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ENERGY EFFICIENT REGIONAL DEVELOPMENT STRATEGIES

Abstract. The methodical approach to formation of energy efficient regional development strategies from the standpoint of providing energy security of regional economy and life sustenance of population of a region is grounded. Regional energy security is seen as a state of security of a region from potential threats due to energy supply constraints in a region, its sustainable social economic development provided by government and local authorities through appropriate institutional and legal mechanisms.

The need to consider energy supply risk management in the context of bifurcation impact of changes in external and internal environment of a region, enterprise has been shown. It has been proved that regional energy efficient development strategies should be formed considering the following strategies: a regional oil and gas industry development strategy, a regional coal industry development strategy, a regional nuclear power development strategy, a regional thermal power development strategy, a regional alternative and renewable energy sources development strategy, an energy saving strategy (at the level of industries and housing and communal services of a region and enterprises).

Keywords: region, enterprise, energy supply, energy efficient strategy, energy security

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Introduction. Under conditions of the permanent global energy crisis, it is appropriate to form energy efficient development strategies at a regional level. Urgency of the designated is due to the increasing role of the environment in functioning of regions, enterprises in various sectors of a regional economy given increased competition in the markets of resources and products. One of the aspects of solving the energy problem is regional energy security formation as regional economic protection against internal and external factors violating standard operation of energy supply systems which threaten efficient work of operating systems of enterprises and the public, causing a threat to a regional security.

The concept of "security", previously used only in the military sphere and concerned national security, has recently spread to the economic and environmental issues, including energy supply of economic objects and the public of a region.

Energy security is a universal category describing a level of protection of subjects

of economic relations on different levels: national (state), regional, of an enterprise, an individual.

Energy security is formed in two directions:

1) in some developed countries with relatively low primary energy self-sufficiency, energy security is guaranteed by diversification of energy supply sources and availability of the necessary financial resources to import sufficient quantities of energy resources;

2) in less developed countries, due to lack of funds needed to purchase a sufficient amount of energy resources, self-restraint of energy consumption and a need for energy self-sufficiency of energy resources of local origin are urgent.

Literature review and the problem statement. The issue of energy strategies outlined in the document of the EU [GREEN PAPER A European Strategy for Sustainable, Competitive and Secure Energy / Commission of the European Communities (Brussels, 8.3.2006)], in the government document of Ukraine [Enerhetychna stratehiia Ukrainy na period do 2030 r. Shvaleno rozporiadzhenniam Kabinetu Ministriv vid 17 zhovtnia 2011 r. № 1056, zi zminamy i dopovnenniamy], monographs [Afanasiev, Salashenko 2012; Lir, Pysmenna 2010; Pivniak, Shkrabets 2013] has been partly addressed by us in a number of publications [Havrysh, 2007; Havrysh, Perebyynis 2015; Perebyynis 2003; Perebyynis 2004; Perebyynis, Fedirets 2012; Zerkalov 2012]. There is a need for further elaboration of theoretical and methodological aspects of strategic management of regional development, which would become a basis for formation of appropriate energy policies and target programs.

The aim of the article is to highlight issues of formation of energy-efficient strategies for regional development taking into consideration risks of energy supply and necessity to control them.

Research results. The issue of formation of energy-efficient development strategies in the context of regional energy security is shown by the following features:

- given that energy security is an important factor of production and activity of enterprises and livelihood of the public, the energy problem is directly related to each region, jeopardizing the current paradigm of existence and development;

- the energy supply issue can not be optional in nature, it can not be ignored because of its objectivity, so attempts to underestimate its negative impact on a regional level can have (and are having) serious consequences;

- the energy security issue forces regional authorities to solve problems of stability of energy supply of the community and enterprises in a region systematically.

As a multidimensional concept, energy security can be considered:

- at the macrolevel (as a part of the economic security of the state);

- at a regional level (as a part of the economic security of administrative units, enterprises and the public);

- at the microlevel (as a part of the economic security of a particular enterprise and particular inhabited locality).

Conflicts in the energy sector can occur:

- between countries over territories having energy resources;

- between energy producing (energy supply) companies for access to lucrative energy deposits;

- between energy producing, energy supply, energy consuming companies, the public over prices (tariffs) of energy resources;

- between companies engaged in mining, processing, transportation and consumption of energy resources and the state, regions on contributions to the budget, compliance with environmental safety and others.

The system of regional energy security as a part of regional security, in our opinion, must be focused on protecting interests of the community in a region, meeting needs of citizens concerning dignity of life by creating a self-sufficient, socially oriented market economy. Interests in the energy security sphere are expressed in the community's quest to reach the condition of meeting its own energy needs that allows normal life and development.

It is reasonable to distinguish four levels of interests in the energy security sphere:

- 1) interests of the society and the state which are to provide standard functioning of government institutions, following the law and order, ensuring interests and needs of the public;
- 2) regional interests and interests of local communities manifested in deriving an income in taxes from the efficient operation of energy supply and energy consuming of enterprises that can be used for territorial development in the interests of their residents;
- 3) interests of economic entities (enterprises) - economic interests manifested in ensuring production activity with such essential resources as energy and meeting needs of both its personnel and owners;
- 4) interests of people consisting of ensuring their rights to work for enterprises that produce energy resources, communal-general, cultural and other services provided by relevant energy consuming organizations.

The level of energy security of the state seems to be determined through a system of indicators (thresholds), and their compliance ensures ability of key industries to keep and relatively quickly acquire a critical level of ensuring needs of the state, enterprises and the public in case of lack of energy or destabilization of energy supply.

In our opinion, regional energy security (in the context of regions of the state) is the condition of security in a region from potential threats due to restriction of energy supply in a region, its sustainable social and economic development provided by government and local authorities through appropriate institutional and legal mechanisms.

Under conditions of energy and economic crisis, regional energy security is of particular importance because the level of energy resources supply security affects not only the economic life of a region, living conditions of the public, but also social and psychological state of the people in a region, political situation and others.

An important role in formation of regional energy security is played by relations between the center and regions, which are determined to some extent by delegation of their powers, particularly, concerning formation of state and local budgets. It should be noted that a level of filling local budgets essentially depends on social and economic development of regions, their individual communities. Therefore, while implementing the administrative reform, discussing the issue of changing the administrative-territorial structure of the state, it is also advisable to take into account the way of ensuring energy security of certain regions.

It is important to increase coordination of relevant central executive bodies whose activities are related to provision of energy security, with bodies of regional state administration, corresponding departments (offices, divisions) and to carry out activities aimed at ensuring regional energy security within their competence.

An enterprise is a dynamic developing system that requires ensuring stability of functioning of its major systems. Energy security as a type of resource security is an important component of economic security of an enterprise largely determining efficiency of its operation.

It is advisable to understand energy security of an enterprise as a condition of protection of its economic interests from internal and external threats violating effective functioning of its operational and logistic systems, life support in general, is associated with lack (forced irregularity) of energy supply which is dynamic in nature. It is a set of conditions and factors ensuring ability of an enterprise to adapt to changes in energy supply not to affect negatively on its operations.

Energy security management of an enterprise should be considered as a part of operational management and energy management. Energy security management as a part of operational management focuses on functioning of operating system of an enterprise under uncertainty and risks while ensuring production of goods (services) with energy resources. Energy security management as a component of energy management focuses on functioning of energy supply subsystems, energy consumption efficiency of an enterprise.

It is advisable to provide at least three levels of energy security management of an enterprise:

- 1) a minimum (supporting) level when energy security state of an enterprise is fragile due to irregular functioning of operating system of an enterprise for any of several reasons;
- 2) an adequate level when energy security state of an enterprise is relatively sustainable due generally rhythmic functioning of operating system of an enterprise;
- 3) a high level of energy security management of an enterprise which is carried out with minimum necessary consumption of energy resources.

Energy security of an enterprise can be considered:

- 1) in the short term (ensuring sustainable operation of an enterprise in a relatively short time, e.g. 1 year);
- 2) in the long-term (ensuring dynamic development of an enterprise during a relatively long period, e.g. 5-10 years).

The concept of "energy security" is closely linked with the concept of "risks". Risks are inherent in operation of any enterprise, particularly its operating system. Risks are caused by limited resources, particularly energy. Risks are often caused by insufficient information support. A risk (as a concept of probability) can be calculated.

Energy supply risks are associated with unfavorable effects caused by operation of the energy supply subsystem of enterprises in the face of uncertainty. Uncertainty means lack of uniqueness.

There are two types of uncertainty:

- 1) truth due to intrinsic properties of an object of a study (in this case - energy security);
- 2) absence (lack) of information about properties of an object of a study (energy security).

The category of "uncertainty" is closely associated with the category of "accident". This means that in many cases it is difficult to predict uncertainty. It is advisable to consider a change of input flow of energy resources which can be predicted only with some accuracy being energy supply risk factors.

Objectivity of energy supply risks is due to dynamic external and internal environment, their factors which interact. A subjective aspect of availability of energy supply risks is primarily due to presence of human factors, in particular, professional skills of managers making decisions on functioning of operational processes, logistics of energy resources and others. Therefore, energy supply risks should be seen as an objective phenomenon of operational process. Risks should be analyzed, factors determining a level of risks should also be considered.

Depending on a degree of influence on the operation of an enterprise, energy supply risks can be classified as follows:

- 1) acceptable risks producing a threat to the normal functioning of the operating system and leading to a possibility of reducing output of the planned number of products (services) and profit;
- 2) critical risks threatening to stop most operating (manufacturing) processes, non-output of goods (services), partial proceeds from sales;
- 3) catastrophic risks leading to termination of activities of an enterprise and its subsequent bankruptcy.

Energy security of an enterprise is linked to the way in which its support subsystem (logistics system) can withstand the bifurcation impact of changes of the external and internal environment. External environmental factors of an enterprise determining the risk of energy supply can be divided into factors of direct effect, directly determining a level of risk, and factors of indirect (incidental) effect, indirectly affecting a level of risk.

The factors of direct effect (impact) should include:

- a national legislation regulating economic activity of energy supply organizations and consumers of energy resources (primarily, a tax system);

- a state of competition between energy supply organizations affecting the level of prices on energy resources markets;
- a level of relations between energy supplying and energy consuming enterprises;
- activities of governmental bodies, particularly law enforcement agencies to prevent unauthorized actions of the authorities (corruption), criminal gangs (racketeering) and others.

The factors of indirect effect (impact) include:

- an international situation affecting economic activities, including an exchange rate;
- emergencies in the world and the country (natural disasters, etc.);
- an economic situation, particularly, a state of an energy sector and others.

A negative impact (action) of the environment is objective due to the economic conditions of energy resources and energy products (services) markets, force majeure and so on. A deformation of an economy structure, particularly, its shadowing, an imperfect tax system and others are external environmental factors determining a level of energy supply risks. Inflation, political situation and others can be attributed to external factors determining energy supply risks.

An amount of working capital, size of accounts receivable, enterprise management level and others are internal factors influencing an energy supply risk. A significant depreciation of fixed assets (fixed capital) is an internal environment factor determining a level of energy supply risk. The negative impact (effect) of the internal environment is subjective due to inefficient operation of a personnel at an enterprise.

It is advisable to distinguish three levels of enterprise operation stability:

- 1) considerable uncertainty when an enterprise operates from time to time due to energy shortage (because of lack of funds for their purchase, systematic failure of individual elements of energy system, etc.);
- 2) incomplete stability when in some cases, operation of an enterprise is partially broken but it continues to work because of an operative measure (receiving energy resources, repair works of the energy system);
- 3) dynamic stability when an enterprise operates due to effective energy security management.

The consequence of failure of an energy supply subsystem is a set of changes in economic, environmental and social indices caused by violation of normal functioning of an enterprise. These consequences should be divided into two types:

- 1) economic consequences of measurable value (economic) evaluation;
- 2) other (environmental and social) consequences with no measurable value (economic) evaluation and can be measured in others (non value) units.

Inability to evaluate all the consequences breaking energy supply makes it difficult to estimate total costs, their analysis and a choice of priorities in implementation of measures to increase an energy security level.

Costs of failure (deterioration) of technical means of energy supply can be divided into three groups:

- 1) costs to prevent consequences of failure of an energy subsystem that may be expected in the future (costs to increase in oil inventories in warehouses, backup electricity generation capacity, etc.);
- 2) costs due to failure of energy supply means (damage of output or a failure to obtain it) because of transport and handling equipment lay-up;
- 3) costs to eliminate or reduce harm resulting from failure of energy supply means.

In our opinion, energy supply risk management is a set of actions aimed at determining sources, factors and types of risks (their identity), qualitative and quantitative assessment of risk proportions, risk adaptation (reducing their level and preventing losses), risk control. Energy supply risk management is identifying (determining) risks, assessment of risk proportions, predicting effects of risks, their insurance.

It is advisable to allocate such energy supply risk management techniques as:

1) avoiding energy supply risks (avoiding relationships with energy supply companies having unsavoury reputation, refusing to use energy supply systems having insufficient reliability);

2) energy supply risk insurance (liability insurance aimed at possible insurer's liability for damages to third parties; insurance of business risks directed at non profits or loss due to interruption of an operating system of an enterprise; hedging as a form of insurance of prices and profits in futures contracts, etc.);

3) energy supply risk localization (creation of business units specializing in development and implementation of high-risk innovative energy-saving projects or venture enterprises of a similar type);

4) energy supply risk dissipation (diversification of energy supply sources, types of production activities or operating system, distribution of a risk over time, etc.);

5) energy supply risk compensation (backup of energy systems, strategic planning and predicting environment of an enterprise, etc.);

6) energy supply risk limiting (increasing reserves of energy resources at an enterprise, etc.).

Innovation in energy supply is a result of realization of new ideas aimed at implementing research results in the field of energy supply, increasing energy output and reducing energy intensity of goods (services) production.

Innovative projects in the field of energy saving are characterized with:

- a fairly high risk level both while developing and implementing innovative energy-saving projects due to dynamics of the external and internal environment of an enterprise ;

- complexity in determining likelihood of risk effects caused by high levels of uncertainty due to lack of objective information which complicates the ability to predict a size of an effect of implementation of innovative projects;

- presence of communication barriers in interaction of a significant number of contributors of energy-saving projects and their implementation whose interests may not coincide which may lead to a loss of time and an increase in costs.

An important method of improving reliability of energy supply systems is a reservation that requires a number of additional elements and links of an energy system compared to the minimum necessary to perform regulatory energy supply functions under standard (medium) production conditions.

Main components of an energy system are elements of an energy structure ensuring its working capacity. Emergency elements of an energy system are elements used to ensure working capacity of an energy system in case of failure of main elements.

Reservations of energy systems is advisable to classify on several grounds.

Classification by an energy system reservation level:

- a general energy system reservation in which a backlog is expected in case of failure of an energy system as a whole;

- an elementwise energy system reservation in which individual elements of an energy system are reserved;

- a mixed energy system reservation with general and elementwise reservation.

Classification by multiplicity of a energy system reservation (a ratio of a number of reserve elements to a total number of basic elements of an energy system):

- a single (duplicate) energy system reservation;

- a repeated energy system reservation.

Classification of a energy system reservation by a state of reserve elements of energy systems to be included in operation:

- a loaded energy system reserve when reserve components are loaded as well as main ones;

- a light-weight energy system reserve when reserve components are less loaded than main ones;

- a free energy system reserve when reserve components are not included in operation.

Classification of a energy system reservation by a way of joining main and reserve elements in a reserved energy system:

- a permanent connection of all the elements when they are connected to the total load during energy system operation;
- a semi-permanent connection when only workable elements are included in the total load and broken-down elements are turned off;
- semi-substitution when only workable basic elements are connected to total load at the beginning of operation and a reserve element is connected in case of a failure of one of them; the main broken-down element is connects manually, automatically or by an appropriate device.

Conceptual approaches to strategic regional energy security management, in our opinion, are in:

- predicting results of operation of enterprises in energy supply risks and uncertainties;
- assessment and analysis of factors making the situation of energy supply more risky;
- development of a system of measures to prevent or reduce losses because of ignoring energy supply risk factors;
- ensuring risk immunity of enterprises in a region allowing to neutralize or make up for negative results in energy supply and energy consumption.

Energy security of an enterprise is formed by an administrative staff machinery (management of an enterprise) through development and implementation of appropriate management systems, thus sustainable and efficient production and sales activities are provided.

Forming energy security management systems of an enterprise should include:

- presence of a system of enterprise energy security indicators;
- continuous monitoring and assessment of an enterprise energy security level;
- determining and classification of conditions, factors and threats to economic security;
- determining an agent of management of this process, its functions, powers, responsibilities, etc.;
- elaboration of an algorithm of impact of an agent of energy security management on an object of energy security management.

The issue of energy sources quality is crucial for regional energy security. The purpose of diversification is increasing an energy security level by ensuring security of energy supply, possibility of purchasing energy resources at low prices (given existence of competition in the energy markets).

It is commonly believed that supply of imported energy is reliable if it is carried out from at least three sources. The negative consequences of impairment of obligation to diversify internal sources of energy supply can be:

- increase in prices of energy resources due to the monopolization of their supply;
- limiting energy supply in case of deterioration of the international situation;
- cutting down volumes of supply of energy resources due to reduction of their production in exporting countries;
- irregularities in energy supply in case of failure of the main transnational oil and gas pipelines, railways and others.

Strategic energy security management involves development and subsequent periodic clarification of the energy strategy which is based on projected scenarios of the economic development and, in particular, the fuel and energy complex as well as predictive balances of energy resources.

Energy efficient strategies of regional development should be formed in consideration of such strategies as:

- 1) a strategy of development of the oil and gas industry of a region;
- 2) a strategy of development of the coal industry of a region;
- 3) a strategy of development of the nuclear power engineering of a region;

- 4) a strategy of development of the thermal power engineering of a region;
- 5) a strategy of development of the alternative and renewable energy sources in a region;
- 6) energy saving strategies (at the level of industries, housing and communal services of a region and enterprises).

While forming energy strategies, the issue of legal, personnel, financial and scientific support of implementation of strategies should be studied, it is also advisable to take into account economic aspects of implementation of these strategies.

An important component of strategic energy security management of a region is its strategic planning. A strategic plan of energy security of a region should include basic prospective measures to improve energy supply and energy consumption. At enterprises, on the basis of a strategic plan, it is advisable to have a detailed operational plan of energy security ensuring which must be periodically reviewed adequately considering changes of the internal and external environment.

The purpose of energy security management of an enterprise is to achieve financial stability of an enterprise, competitiveness of manufactured products (services), standard operation of enterprise subsystems, including energy supply subsystems, human resources' stability, their high-level skills and motivation.

On the organizational and legal positions, energy security includes a personnel legal protection system, technical means of energy supply and energy consumption, reserves of energy resources. In our opinion, the mentioned system of enterprise energy potential protecting should include:

- legal protection ensuring security of persons, property, commercial information on energy supply and consumption;
- organizational and technical ensuring of energy security done by an enterprise security service equipped with appropriate technical means.

Thus, regional energy-efficient development is carried out on the basis of an energy security level as an important component of economic security. Strategic energy security management should consider risks and uncertainties in regional energy supply, its communities forcing the need to develop regional energy efficiency strategies.

Conclusions. Regional energy efficient development is carried out on the basis of energy security as an important component of economic security. Energy security strategic management should consider risks and uncertainties in energy supply of a region and its communities. This makes the need to develop regional energy efficiency strategies which should be formed considering the following strategies: a regional oil and gas industry development strategy, a regional coal industry development strategy, a regional nuclear power development strategy, a regional thermal power development strategy, a regional alternative and renewable energy sources development strategy, an energy saving strategy (at the level of industries and housing and communal services of a region and enterprises).

References

- Afanasiev, M., & Salashenko T. (2014). *Stratehiia pidvyshchennia enerhoefektyvnosti promyslivosti rehionu: teoretyko-metodichni aspekty formuvannia: monohrafiia*. Kharkiv: Publishing House of Kharkiv National Economic University named after S. Kuznets.
- Enerhetychna stratehiia Ukrainy na period do 2030 r. Shvaleno rozporiadzhenniam Kabinetu Ministriv vid 17 zhovtnia 2011 r. № 1056, zi zminamy i dopovnenniamy*. Retrieved from <http://zakon3.rada.gov.ua/laws/show/1056-2011-%D0%BF>.
- GREEN PAPER A European Strategy for Sustainable, Competitive and Secure Energy / Commission of the European Communities [Brussels, 8.3.2006]*. Retrieved from http://europa.eu/documents/comm/green_papers/pdf/com2006_105_en.pdf.
- Havrysh, V. (2007). *Zabezpechennia efektyvnoho vykorystannia palyvno-enerhetichnykh resursiv u ahrarnomu sektori ekonomiky: teoriia, metodolohiia, praktuka*. Mykolayiv: Mykolayiv State Agrarian University.
- Havrysh, V., & Perebyynis, V. (2015). *Upravlyeniye investitsionnymi proektami*

- biogazovyh kompleksov*. Saarbruken: LAP Lambert Academic Publishing.
- Lir, V., & Pysmenna, V. (2010). *Ekonomichnyi mehanizm realizatsiii polityky enerhoefektyvnosti v Ukraini: monohrafiia*. Kyiv: Institute of Economics and Forecasting of National Academy of Science of Ukraine.
- Perebyynis, V. (2003). Enerhetychna bezpeka rehionu ta pidpriemstva: upravlinskyi aspect. *Aktualni problemu derzhavnoho upravlinnia. Zbirnyk naukovykh prats, 3 (18)*, 142-149.
- Perebyynis, V. (2004). *Enerhetychnyi menedzhment: Nabchalnyi posibnyk*. Poltava: Interhrafika.
- Perebyynis, V., & Fedirets O. (2012). *Enerhetychnyi factor zabezpechennia konkurentospromozhnosti produktsiii: monohrafiia*. Poltava: Poltava University of Economics and Trade. Retrieved from <http://dspace.uccu.org.ua/handle/123456789/1541>.
- Pivniak, H., & Shkrabets, F. (2013). *Alternatyvna enerhetyka v Ukraini: monohrafiia*. Dnipropetrovsk: National Mining University.
- Zerkalov, D. (2012). *Enerhozberezhennia v Ukraini: monohrafiia*. Kyiv: Osnova.

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