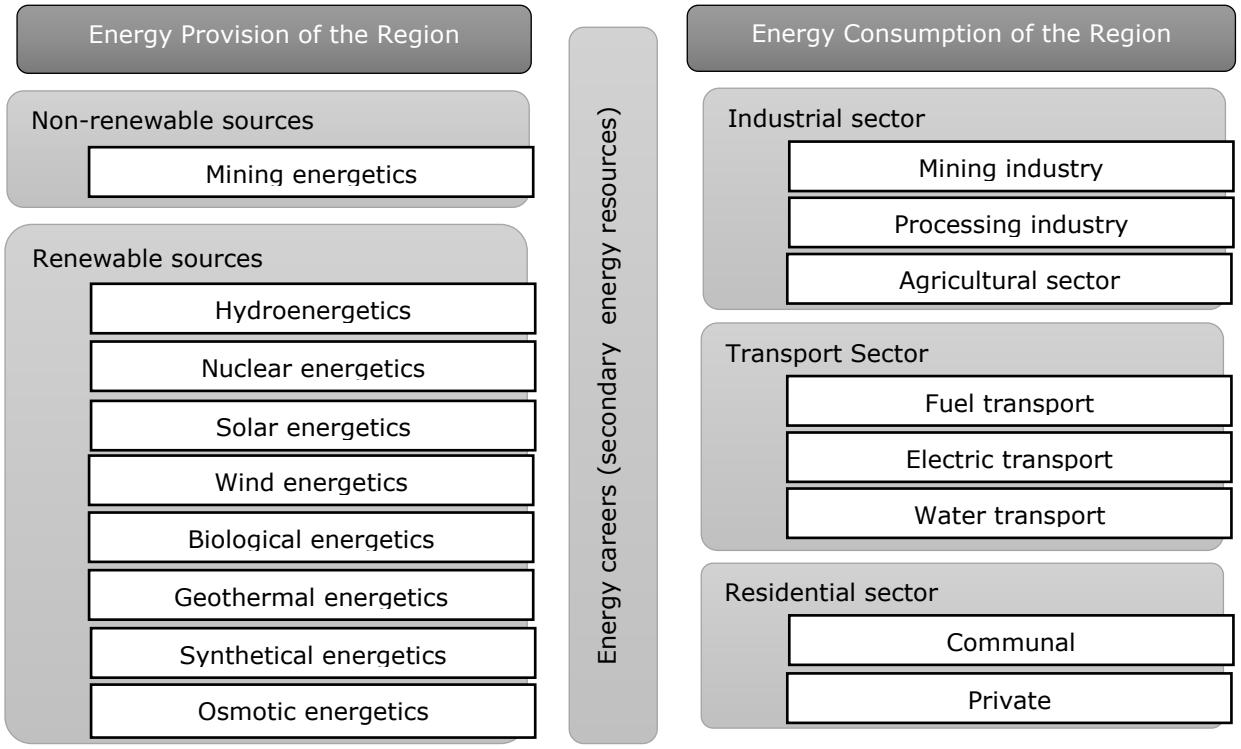

Figure 1 - Innovational Energy Balance of the Energy Provision and the Energy Consumption of the Region [Lazarenko 2014]

Source: compiled by authors

The essence of the implementation of the socioeconomic indicators is in the following [Sokha 2011]:

– Creating the conditions for the unified assessment of the energy efficiency of the industries of the region;
– Defining the level of the dependence of the region on the energy resources;
– Determining the specific proportion of the consumption of the renewable energy;
– Determining the specific proportion of the non-productive energy (losses energy);
– Possibility of the monitoring of the macroeconomic indicators of the energy efficiency;
– Loading of the energy sector on the environment and ecological safety;
– Measuring the economic impact from the introduction of the energy saving measures.

In accordance with the expediency (productivity) the final consumption of energy can be logically divided into:

1) *non-productive energy* (losses energy), lost in the conversions of thermal power stations, engines, etc.;

2) *useful energy* (consumption energy), which directly fulfills work.

In Europe, the problem of the non-productive energy losses occurs at all the stages of the energy conversion and reaches the emergency proportions. The specific proportion of the non-productive losses exceeds 62% (Figure 2). This is according to the data of the International Energy Agency [International Energy Agency 2016].

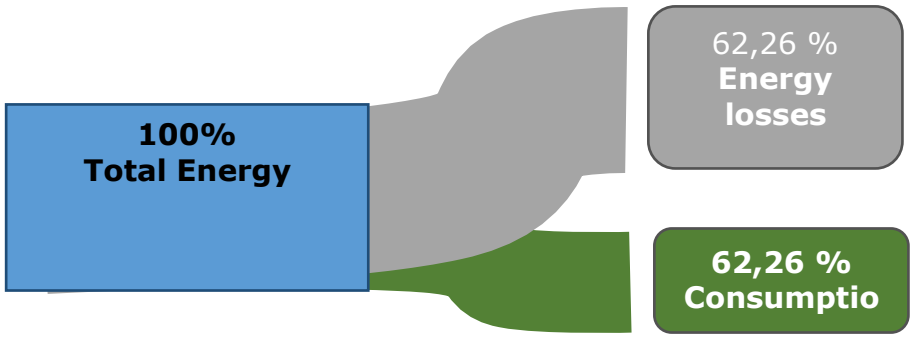

Figure 2 - Energy Distribution According to Productivity
Source: compiled by authors

Up to 90% of these losses are typical only of traditional energetics. The economic indicators characterizing the efficiency of the energy systems depend on many technical specifications. With decreasing the efficiency the amount of the useful energy decreases, so the decrease of the progressive indicators of productivity (from 1 to 0).

At the same time, the increase of the level of hydrocarbon emissions into the ecosystem, characterizes the shortfall of the useful energy, i. e. reduces the social significance of this energy and this negatively affects the environmental safety (from 1 to 0).

If absolutely productive energy systems (CRC - 100%) have zero emissions, that means that all the energy from its generation to the consumption is transmitted without any losses. In this case the socioeconomic indicators will be maximum:

- productivity of the energy generation – 1;
- productivity of the energy transformation – 1;
- productivity of the energy consumption – 1;
- ecological security – 1.

Energetics based on the renewable sources provides the minimum emissions, so replacing the traditional energetics to an alternative generation will enhance the socio-

economic indicators.

The energy generation of the future will be determined whether by the fully restored or virtually renewable sources.

A new source of clean energy the scientists of the Laboratory of Nanobiology of the Polytechnic School of Lausanne have discovered - osmotic. The energy is generated by the contact of the fresh water with the salt one through the membrane of the thickness of three atoms, in which it is the main innovation. The potential of such a system is huge. According to the calculations, the membrane with area of 1 m^2, 30% of which is covered with the nanopores will be able to produce 1 MW of electricity. And as molybdenum disulfide is common in nature, the whole system is easy to increase to industrial scales. The non-productive emissions from this generation are completely absent [EcoTown 2016].

The next level of the indicators characterizes the dependence / independence of the region on the energy resources. In order to avoid the dependence of the region on the energy resources it is necessary to analyze the energy sources and to determine the specific proportion of those ones that are of the renewable character (Figure 3).

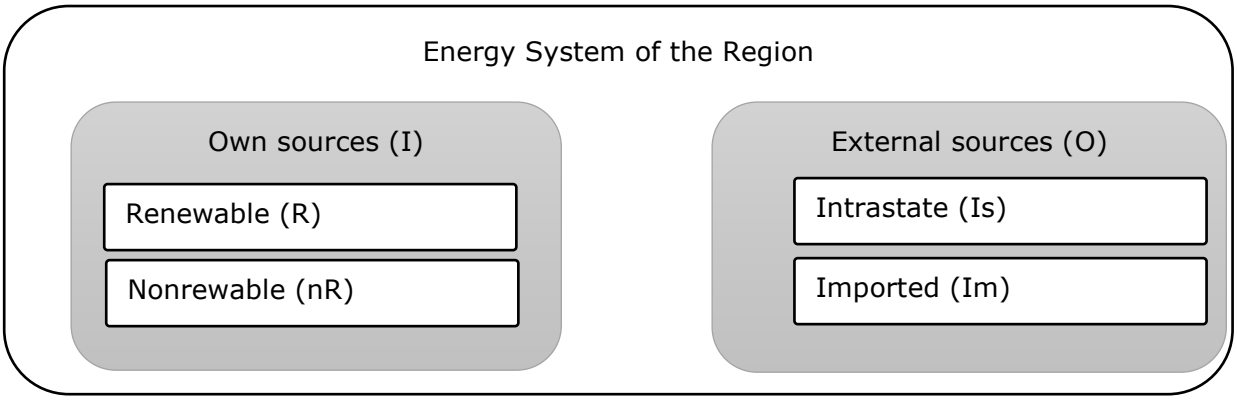

Figure 3 - Dependence of the Energy Generation of the Region on the Energy Resources

Source: compiled by authors

Coefficient of renewing of the own sources of the region k_R is the relative indicator characterizing the specific proportion of the renewable resources in the energy generation (from 0 to 1).

$$k_R = \frac{R}{R+nR} \quad (1)$$

Coefficient of the energy dependence of the generation of the region k_O is the relative indicator characterizing the dependence of the region on the external sources of energy (from 0 to 1).

$$k_O = \frac{I}{I+O} \quad (2)$$

The indicator of the dependence of the energy generation (I_G) of the region on the energy resources is calculated according to the formula:

$$I_G = k_R + k_o, \quad (3)$$

where k_R – coefficient of the renewing of the own sources of the region;
k_o – coefficient of the energy dependence of the generation of the region.

The transport sector is one of the most power-consuming, and now it is in the state of advanced modernization. The progressive development of the automobile industry promotes the increase of profitability of passenger traffic on the wireless electric transport. The use of electric motors is quite successful in public transport (taxis, electrobuses) in Norway, Denmark and Sweden. The Ukrainian concern "Electron"

specially for Lviv region has begun the production of the electrobuses of Model E19101 with the ability to carry up to 100 passengers at a time. It is a completely ecological means of transport with the increased comfort for passengers. By 2025, in Lviv it is planned to replace 75% of the vehicle fleet.

The transition of the regional public transport to electric cars increases the socio-economic indicators.

The search for alternative fuels continues worldwide. The Japanese car manufacturer Toyota has started the mass production of the world's first car with a hydrogen engine „Mirai". The vehicle only runs on hydrogen, and instead of harmful emissions, it produces clean water. To motivate consumers to buy environmental cars the program the government provided program subsidies of $ 17 thousand at every purchase [Toyota, 2016]. In the near future the market of hydrogen cars other manufacturers are planning to enter.

Conclusions. The socioeconomic indicators of the energy efficiency can be used in the governmental programs on the increase of the energy efficiency, in the projects of the technical help of the international financial organizations and as a means of the control of the efficiency of work of regional executives by the public.

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