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REGIONAL ENERGY MANAGEMENT SYSTEMS BASED ON ESCOs: FEATURES OF CREATION AND APPLICATION

Excessive consumption and inefficient use of fuel and energy resources, unsatisfactorily high energy intensity of production of goods and services and their associated low competitiveness in domestic and foreign markets, in the context of a shortage of own energy resources and constant growth of prices for them, puts the problem of improving energy efficiency and energy saving of the regional and, as a result, national economy in the category of primary importance and relevance. The solution to this problem is achieved by creating a regional energy management system in regions (districts) on the platform of regional energy service companies, which allows, through a unified energy policy for the development and implementation of energy efficiency and energy saving projects in the region and the introduction of renewable energy sources, to more effectively address the problems of attracting foreign investment in the recovery and innovative development of the regional economy.

Keywords: energy management, energy service companies, energy efficiency, energy saving, regional management system.

Introduction

Energy efficiency and energy saving are crucial factors for sustainable economic development and the competitiveness of goods and services produced in any sector of the economy. These factors directly affect the energy security and environmental condition of the region and the welfare of its residents. At the same time, the current state of development of the country's regional economic systems is characterized by excessive consumption and inefficient use of fuel and energy resources (FER), unsatisfactorily high energy intensity of production of goods and services and their associated low competitiveness in domestic and foreign markets. This, in the context of a shortage of domestic energy resources and a constant increase in their prices, puts the problem of improving energy efficiency and energy saving (EE) of the regional and, accordingly, national economy in the category of priority importance and relevance.

The solution to this problem requires a systematically coordinated national and regional energy policy and the introduction of energy-saving, low-waste and zero-waste technologies, equipment, devices and materials, effective systems and means of controlling energy consumption, energy efficiency and environmental protection, and the development of relevant regulatory, methodological and information and advisory materials.

Energy management systems (EMS) are used worldwide as a productive tool for solving this problem, where among the fundamental methods and mechanisms for their implementation on the basis of energy service companies (ESCOs), the main focus is on mechanisms of economic incentives for enterprises and institutions to improve EE, the methodology of integrated resource planning, and the use of performance contracting. It is these methods and mechanisms implemented on the basis of ESCOs that ensure a guaranteed result from the realization of EE measures (projects) for the rational use of resources and budget savings for their purchase, which is crucial for business decisions on the feasibility of implementing EE projects [1-7].

Purpose and objectives of the study.

The aim of the study is to identify, on the basis of SWOT analysis, the strengths, weaknesses, opportunities and threats to the implementation of the tasks of improving the regional system of management of the efficiency of fuel and energy resources and reducing the corresponding financial costs in the budgetary sphere and for the population through the implementation of a set of organizational and technical measures and energy-efficient investment projects.

Material and results of the research.

At present, one of the main factors of competitiveness of goods and services produced in the regions of Ukraine is the reduction of energy intensity of production and, accordingly, the growth of its energy efficiency. Therefore, to manage the energy efficient behavior of enterprises, it is necessary to create appropriate regional energy management mechanisms that meet the requirements of the socio-economic and environmental environment of the region. The required level of energy efficiency is achieved in the process of systematic organizational and managerial activities at the regional level aimed at analyzing, monitoring and planning the

behavior of enterprises in relation to the used energy resources, including their selection, assessment of efficiency, economy and environmental friendliness, implementation of staff motivation measures, etc. [8]

The combination of the regional energy supply system with the regional economic system allows for the fullest use of the potential for efficient use of the region's natural resources in the context of the specifics of its production, distribution, exchange and consumption of materials, goods and services, with internal and external relations. The latter, in addition to the systemic properties of the territory, determine the conditions of reproduction of the gross regional product and fixed assets, optimal distribution of labor force, formation of population incomes and their commodity supply, sources of investment, etc. At the same time, the mechanisms of the region's transition to sustainable development should be aimed at achieving natural and economic balance, taking into account the peculiarities and originality of natural resources, economic and social conditions.

Regional energy management on the basis of ESCOs is a special type of business activity carried out within the territorially united urban and rural communities of a region (oblast, district) in accordance with the goals and on the basis of regional policy mechanisms, and consists in uniting and combining the efforts of local authorities, heads of enterprises and organizations, and small and medium-sized businesses to effectively meet the needs of end users (primarily the population) in fuel and energy resources of local origin.

A regional energy management system (REMS) based on a regional ESCO combines and focuses the activities of local EMSs established at enterprises and organizations in the region, and through their jointly coordinated interaction contributes to additional benefits in terms of improving business efficiency, saving energy resources and preserving the environment.

Among the main tasks of the REMS are the following:

- monitoring the flow of fuel, energy, water and related financial flows in the region;
- optimization of budget expenditures for the purchase of fuel and energy resources;
- improving the quality of energy services;
- initiating, preparing and monitoring the implementation of energy service projects;
- attracting investment in technological upgrades and energy-efficient modernization of regional infrastructure;
- shaping the economical behavior of energy consumers and promoting energy efficiency;
- motivation for energy and water conservation by the population and utility workers.

The regional ESCO (RESCO) is the central executive element of the REMS, responsible for the development and implementation of EE projects within the region. For this purpose, it is authorized to redistribute a share of resources of local energy service companies attracted on voluntary mutually beneficial terms and fixed by energy service agreements with each of them.

RESCO is an energy service company that provides energy services, i.e., carries out measures that allow for a guaranteed increase in energy efficiency and energy savings. A typical list of RESCO services includes: energy audit; feasibility study of proposed EE measures; attraction of financial resources for project implementation; management of financial and technical risks associated with the implementation of energy saving measures; supply, installation, operation and maintenance of equipment; supervision of energy saving measures and control of achieved savings; conducting trainings for customer's personnel aimed at changing people's behavior aimed at efficient use of energy resources.

The effectiveness of coordinated cooperation between RESCO and local EMSs largely depends on their ability to take into account the absolute and comparative advantages of cooperation between enterprises and organizations located in different territorial and economic zones of the region's internal and possibly external markets. Fig. 1 shows a structural and functional diagram of the proposed mechanism of cooperation between RESCO and enterprises operating in different economic zones. The boundary line in Fig. 1 conditionally separates the two zones where enterprises (RESCO's clients) are located or carry out business activities within the framework of local EMS projects.

The organization of a REMS based on cloud-based virtual energy management computer technologies opens up fundamentally new opportunities that allow remote control of various energy-consuming equipment, such as heating, ventilation, air conditioning systems, etc., collecting operational data on the efficiency of each unit of the identified energy-intensive equipment and generating specific recommendations in real time to find and use the most attractive energy saving opportunities at the enterprise (company, organization). Such opportunities also include the interaction of REMS with suppliers of fuel and energy resources and communal services, as well as with manufacturers and suppliers of energy-efficient equipment and materials and, most importantly, with consumers of the services provided (Fig. 2).

Within the virtually organized RESCO community, these difficulties are largely overcome by [9]:

- Systematic coordination of interaction between the community members (clients) based on the principle of relative organizational and functional independence of each of them,
- Systemic ranking of projects submitted by clients to identify the possibility, feasibility and priority of their financing, in whole or in part, at the expense of the community (RESCO),

- Integration and further optimization of the parameters of financial, economic and energy resources provided by project clients,
- Integrated attraction of investments in a set of projects of the community members and provision of prompt assistance to participants in cases of unforeseen expenses (losses, etc.).

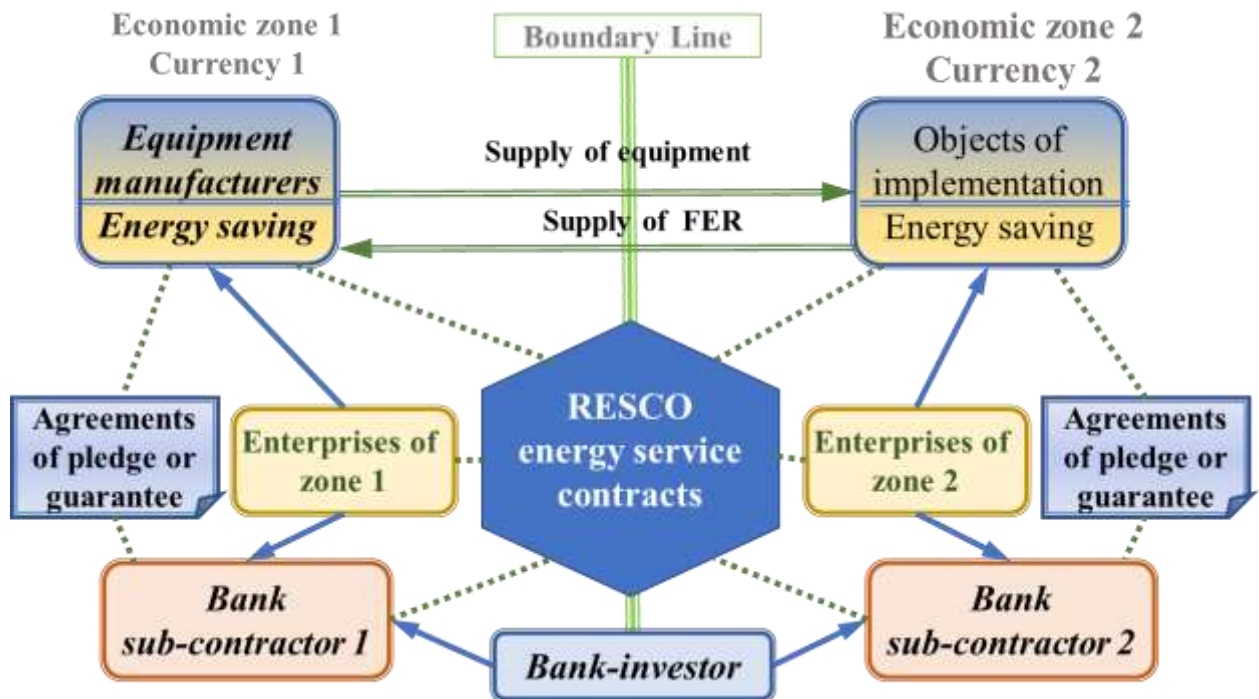


Figure 1. *Structural and functional diagram of the RESCO mechanism for cooperation between enterprises operating in different economic zones*

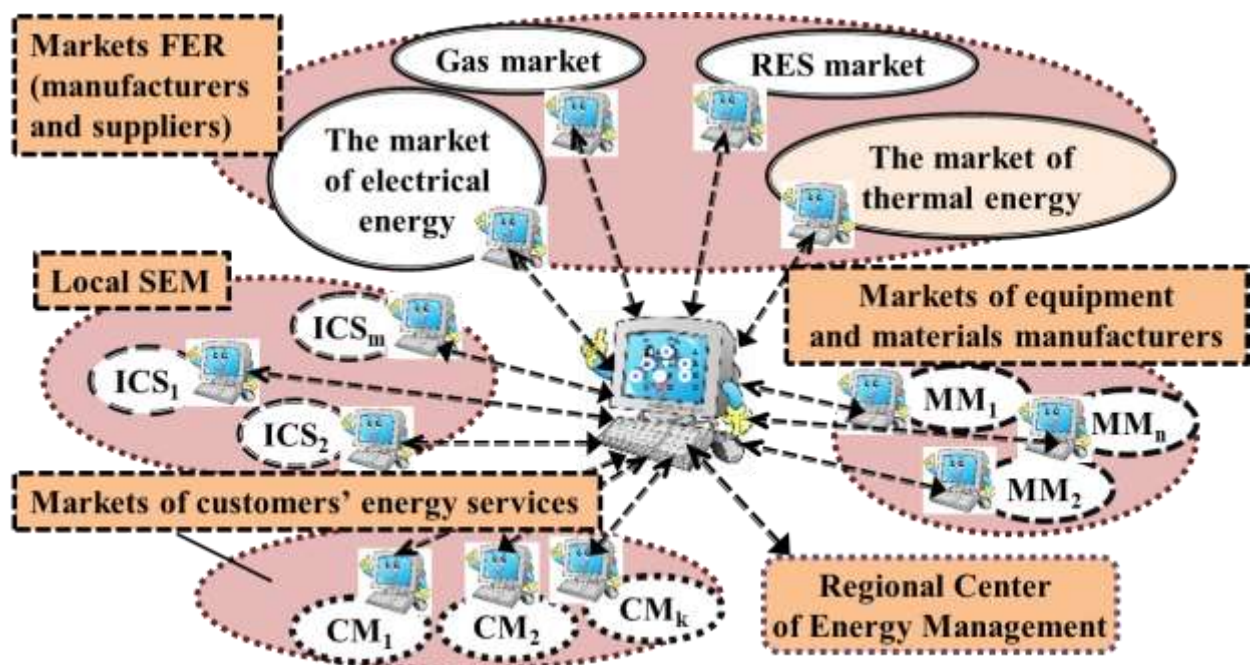


Figure 2. *Participants (service providers and customers) of REMS.*

REMSs based on cloud information and communication technologies used by system operators to monitor, control and optimize the parameters of business activities of an organization (company), including those related to

the actions of personnel to control the operating modes of technological and auxiliary equipment [10]. The main advantages of using such REMSs are their capabilities for further development of the service market, which are realized by: improving the efficiency of service provision; more sustainable and reliable investment attraction; use of renewable energy sources, energy storage; introduction of virtually organized systems of automated control of energy facilities of customers, etc.

The implementation of energy management services in the environment of virtually organized local EMSs allows to expand the scope and improve the quality of energy service provision by specialized companies by combining their resources, capabilities and information. The list of the latter usually includes various service-oriented organizations, consulting and research institutes, construction and installation organizations, industry associations, governmental organizations and independent consultants providing specialized legal or insurance services, marketing expertise, etc. This allows the members of the virtual business community of local EMSs united under the responsibility of the REMS to reduce business costs and risks, increase the efficiency and flexibility of data and modern technology exchange, facilitate access to new markets and improve the conditions for financing joint projects.

Among other advantages of using virtual energy management services, we would like to highlight their potential for further development of the energy service market, which is realized through:

1. Improving the efficiency of service delivery,
2. More sustainable and reliable investment attraction,
3. Use of renewable energy sources, cogeneration, heat pumps, energy storage, etc,
4. Managing the workload of project customers (clients),
5. Organizing portfolio supplies of equipment and materials,
6. Use of distributed generation,
7. Simplifying the procedure for effective search and selection of partners and establishing fair competition.

An analysis of the international experience of developed countries, as well as Ukraine, shows the effectiveness of creating and operating regionally oriented energy management systems based on ESCOs in the form of a municipal enterprise or a limited liability company. In any case, they are responsible, in whole or in part, for energy management and planning, energy service project management (preparation of such projects, support of energy service procurement, protection of community interests), conclusion and implementation of energy service contracts, supervision of their implementation, mediation between the municipality and business in the field of energy efficiency and energy supply, attraction of financing for EE projects, conducting information campaigns and trainings in the field of energy efficiency.

Establishing a community-based RESCO in the form of a municipal enterprise to implement energy service projects has a number of advantages. First, a municipal RESCO selects objects for investment in energy efficiency measures taking into account the interests of the community, second, it keeps the saved funds in the community, and third, it has the ability to attract external financing for projects. I.e., its effective operation increases the community's ability to attract loans and grants from Ukrainian banks and international financial institutions by using the mechanism of local guarantees of debt obligations that significantly improves the RESCO 's creditworthiness, reduces the cost of financing the energy efficiency projects. And finally, a municipal RESCO increases the institutional capacity of the community in the field of energy efficiency. According to the relevant decision of the council of the respective territorial community, the RESCO may have the status of a municipal company with its own staff, which usually includes the positions of director (also known as regional energy manager), regional energy auditor and investment project finance specialist. Their primary task should be to form teams of qualified specialists in engineering, energy efficiency and construction for the regional and local EMS.

In practice, other options are also possible, for example, the creation of RESCO as separate unit at the operating utility company of the region.

Conclusions.

The creation of a regional energy management system in oblasts (districts) on the platform of a regional ESCO, which coordinates the activities of local EMSs, is undoubtedly necessary, since the era of energy efficiency and energy saving projects and even the implementation of renewable energy sources funded by grants from international organizations is already over, and existing local ESCOs are not able to offer projects large enough in terms of funding to be attractive to investors, both external and internal.

It is important that the systemic combination of two usually separate approaches (EMS and ESCO) allows for a unified energy policy for the development and implementation of EE and RES projects in the region to more effectively address the problems of attracting investment in the recovery and innovative development of the regional economy.

In our opinion, the establishment of a regional ESCO in the form of a municipal enterprise is more attractive than in the form of a limited liability company, mainly due to the wider possibilities to support ESCO activities in terms of using local debt guarantee mechanisms to improve the creditworthiness of ESCOs and create favorable conditions for attracting loans and grants from Ukrainian banks and international financial institutions for the

implementation of large-scale EE and RES projects at the regional level. It should also be noted that despite the fact that ESCO projects are self-sustaining (they pay for themselves through energy savings achieved as a result of their implementation), project customers should also take an active part in their financing.

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СПЕЦИФІКА СТВОРЕННЯ РЕГІОНАЛЬНИХ СИСТЕМ ЕНЕРГЕТИЧНОГО МЕНЕДЖМЕНТУ НА БАЗІ ЕСКО

Надмірне споживання та неефективне використання паливно-енергетичних ресурсів, незадовільно високий рівень енергоємності виробництва товарів і послуг і пов'язана з цим низька їх конкурентоспроможність на внутрішньому та зовнішніх ринках, в умовах дефіциту власних енергоресурсів і постійного зростання цін на них, висуває проблему підвищення енергоефективності та енергозбереження регіональної і, як наслідок, національної економіки у категорії першочергової значущості та актуальності. Вирішення цієї проблеми досягається шляхом створення регіональної системи енергетичного менеджменту в областях (районах) на платформі регіональних енергосервісних компаній, яка координує діяльність місцевих систем енергетичного менеджменту, що дозволяє за рахунок проведення єдиної енергетичної політики з розробки та впровадження в регіоні проектів з підвищення енергоефективності та енергозбереження і впровадження відновлюваних джерел енергії більш ефективно вирішувати проблеми залучення іноземних інвестицій у відновлення та інноваційний розвиток регіональної економіки.

Ключові слова: системи енергетичного менеджменту, енергосервісні компанії, енергоефективність, енергозбереження, регіональна система управління.

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