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## **SYSTEMATIZATION OF INTERNATIONAL AND DOMESTIC EXPERIENCE IN PROJECT MANAGEMENT AIMED AT ADAPTING PUBLIC-PRIVATE PARTNERSHIPS TO THE IMPLEMENTATION OF SUSTAINABLE ENERGY DEVELOPMENT PROGRAMS**

**Abstract:** European countries are recognized leaders in the use of public-private partnerships in project management for large-scale infrastructure projects, including those that contribute to energy efficiency in various sectors of the economy. Their experience is a useful example for Ukraine in its quest for energy independence and economic stability. Establishing partnerships with business will increase the resources of the state and promote the involvement of the private sector in the implementation of profitable and image projects for both stakeholders. The development of mechanisms and recommendations for the development of public-private partnership (PPP) should be preceded by an analysis of international experience in creating a favorable and attractive environment in which public-private partnerships can be intensified. Since energy efficiency is the key to the successful functioning of the economy of any state, it is necessary, creating the conditions for the successful functioning of public-private partnership, to develop programs and projects to improve energy efficiency, which will be implemented under the PPP on a priority basis.

**Keywords:** energy efficiency, energy conservation, public-private partnership, fuel and energy resources, renewable energy sources.

### **Statement of the problem as a whole**

In the field of energy efficiency, Ukraine lags behind European countries. Among the main factors of low energy efficiency in Ukraine: obsolete and worn-out technological equipment; significant energy consumption during its transportation; a significant share in the structure of the gross domestic product (GDP) of energy-intensive industries and illegal use of energy resources in all sectors of the economic complex of the state and the population. At the same time, energy saving is not the only way to ensure the stability and energy security of the country. An important step in this direction is the implementation of large-scale innovative projects to improve energy efficiency and the development of renewable energy sources. This will require the involvement of significant financial and human resources, which can only be provided by a synergy of state and business efforts. Therefore, the need to implement public-private partnership projects in the field of energy efficiency could ensure successful cooperation between the public and private sectors to increase the competitiveness of the domestic economy and achieve Ukraine's true, dreamed of years of energy independence.

### **Analysis of basic research and publications.**

Public-private partnership is a relatively new tool for Ukraine to stimulate economic development. World experience shows that this type of partnership between government and business can improve management, attract investment, implement innovative solutions and technologies, as well as distribute business and investment risks between partners.

As it is known, the basis of the well-being of any country is energy stability, so it would be appropriate to apply the international experience of PPP in the field of energy efficiency.

Foreign authors such as Wen C.H., Liu Z.Y., Li Z.X. more attention is paid to proving the need to switch to new energy sources, as the development of energy efficiency projects themselves is carried out directly by the state.

Foreign scientists such as Armstrong, M. and Brown, D. analyze already implemented energy efficiency measures, which helps to make adjustments and improve the results already obtained, while in Ukraine we are still at the beginning of the path to the implementation of energy efficiency projects on the basis of state private partnership.

National priorities of energy efficiency in Ukraine were considered by such scientists as Stogniy B.S, Kyrylenko O.V, Prakhovnyk A.V, Denysyuk S.P, Butso Z.Y, as Bila I.S, Petryshyna N.V, Boyko O., Dlugopolsky O.V, Zhukovskaya A.Yu., Kredisov A.I, Belous A.O, etc. [6, 8, 9, 19, 20]. Problems and prospects of stimulating investment in the energy sector of Ukraine were studied by Tsygankova M.O and Uzunov F.V. The state and forecasts of the development of energy efficiency of Ukraine in the conditions of European integration were considered by Zaverbny A.S and Psui M.S. [2, 4, 5, 10].

However, the current economic situation in Ukraine requires a combination of projects using international experience of public-private partnership with the intensification of energy efficiency. There is a great need to generalize the foreign experience of public-private partnership in the field of energy efficiency and develop guidelines for the application and/or adaptation of its main provisions, taking into account the specifics of Ukraine in their implementation in practice.

The aim of the article is to prove the importance of implementing energy efficiency programs and projects based on public-private partnerships and to develop practical recommendations for key PPP stakeholders based on the analysis of international experience.

### **Presentation of the main research material**

At the beginning of the XXI century formed a modern vision of the mission of world energy – the most efficient use of natural fuel and energy resources (FER) and the potential of the energy sector to grow the world economy and improve the quality of life of the world's population [4].

Global investment trends are relevant in the world energy today:

1) restructuring of the gas market: mobile, competitive, with developed distribution and spot prices;

2) growth of environmental requirements;

3) technological progress aimed at more efficient and cheaper energy solutions;

4) new centers of investment attraction with lower «entry thresholds» than in traditional energy;

5) a radical change in the nature of demand and the status of energy consumers in the market: the demand for «digital energy»; «Electrification» of the energy market and reduction of heat supplies; increasing the level of consumption management by the user;

6) directing intellectual, administrative, engineering and technical solutions and efforts of the project team to obtain synergies from the application of technological and managerial «know-how», followed by the introduction of the resulting «synergy project product» in municipal and regional functional systems (in particular, those use the Smart Grid platform);

7) restructuring of business processes; the «dispersed» nature of the new energy requires network organization of the industry, flexibility of major players and infrastructure.

Today, a new energy civilization is being formed in the leading countries, the main features of which are: energy efficiency; intelligent energy systems built according to the Smart Grid concept (Fig. 1); decentralization of energy; new energy sources.

Energy development will be implemented within the following models:

- model «Energy efficiency +»: development of nuclear energy, non-traditional and renewable energy sources (RES); launch of second wave energy efficiency programs (online consumption management), CO<sub>2</sub> capture and sequestration technologies (CCS); strengthening in the fuel and energy balance (PEB) of renewable energy, etc.;
- model «New paradigm – power market»: market liberalization in the field of generation, dispersed generation; Smart Grid in the «active networks» version; instead of the market of energy services and fuel – the market of energy capacities and the exit of the «buyer – seller» (active houses, electric transport, etc.); reconstruction of cities [5].

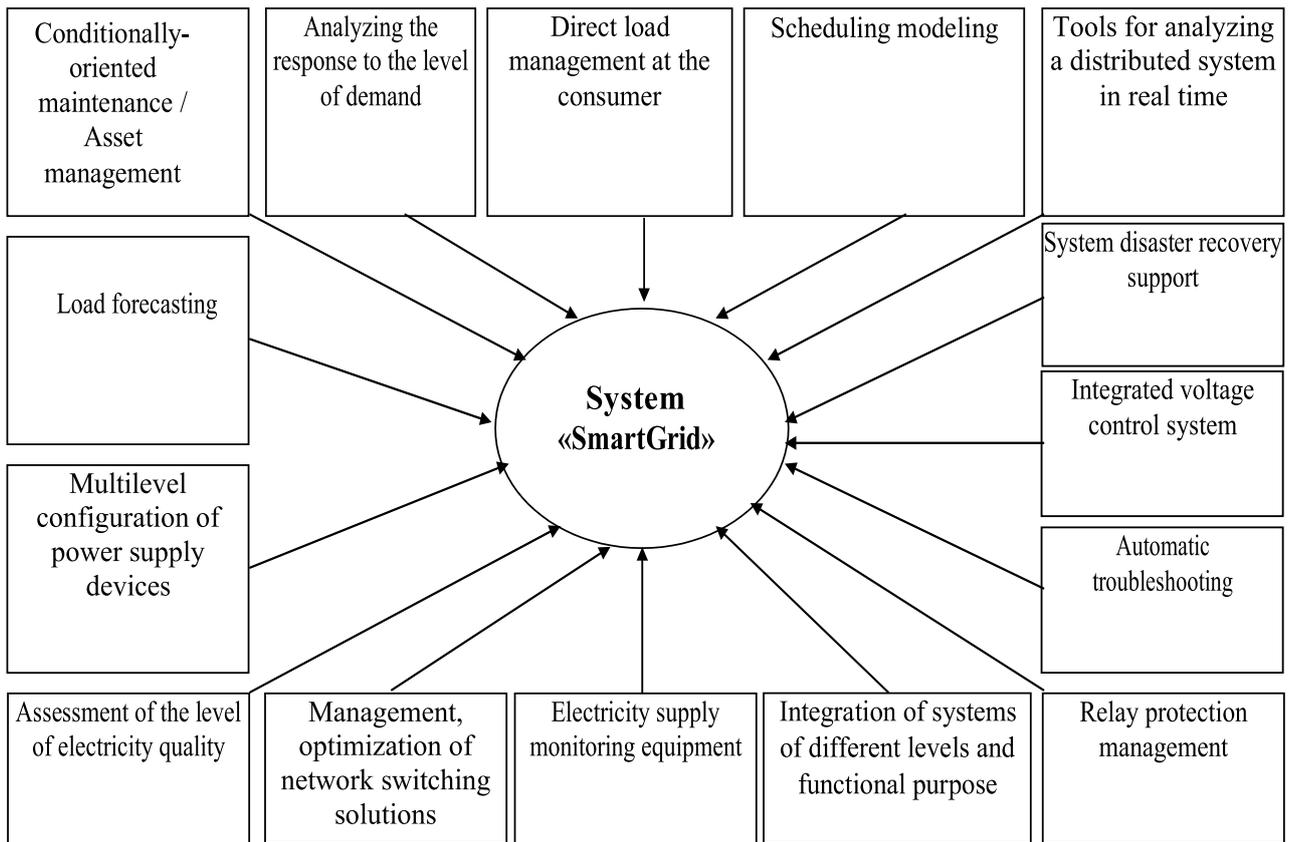


Fig. 1. Key elements of the intelligent energy system «SmartGrid».  
 Source: built by the author based on [6]

In this case, energy efficiency is considered as a macroeconomic indicator that characterizes the competitiveness of the country's products and acts as a determining factor and indicator of its innovative development. The degree of economic development of the world economy is determined by a system of technological systems. In most of the analyzed scientific and applied sources, technological systems are structured on 6 levels:

- the first level is based on the use of «learning» tools;
- the next level is based on «primary technical means»;
- the third level of the structure contains machine technologies;
- the next level is provided by complex mechanized technologies;
- information and computer administration technologies;
- nao-, bio-, convergent and resource-saving technologies.

Resource and economic characteristics of the functioning of technological systems 1-6 are fundamentally different. If in Ukraine today the most common are III and IV technological systems, the requirements for the implementation of energy efficiency policy in our country are different from the leading EU countries (primarily – Germany, Italy, the Netherlands, France, Sweden) and the United States, where sectors of economics of the VI technological way [7].

The experience of such countries, the United States, Germany, Japan, South Korea has shown that significant growth in energy efficiency can only be achieved if the implementation of state energy efficiency policy, which should cover all levels of the economy – from local, regional to national and coordinate administrative, legislative and financial measures energy efficiency.

Energy saving can be said as a new energy resource, the involvement of which in economic circulation will reduce the energy intensity of social production. It is assumed that energy

saving, displacing other energy resources from the fuel and energy balance, becomes a kind of energy resource.

The philosophy of energy-saving and energy efficiency for Ukraine has its own characteristics. For a long time, the declared priority of energy saving policy has not been supported by an effective form and mechanisms of interaction between government, business and scientific potential in the implementation of innovative energy-saving technologies based on public-private partnership. The goal of energy saving policy is not to administratively limit the consumption of energy resources, but to increase the efficiency of primary energy use [1].

For example, in Ireland, a number of infrastructure projects in the energy, transport and social services sectors are being implemented through public-private partnership mechanisms on the basis of an adopted concept with a centralized body, the Central Public-Private Partnership Division.

World experience shows that due to the use of PPP in the implementation of state policy to improve energy efficiency, there is a rapid increase in the competitiveness of the state. If in Western Europe the value of energy saving potential is equal to 10-20% of energy consumption, in Ukraine this figure exceeds 45%. Significant improvement of energy efficiency should be based on a systemically balanced state and regional policy – through the introduction of PPP (Table 1).

Table 1. Stages of development of public-private partnership in the world

The degree of development of PPP	Characteristic features
Stage I	<ul style="list-style-type: none"> <li>• Formation of the political basis of PPP;</li> <li>• Introduction of basic PPP concepts;</li> <li>• Establishment of the PPP services market;</li> <li>• Identification of priority projects.</li> </ul>
Stage II	<ul style="list-style-type: none"> <li>• Creation of PPP structures;</li> <li>• Formation of the regulatory framework;</li> <li>• Development and expansion of projects with the inclusion of new facilities;</li> <li>• Writing and publishing practical methodological manuals.</li> </ul>
Stage III	<ul style="list-style-type: none"> <li>• PPP models introduced have become popular;</li> <li>• Elimination of legal restrictions and barriers to public policy that hindered the development of PPPs;</li> <li>• Growth of PPP-based contracts;</li> <li>• Growth of investments in infrastructure projects at the state level.</li> </ul>
<i>Source: built by the author based on [1]</i>	

At a time when many leading European countries are already in the third stage of PPP development, Ukraine is only in the first stage. As there are a number of economic problems in the country, it is necessary to intensify cooperation between the public and private sectors as soon as possible to ensure the development of the national economy and overcome crises based on a harmonious and rational combination of mutual interests (Fig. 2).

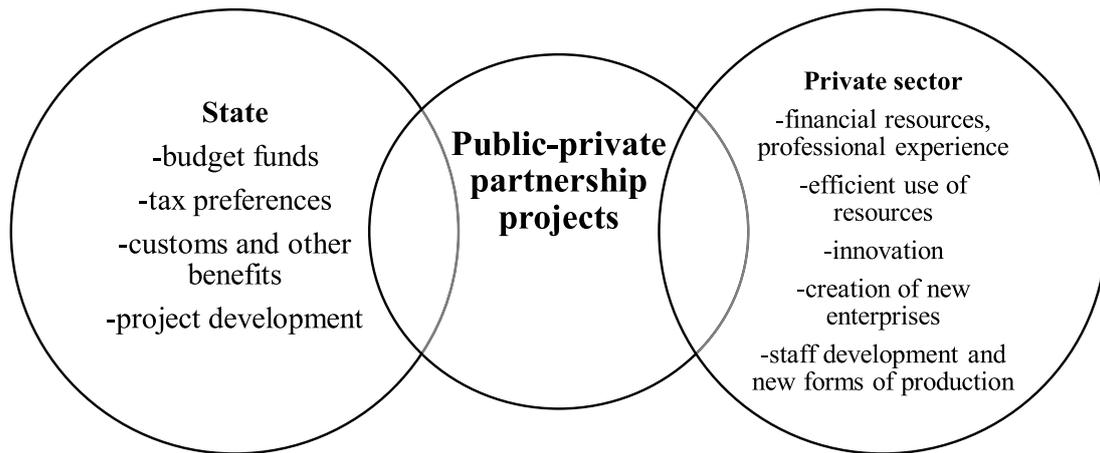


Fig. 2. Rational and harmonious cooperation between PPP partners  
 Source: author's own development

In the state economic policy in Ukraine for a long time often used the concept of «energy-saving», while in European and other developed countries operate the concept of a slightly different and more complex dimension – «energy efficiency», which is considered in a single coordinate system with environmental friendliness and competitiveness.

In the XXI century to solve the problem of increasing the efficient use of fuel and energy resources is possible only through the introduction of the latest energy efficient technologies and equipment that would meet the needs and requirements of today [8].

The dominant influence on global regulatory activity in energy efficiency and energy consumption projects and programs is played by the IEA (International Energy Agency) [21] (IEA Energy Scenarios: Change We Have to Believe In. Allianz Knowledge. 2008-06-23). This agency successfully operates as systematic information and administrative group, collectively responding to the requests of about 30 member countries. The IEA recommendations can and should be the basis for the formation of energy efficiency policy in individual countries and regions in the areas of intersectoral activities, industry and buildings (Fig. 3).

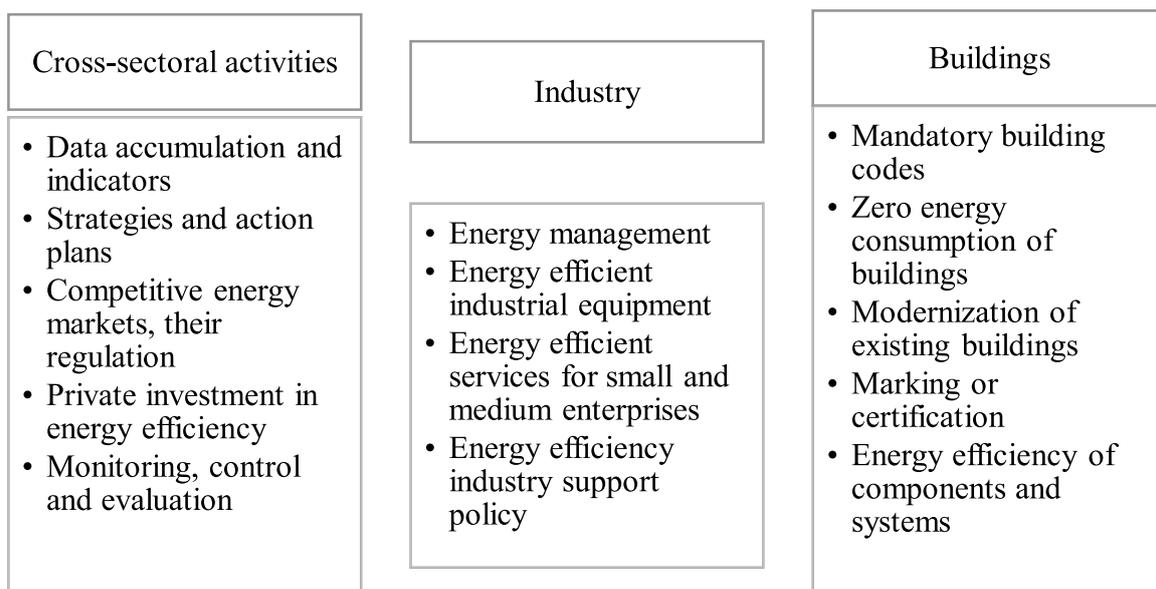


Fig. 3. Recommendations of the International Energy Agency in the areas of intersectoral activities, industry and buildings. Source: built by the author based on [7].

Abroad, energy efficiency is not just the use of resource-saving technologies (including recuperation, installation of energy-efficient windows, wall insulation, etc.). This is a comprehensive approach from the design stage to the commissioning and operation of the facility or technology (equipment).

Implementation of an effective policy to increase energy efficiency and development of energy production from renewable energy sources and alternative fuels will provide Ukraine with the opportunity to create conditions for reducing the energy intensity of gross domestic product, optimize the energy balance through increased use of RES, ADE and secondary energy resources.

Today, the problem of improving the efficiency of the energy structure of our state requires a comprehensive modernization of all its components, which is almost impossible to implement without the involvement of the private sector. Improving the efficiency of energy infrastructure can be carried out both for individual technologies (technological modernization), object-by-object (object modernization), and the system as a whole (system modernization). Finding the optimal configuration of project management opportunities with the existing economic, environmental and social constraints in the energy sector is an unresolved urgent problem and challenge for society [10].

From the world community, the most significant achievements in the field of energy efficiency have been achieved by the EU countries, so their experience is of the greatest interest to Ukraine. Of the world community, the most significant achievements in the field of energy efficiency have been achieved by the EU countries, so they have become of the greatest interest to Ukraine. This is due to the fact that Ukraine has established successful trade and resource relations with EU countries, in particular in the supply and distribution of energy resources [9].

At the state level, the number one issue is to increase the country's energy security through the introduction of alternative energy sources. Currently, the weight of renewable energy sources in the structure of the general supply has increased.

According to Eurostat, the average share of renewable energy sources in the EU is 15%. The highest indicators are in Sweden – 52.1%, Latvia – 37.1%, Finland – 32.6%, Denmark – 27.2% [11].

The experience of forming public-private interaction is spreading in all regions of the world. According to the analysis of international practice, the most common objects of public-private partnership are:

- energy-saving;
- housing and communal services (production and transportation of electricity, water supply, operation and improvement);
- construction and maintenance of highways;
- operation of buildings of the budget sector of the economy.

As a result of studying and analyzing the experience of European countries, it was found that the features of the mechanisms for public-private partnership are as follows:

- duration of relations between public authorities, local governments and private partners;
- preservation of state and communal ownership of facilities with the simultaneous introduction of infrastructure management mechanisms by private partners;
- openness and transparency of the activities of state and local authorities in determining private partners;
- ensuring the provision of quality and cheaper services as an indicator of the effectiveness and efficiency of public-private partnership;
- combination of resources of financial and credit institutions under the guarantees of state and local authorities;

- risk allocation, the definition of obligations and responsibilities in the public-private partnership agreement;
- protection of the interests and satisfaction of community needs, control over the quality of services provided by private partners, discussion and monitoring of projects with the participation of public organizations.

In the face of certain financial difficulties, the EU government is focusing its efforts on the transition to predominantly low-carbon and resource-saving energy.

Back in November 2016, the European Commission proposed to set a new target for energy efficiency growth – by 30% by 2030 and to amend the Directive 2012/27 / EU on energy efficiency. The EU has developed a list of measures to improve energy efficiency:

- an annual decrease of 1.5% in energy sales;
- energy-efficient renovation of buildings owned by the state or rented by the central government in the amount of at least 3% per year;
- mandatory certification of energy efficiency, which is accompanied by the sale and lease of buildings;
- application of energy efficiency standards and labeling for various goods, such as boilers, household appliances, lighting and television equipment (EcoDesign);
- preparation of national action plans to improve energy efficiency every three years;
- energy audit in large companies, at least once every four years;
- protection of consumers' rights to obtain easy and free access to data on energy consumption in real-time.

But it is also necessary to take into account the risk assessment in the implementation of effective policies to improve energy efficiency and development of energy production from renewable energy sources. It is limited by the company's ability to respond to poorly predictable and non-cyclical events, when the bulk of the events considered in this process are rather major deviations from general trends and does not allow management to reconsider and reconsider the company's development to improve energy efficiency, which in turn contradicts the main factor in the effectiveness of the risk management process – cyclicity.

To solve this problem, we propose to consider the method of using weak signals in the process of anticipative management of the enterprise on the basis of public-private partnership. The main premise of this theory is that as the rate of change increases, it becomes increasingly difficult to predict with sufficient accuracy the nature of these changes, and difficult to predict events are nothing but a weak signal coming from the internal or external environment of the enterprise. The application of this technique to the methodology of PPP risk management is sufficiently justified by the fact that the system of anticipatory management of the enterprise is nothing more than a subsystem of strategic management [19].

For a two-factor assessment of this impact, the author proposes a method of building a model of the risk environment of the production structure of the enterprise, which is as follows (table 2).

This model of the risk environment of the enterprise is based on a two-factor analysis (expert and quantitative) of the entire risk array of the organization's environment and allows to assess the risk burden on the entire management structure of the enterprise for energy efficiency as a whole and a separate area of activity and any potential economic risk in the implementation of the PPP project.

As can be seen from the table in the basis of this technique the primary role is played by the risk map of the enterprise, which allows to identify the analyzed array of economic risks that affect or could potentially affect the organization and group these risks according to economic activity. On this basis, each economic risk is assigned its own unique index, such as «risk B11», which means business risk (D) in investment (I) activities, according to the first expert (1).

Table 2. Model of risk assessment of the enterprise environment [18]

Type of risk	Sphere of activity of the enterprise	Sphere of activity of the enterprise	Qualitative method of assessment based on score, Ire $\sum Ire = \sum Ire(1-i)/i$				Quantitative estimation method, Irk $\sum Irk = \sum Irk(1-i)/i$			Risk index, Ir
			Expert 1	Expert 2	Expert i	$\sum Ire$	Cach-flow	...i	$\sum Irk$	
Business	Investment	Risk BI <sub>1</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk BI <sub>2</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk BI <sub>3</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk BI <sub>i</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
Market	Financial, operational	Risk MF <sub>1</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk MF <sub>2</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk MF <sub>3</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk MF <sub>i</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk MF <sub>1</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk MF <sub>2</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk MF <sub>3</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk MF <sub>i</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
Credit	Financial	Risk CF <sub>1</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk CF <sub>2</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk CF <sub>3</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk CF <sub>i</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
Operating	Operating room	Risk OO <sub>1</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk OO <sub>2</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk OO <sub>3</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$
		Risk OO <sub>i</sub>	Ire <sub>1</sub>	Ire <sub>2</sub>	Ire <sub>i</sub>	$\sum Ire = \sum Ire(1-i)/i$	Irk <sub>1</sub>	Irk <sub>i</sub>	$\sum Irk = \sum Irk(1-i)/i$	$Ir = \sum (Irk+Ire)/2$

Next, each of these investment risks (Ir) is assessed by the i-th number of experts (e), each of which, based on their own perception, assigns each risk the value of Irei. Therefore, the total opinion of experts from the first (1) to the i-th (1→i) is calculated by the formula:

$$\sum Ire = \sum Ire(1 \rightarrow i)/i, \tag{1}$$

where  $\sum Ire$  – the total opinion of all opinions of experts in point terms,

$\sum Ire (1 \rightarrow i)$  – the sum of points of all expert opinions,  $i$  – the number of experts.

In this case, based on the classification of risks according to the level and degree of impact given above  $Ire = Pe \times I$ , ie the probability of damage from an activity (P) according to the expert – Pe, multiplied by the probability of a risk situation – I.

When applying the quantitative approach, the level of impact of a risk on the level of profit is estimated, in our opinion, the analysis of VfM enterprise is necessary and sufficient for this type of assessment, but for this purpose it is possible to use other methods mentioned above.

Thus, according to a similar algorithm to the point expert assessment, the total result of quantitative (k) approaches is calculated by the formula:

$$\sum I_{rk} = \sum I_{rk}(l \rightarrow i) / I_k \quad (2)$$

in this case, based on the classification of risks according to the level and degree of impact given above  $I_{rk} = P_k \times I_k$ .

The final risk index (Ir) of the proposed two-factor model of the risk environment, each of the assessed economic risks, is as follows:

$$Ir = Ir (I_{rk} + I_{re}) / 2 \quad (3)$$

As you can see, this result allows you to fully assess a particular economic risk of the enterprise. To assess the risk load on a particular area of activity, we propose the following formula:

$$IrX = (I_{rx1} + I_{rx2} + \dots + I_{rxi}) / i, \quad (4)$$

where IrX – risk index of a particular area of activity, and  $I_{rxi}$  – a separate economic risk in this area.

Therefore, to assess the total risk burden on the entire organization should use the formula:

$$IrP = (I_{rp1} + I_{rp2} + \dots + I_{rpi}) / i, \quad (5)$$

where IrP is the aggregate risk index, and  $I_{rxi}$  is the entire array of estimated economic risks of the PPP project.

Early detection of a strategic task, with the mandatory allocation of its risk component, increases the response time to it, but in the event of sudden situations, the response time will decrease accordingly, and, therefore, until sufficient information to make management decisions, there is a lack of time to its implementation, which in turn leads to direct or indirect loss or loss of profitability. From the above we can conclude that often obtaining complete information about a situation leads to the fact that the solution of this situation on the basis of management decisions is not possible. Therefore, to solve this problem, it is necessary to change the approach to obtaining and using information, shifting the focus of their efforts from waiting for sufficient information towards the algorithm of step-by-step multivariate planning of enterprise risk reduction in different developments related to internal and external changes. environment. Based on this, risk mitigation measures should be taken based on the level and in direct proportion to the information available. Which in turn can significantly increase the strategic flexibility of the enterprise risk management system by gradually strengthening the response.

It is also necessary to characterize the features of the innovation strategy and energy efficiency strategy that can be proposed for Ukraine. The course on energy efficiency indicates promising directions for the development of innovations, expands the possibilities of public-private partnership in the field of energy-saving and energy-efficiency, stimulates the demand for energy-saving products and technologies.

Principles of public policy (Fig. 4), necessary for the promotion of the flywheel generation and commercialization of innovations in the field of energy efficiency:

State policy to increase energy-efficiency as a chance for the development of innovations. The path from modernization to an innovative breakthrough in the field of energy saving. At the same time, the methodology of public-private partnership in the field of energy efficiency should be actively developed.

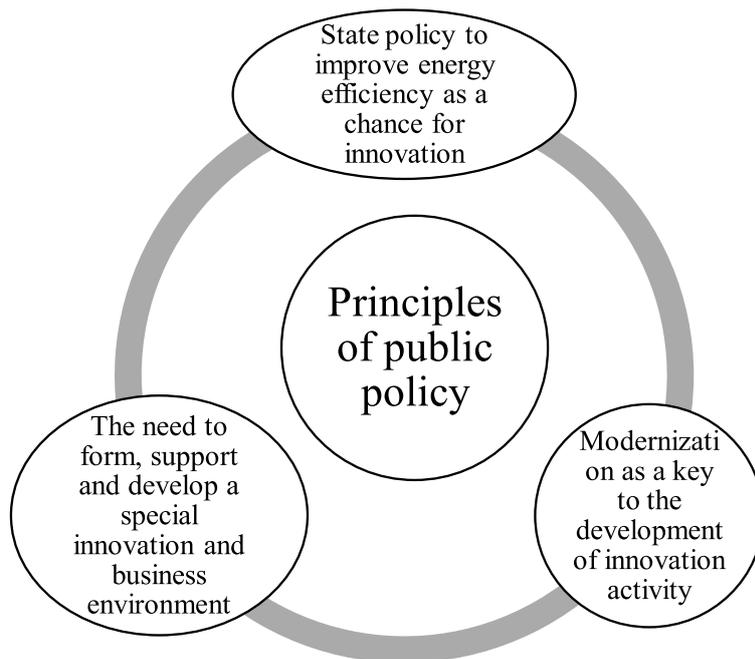


Fig. 4. Principles of public policy necessary for the development of innovations in the field of energy efficiency. *Source: built by the author based on [10]*

## 2. Modernization as a key to the development of innovation activity:

- the goal of obtaining innovations for the sake of innovations should not be pursued; the main criterion for success – commercial efficiency;
- it is necessary to pass in the shortest possible time the path taken by Western countries in terms of energy efficiency;
- successfully implemented in practice projects should create a solid basis for further revolutionary technological changes.

## 3. The need for the formation, support and development of a special innovation and business environment:

- gaining practical experience by young specialists, including at the stage of commercialization of the results of development and research, necessary for further independent work in the market;
- stimulation and support of entrepreneurial activity in the sphere of innovation among Ukrainian youth working in the field of scientific research;
- formation in a limited area of the “critical mass” of young talent, creating an atmosphere of creative freedom.

Energy management is a tool that can provide the state and its enterprises / organizations with savings by conducting a competent energy policy for the use of energy resources. Directions for improving energy efficiency in Ukraine:

- planning of development of separate (sub) branches through development of road maps of complex system of management of energy efficiency within the limits of public-private partnership;
- ensuring systematization in national economic policy, industrial policy, regional (local) policy and energy efficiency policy;
- creating favorable conditions for business, including sectoral energy resources;
- taking into account the interests of all stakeholders in decision-making in industrial and energy policy;

- intensification of the practice of planning, including energy, which eliminates separation of individual issues at different levels;
- dissemination of a culture of energy-saving lifestyle and business, information about opportunities and advanced technologies, educational activities;
- providing complete and reliable information on energy consumption at various levels to make the necessary decisions;
- ensuring greater availability of financial resources for modernization and energy efficiency, including through the development of energy services.

Implementation of a systematic approach to energy efficiency is possible due to the priority construction of a road map of a comprehensive energy efficiency management system. The roadmap is a clear sequence of targeted actions in the organizational and legal, industrial and technical, financial and economic, scientific and humanitarian spheres, which reduce energy consumption, replace expensive and scarce fuel and energy resources with more accessible ones and increase their efficiency [20]. When forming it, it is important to consider the following energy efficiency priorities:

1) industrial enterprises – the energy efficiency of industrial equipment and technologies, elimination of irrational energy use is important;

2) budget organizations, housing and communal services sector – the priority is to ensure energy efficiency of buildings (first of all – their insulation and efficient heat supply), elimination of wasteful energy use.

3) educational institutions – conducting a policy of energy efficiency, ie participation in the formation of national policy on energy conservation and energy efficiency, the formation of energy-saving worldview, and on this basis to ensure energy-efficiency of buildings, eliminate wasteful energy use [14, 18].

Experience shows that the probability of achieving successful results in the implementation of energy efficiency policy is highest in the presence of an effective energy efficiency management system both at the national level and at the level of individual enterprises, organizations and institutions.

Energy efficiency management involves a combination of legislation and funding mechanisms, institutional arrangements and coordination mechanisms, all of which are aimed at supporting the implementation of energy efficiency strategies, policies and programs. Energy efficiency management is a complex problem in which the main aspects of management can be identified: legal environment (laws and regulations, strategies and action plans, funding mechanisms), organizational structure (executive bodies, resource requirements, role of energy companies, stakeholder involvement). cooperation between the public and private sectors, international assistance) and coordination mechanisms (state coordination, targets, evaluation).

## **Conclusion**

Today it is important for Ukraine to identify growth points of scientific, technical and innovative activities in the field of energy saving and energy efficiency, which are such areas and types of scientific, technical and innovative activities that can give the most significant effect and become a driver of energy efficient society. This is possible through the pooling of public and private sector resources, the creation of public-private partnership programs in the field of energy efficiency and other sectors of the national economy.

Further explorations see the application of international experience and proposed recommendations for the development of an optimal and gradual strategy of public-private partnership in the field of energy-efficiency, adapted to Ukrainian realities.

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