Ministry of Education and Science of Ukraine

National University «Yuri Kondratyuk Poltava Polytechnic»

Educational and Scientific Institute of Finance, Economics and Management

Department of Economics, Entrepreneurship and Marketing

Department of Finance, Banking and Taxation

STUDY TUTORIAL
"THE CHALLENGES OF ENERGY EFFICIENCY: COOPERATION OF UKRAINE WITH THE EU"

for students of the second level of Higher Education by specialty 076 "Entrepreneurship, trade and stock market", 101 "Ecology", 192 "Construction and civil engineering"

within the framework of the Jean Monnet project "The challenges of energy efficiency: cooperation of Ukraine with the EU" (599740-EPP-1-2018-1-UA-EPPJMO-MODULE)

With the support of the Erasmus+ Programme of the European Union

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N 15 Study tutorial "The challenges of energy efficiency: cooperation of Ukraine with the EU" for students of the second level of Higher Education by specialty 076 "Entrepreneurship, trade and stock market", 101 "Ecology", 192 "Construction and civil engineering". – Poltava: National University «Yuri Kondratyuk Poltava Polytechnic», 2021. – 178 c.

Explanations and recommendations on the topics of the lecture course (within the framework of the Jean Monnet project "The challenges of energy efficiency: cooperation of Ukraine with the EU" (599740-EPP-1-2018-1-UA-EPPJMO-MODULE). Study tutorial was worked out to highlight the European experience of building energy efficient economy and spreading European practices of energy consumption culture upbringing in Ukraine. The tutorial is intended for the students of economic, ecology and construction specialties at higher educational establishments, post-graduate students and lecturers, business schools students, enterprise specialists.

CONTENT

INTRODUCTION

Jean Monet module "The challenges of energy efficiency: cooperation of Ukraine with the EU" created by the project team aims to popularization and form a complex system of target audience knowledge connected with the introduction of European practices of energy efficiency management in Ukraine; of practical skills in the development and introduction of energy saving events, rational usage of energy sources both at home and in the workplace.

During the recent years the energy system of Ukraine has been in a difficult situation caused by the increased development of energetic branches of the economical complex; out-of-date technologies. Thus, the project team thinks that the top priority of the training course is formation of the new target audience thinking type, which is based on the understanding of consumed resources value, the problem of their insufficiency.

According to the first target the module envisages improvement of basic principles of the European model of energy efficient economy as well as overviewing strategic documents like "Green and White book", corresponding Road maps, Directives, which allow to develop recommendations for Ukrainian legislation adaptation to EU standards, perform civil hearings.

It is especially topical for Ukraine during the crisis time to learn the European technical and technological system as well as funding energy efficient events. The experience of passive construction is thoroughly studied according to the "Passive House Classic" standard. The issue of spreading in Ukraine “Termodim” technology based on the primal Italian experience "Platsbau" and its popularization of energy efficient thermal blocks "Ytong Energo" in Germany, the USA, Canada, Israel, Holland, Finland is studied separately. On the basis of the existing project developments it is suggested to perfect the string of resource efficient load-carrying constructions based on the experience of Poland, Germany, Denmark, Latvia, Sweden.

The module envisages formation of the current knowledge in the sphere of energy audit according to European standards, overviewing methods and requirements for European countries about performing energy audit and energy management.

To implement technical and technological solutions, it is necessary to give the target audience the fundamental skills in assessment and adaptation of energy efficiency project funding instruments of European countries in Ukraine (by international organizations, ESCO - company, lessors, financial and credit institutions, collective investment institutions).

Project relevance to the second specified target is confirmed by the materials, designed by the project team: meaningful lectures, accumulating the best European practices in the field of energy, team's own research and its innovative developments. Innovative in content and form, practical classes will make it possible for the target audience to form skills of development of energy management system, a portfolio of energy efficiency projects, evaluation of their investment attractiveness, and most important - the formation of energy-saving habits, understanding of inevitability of energy-efficient and environmentally friendly lifestyle. The course is unique because the recommendations on implementing energy saving measures are aimed at different sectors of the economy, reforming the housing-communal services.

The training module is multidisciplinary as it accumulates knowledge of materials science, technologies and organization of production, project analysis, investment, Economics of enterprise.

This manual contains a summary of lectures, the necessary explanations, as well as questions to control knowledge and a list of references.

THEME 1

EUROPEAN MODEL OF ENERGY EFFICIENT ECONOMY

European experience of transition from energy management of the economy to energy saving and energy efficiency. Basic principles of the European model of energy efficient economy. Components of the EU's energy-efficient economy: Poland, Germany, Denmark, Latvia, Sweden. State regulation of relations in the field of energy saving. Energy efficiency policy-making: challenges and European landmarks.

The European Union, abbreviated: "EuroUnion", "EU", less often: "European Community" is an economic and political union that unites the 27 independent member states located in Europe. It dates back to the formation of the European Coal and Steel Community (ECSC) and the European Economic Community (EEC), which consisted of six countries in 1957. In the following years, the territory of the EU was enlarged due to the inclusion of new member states, while increasing its sphere of influence by expanding its political powers. In its current form, it exists on the basis of the Maastricht Treaty, signed on 7 February 1992 and in force since 1 November 1993. The last significant revision of the EU's constitutional principles was approved by the Lisbon Treaty, which entered into force in 2009. Legally, there are no capitals in the EU, but de facto this is the city of Brussels, where most of the European Union's institutions are based.

The EU operates through a system of independent supranational institutions and jointly agreed decisions of the Member States. The most important EU institutions are:

- The European Commission;
- Council of the European Union;

- European Council;

- Court of Justice of the European Union;

- European Central Bank;

- The European Parliament, elected every 5 years by the citizens of the European Union.

The EU has a single market through a standardized system of laws in force in all Member States. In the Schengen area (which consists of 22 Member States and 4 non-EU countries), passport control has been abolished. EU policy is aimed at ensuring the free movement of people, goods, services and capital, legislation on common equity issues and supporting the common trade policy, agriculture, fisheries and regional development.

The five largest national economies in the EU are (in ascending order, as of 2018): Spain, Italy, France, the United Kingdom and Germany - together they account for about 70% of nominal GDP in the EU as a whole. The largest trading partners of the European Union are (in descending order, as of 2018): the United States, the CIS, Switzerland, Russia and Turkey. Ukraine ranks 21st in this ranking (between Hong Kong and Algeria), in 2017 it ranked 25th. The EU is a full member of the World Trade Organization, the G7 and the G20.

The first agreement regulating relations between Ukraine and the European Union was the Partnership and Cooperation Agreement signed on June 16, 1994.

As of 2019, the main document governing relations between Ukraine and the EU is the Association Agreement between Ukraine and the European Union, which entered into force on November 1, 2014, entered into force on September 1, 2017. This agreement became the next stage in the rapprochement of Ukraine and the EU (after the Partnership and Cooperation Agreement) and allows to move from partnership and cooperation to political association and economic integration of the two parties.

According to a 2007 poll, 55% of respondents in Germany, France, the United Kingdom, Italy, Spain and Poland supported Ukraine's accession to the EU if Ukraine met the necessary conditions. 34% were against Ukraine's accession to the EU.

On June 11, 2017, the visa-free regime between Ukraine and the European Union came into force. It allows citizens of Ukraine who have biometric passports to come for business or tourist purposes or for family matters for up to 90 days during a 180-day period to 26 of the 28 EU countries (all except the UK and Ireland) and 4 other members of the Schengen area (Iceland, Norway, Switzerland and Liechtenstein).

According to a survey conducted in 2017 in Germany, France, Italy, Ditva, Great Britain, Poland and the Netherlands, 48% of respondents supported Ukraine's accession to the EU, 52% did not support it. The main arguments against Ukraine's accession to the EU are the general reluctance to join the EU (regardless of the candidate country), Ukraine's poverty (fear of overburdening the EU budget), lack of democracy and corruption (risk of spreading Ukrainian corruption to the rest of the Union). The main arguments for Ukraine's accession to the EU: Ukraine is part of Europe, accession to the EU will strengthen democracy in Ukraine, encourage Ukrainians during the conflict with Russia and increase economic relations with the EU.

The economic potential of any country largely depends on the state of its energy resources and the conditions of their use. Among the world's problems in recent years, one of the most important is the energy problem. For the balanced economic development of all countries of the world, humanity lacks about 5 - 6 times the amount of energy produced at the moment. It is becoming clear that the use of renewable energy sources and energy efficiency must be accelerated for economic growth.

Therefore, the priority areas of research are:

- energy saving, energy efficiency;

- resource conservation, search for alternative fuels;
- waste disposal and utilization;
- environmental protection;
- nanotechnology;
- development of multifunctional materials;
- information and communication systems and technologies.

Consider the basic concepts of energy efficient economy.

Energy saving is an activities (organizational, scientific, practical, information), which is aimed at the rational use and economical use of primary and transformed energy and natural energy resources in the national economy and which is implemented using technical, economic and legal methods.

Energy efficiency is the efficient (prudent) use of energy reserves. Use less energy to maintain the same level of energy supply of buildings or production processes.

In contrast to energy saving (savings, energy conservation), mainly aimed at reducing energy consumption, energy efficiency (energy efficiency) - appropriate (efficient) energy consumption.

For the population - this is a significant reduction in utility costs; for the country - saving resources, increasing industrial productivity and competitiveness; for the environment - limiting the emission of greenhouse gases into the atmosphere; for energy companies - reduction of fuel costs and unreasonable construction costs.

To assess energy efficiency: production or technological process, an **energy efficiency indicator** is used, which estimates the consumption or loss of energy reserves.

Energy saving (energy saving, energy conservation) refers to the reduction of energy consumption through the use of fewer energy services.

Energy saving is different from energy efficiency, which involves using less energy for the same service.

For example, to use a car less - to save energy, and to switch to a car with lower fuel consumption, or to an electric car - energy efficiency. But both energy saving and energy efficiency are techniques for reducing energy use.

Energy saving mechanism is an implementation of legislative, legal, organizational, technical, economic, scientific and informational measures aimed at the efficient use of energy resources and improving the environment.

Energy efficiency is a characteristic of equipment, technology, production or system as a whole, which indicates the degree of energy use per unit of final product. Energy efficiency is assessed both quantitatively (amount of energy per unit of final product) and qualitative (low, high). Improving energy efficiency is achieved through the implementation of a system of organizational and technical measures.

Energy-saving technology is the method of producing products with rational use of energy, which allows to simultaneously reduce the energy load on the environment and the amount of energy waste generated during the production and operation of the manufactured product.

Energy use is a natural or purposeful use of energy of different types at the stages of the life cycle of the object (product, product, process) and in the provision of services at a given level of development of society.

The energy intensity of gross domestic product (GDP) is the main indicator of economic efficiency - in Ukraine is much higher than in industrialized countries. This is a consequence of a certain technological backwardness, imperfect sectoral structure of the domestic economy and the influence of its "shadow" sector.

This situation limits the competitiveness of national production and places a heavy burden on the economy – especially given its external energy dependence. Unlike Western countries, where energy saving is an element of economic and environmental feasibility, for Ukraine it is a matter of survival, as the problem of both domestic balanced solvent consumption and import of fuel

and energy resources has not yet been resolved.

The problem of rational use of energy resources, increasing the level of energy efficiency and energy security is a necessary condition for the harmonious economic and social development of Ukraine in the context of its European integration. Providing all spheres of Ukraine's economy with various types of energy and fuel is one of the most important tasks of the management system, economic policy of the country, a necessary condition for its successful and harmonious development. The formation and implementation of Ukraine's energy policy is an extremely important component of economic policy in general and further European integration. Only the mutual complementarity of economic and energy policies will achieve the harmonious development of the country in terms of European integration. Given the limited energy resources, there is an acute problem in their efficient use, geographical and other types of diversification of energy products in Ukraine.

One of the strategic directions of Ukraine's economic development is energy modernization and energy efficiency. The need for development and intensification of energy saving processes in Ukraine is due to the presence of persistent negative trends in energy intensity of gross domestic product of Ukraine as the main indicator of energy efficiency.

The consequence of the growth of energy intensity of the domestic economy is inflated tariffs, which leads to an increase in the share of energy costs in the structure of production costs of industrial enterprises.

In addition, the lack of a practically implemented energy saving strategy and the complexity of energy saving measures do not allow industrial enterprises to restrain the growth of costs and increase the competitiveness of their products.

Currently, the problem of energy saving is considered mainly from the point of view of the technological aspect of the implementation of energy saving

projects. Scientific elaboration of the organizational and economic component of energy saving implementation does not meet high requirements.

Energy saving as a factor in improving the efficiency of an industrial enterprise may be due to the following circumstances:

- a factor in increasing the competitiveness of products in terms of reducing the cost of its production, reducing the share of energy costs;

- energy saving can be considered as a factor of additional investment, which contributes to the renewal of technological equipment and improve the quality of products produced by industrial enterprises;

- energy saving is a factor that stabilizes the demand for energy resources in the direction of its reduction, which reduces the environmental load in areas of industrial enterprises.

Energy saving and increasing energy efficiency can have a positive impact on the economy as a whole - including the improvement of the technological base of industrial enterprises with further improvement of the quality of products; market competitiveness of domestic enterprises in the world market; increasing the innovative potential of industrial enterprises and, ultimately, the growth of gross domestic product and improving living standards.

Much attention is currently paid to the problem of rational use of energy resources. Thus, the works devoted to the analysis of the fuel and energy complex of the country and its separate territories are relevant; development and implementation of modern energy-saving equipment and technologies; feasibility study of the efficiency of their use; standardization and standardization of indicators of energy resources use; development and implementation of energy management. There are differences in the terminology and methodological provisions of the problem. Moreover, in most sources, energy conservation is seen as a technological problem, while reducing its socio-economic content.

Energy saving has a significant impact on the energy security of the state, as inefficient domestic consumption of fuel and energy resources requires large volumes (almost 50%) of their imports, which leads to significant dependence on exporting countries. At the same time, the energy saving potential in Ukraine is over 45% of the consumption of fuel and energy resources (FER). Its implementation will in most cases reduce the severity of the problem of external energy dependence.

Low energy efficiency has become one of the main factors of the crisis in the Ukrainian economy. In the structure of costs for the production of industrial products in the first half of the 1990s, the cost component of energy resources in material costs for these products increased almost threefold, reaching 42% of their total volume. The increase in the share of fuel and energy costs is due to a significant increase in the cost of imported energy resources during this period, which led to low profitability. Low profitability has, in turn, been one of the reasons for money laundering from the economy, thus contributing to its barterization and other negative consequences in the transition to market relations and is one of the main causes of crises in the national economy and their consequences.

As a result of state-level efforts in Ukraine, there has been some improvement in the energy efficiency situation. If the energy intensity of GDP increased by 42% during 1990-1996 and almost stabilized in 1997-1999, then since 2000 there has been a significant decrease, and for the first time in the history of Ukraine GDP growth was achieved while reducing consumption of primary energy resources.

Therefore, one of the main directions of improving the energy supply system of Ukraine should be to increase fuel and energy efficiency.

The strategic goals of energy saving policy are radical restructuring of technological, economic and regulatory framework for production, transformation, transportation and use of fuel and energy resources in the

economy and social sphere in order to radically reduce their costs and increase energy efficiency to the level of industrialized countries.

Pursuing an active energy saving policy is an important factor that will guarantee a sustainable and efficient supply of energy resources to Ukraine's economy and its energy and, consequently, national security.

By signing an association agreement with the EU, Ukraine has committed itself to meeting high European energy efficiency standards and participating in the energy market. According to these commitments, Ukraine, which today has the lowest energy efficiency in the world, should become closer to European countries, where one of the most energy efficient economies operates. In fact, this means implementing European standards to improve energy efficiency.

They cover a variety of areas, from improving the central heating system to a more open energy market that allows it to compete with new European companies.

Article 338 of Chapter 1 in Section 5 of the EU-Ukraine Association Agreement defines: the promotion of energy efficiency and energy saving, including through the formulation of energy efficiency policies and the structure of law and regulatory framework to achieve significant progress in line with EU standards, including efficient generation , production, transportation, distribution and use of energy, based on the functioning of market mechanisms, as well as efficient use of energy in the use of equipment, lighting and in buildings.

In accordance with the decisions of the Energy Community adopted in December 2009, September 2010 and October 2011, the Contracting Parties to the Energy Community (including Ukraine) are in the process of implementing the following Directives of the European Parliament and the Energy Efficiency Council:

Directive 2006/32 / EC on energy end-use efficiency and energy services;

Directive 2010/31 / EC on the energy performance of buildings;

Directive 2010/30 / EC on the labeling of energy products;

Directive 2006/32 / EC on energy end-use efficiency and energy services requires EU Member States to prepare three national energy efficiency action plans.

Ukraine's economic growth significantly depends on the level of energy supply, energy efficiency potential and the level of their use in all sectors of the national economy.

The high level of energy intensity of GDP is objectively due to the high share of resource- and energy-intensive industries in the structure of Ukraine's economy: metallurgy, chemical industry, mining. At the same time, the situation is complicated by low energy efficiency in the transformation and energy supply sectors, high specific energy costs for heating and hot water supply to households.

Ukraine has exhausted its previous model of economic growth, in which profits from the production and export of metals and other energy-intensive basic goods went to the consumption economy. Previously, the success of Ukrainian exports depended mainly on cheap energy resources. With rising prices for imported gas, the economy's dependence on imported fuel has become a determining burden for economic growth. Energy imports are the main reason for the constant general trade deficit.

Regulatory intervention and subsidies severely distort energy prices, deplete public finances and encourage excessive energy use. By international standards, Ukraine remains one of the most inefficient energy consumers due to a large share of energy-intensive sectors, outdated and inefficient technologies and extremely depleted fixed assets, including inefficient district heating systems and low-quality building stock.

The development of Ukraine's economy, as well as the global one, is cyclical. The military-political situation in Ukraine and the financial crisis are accompanied by a serious energy crisis.

One of the main ways to overcome this energy crisis is energy saving and energy efficiency.

After all, Ukraine has a significant potential for energy savings, the main part of which is concentrated in the residential sector (34%), industry (28%) and in the sector of energy transformation at thermal power plants (21%). The services and agriculture sectors account for 12% and 4% of energy saving potential, respectively, and construction accounts for about 1% of total energy savings due to the relatively small amount of direct energy consumption.

The Ministry of Regional Development is working to improve the legal framework that will bring Ukraine closer to the European model of energy consumption and accounting.

Ukraine is one of the least energy efficient countries in Europe - in the residential sector, average energy consumption is 2-3 times higher than in the European Union.

To bring Ukraine closer to the best European practices of energy consumption and accounting, the Ministry of Regional Development has developed draft laws "On Energy Efficiency of Buildings" and "On the Energy Efficiency Fund" and others. The adoption of the bills will help increase the country's energy independence. Implement energy security and independence measures, improve the quality of utilities and help attract additional investment through cooperation with European partners.

Questions to control knowledge

1. What is the EU, what are the basic principles?
2. What is energy saving?
3. What is the difference between energy saving and energy efficiency?
4. What are the strategic goals of energy saving policy?
5. What is energy-saving technology?

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THEME 2

IMPLEMENTATION OF EUROPEAN ENERGY SAVING STANDARDS IN UKRAINIAN LEGISLATION

Main stages of formation of legislation in the field of energy saving in the European Union. Types of documents and regulatory framework for energy saving in Ukraine and the EU. European Energy Charter, White and Green Books. Trends and prospects of implementation of European energy saving standards in the legislation of Ukraine. Recommendations for adapting the legislation of Ukraine to the legislation of the European Union.

In a market economy, the most effective mechanisms of state influence on the formation of the energy market include the creation and improvement of legislative and regulatory bases that determine the rules for interaction between market participants. At the same time, the state sets mandatory requirements and criteria that ensure its safety. Economical use of energy is precisely a condition for the security of Ukraine, whose economy depends on foreign energy suppliers. Areas of development of legislative and regulatory bases in the field of energy efficiency in Ukraine are now in different dimensions – the regulatory framework is created in accordance with a clear scientific methodology, is constantly being improved, new documents are introduced annually, while at the level of legislation for a long time there was only the law of Ukraine " On energy saving " from 01.07.94, No 74/94-VR.

In recent years, attempts to improve the legislative framework have been made several times . In particular, in 2014, the draft law of Ukraine "On energy efficiency of buildings" initiated was adopted by the Verkhovna Rada of Ukraine and signed by the president of Ukraine only on 20.07.2017 after its completion. This law regulates relations arising in the field of ensuring the energy efficiency of buildings, in order to increase the level of energy efficiency

of buildings, taking into account local climatic conditions and ensuring appropriate conditions for living and/or life of people in such buildings and is a direct implementation of Directive 2010/31/EC in the legislative field of Ukraine. The law defines the introduction of certification of energy efficiency of buildings from July 01, 2019 and the definition of building classes.

Certificates contain data on the building's energy consumption and recommendations for improving the building's energy efficiency. Certification is carried out on a contractual basis in order to determine the actual energy efficiency indicators of buildings and assess their compliance with the minimum energy efficiency requirements established by the Ministry of regional development, construction and housing and communal services. the public. They are checked every five years. The creation of the building's energy passport for a construction object is entrusted to the construction customer before such an object is put into operation. The document is valid for ten years.

It should be noted that the law of Ukraine "On energy efficiency of buildings" also introduces the procedure of mandatory energy audit of buildings. such audits are conducted by certain certified companies and certified energy auditors. So, simultaneously with the law of Ukraine "On energy efficiency of buildings", the law of Ukraine "On the Energy Efficiency Fund" and the law of Ukraine "on commercial accounting of heat energy and water supply" were adopted, which create conditions for state support and stimulation of energy efficiency measures. So, there are all opportunities to assert that the legislative and regulatory framework forms a certain system for solving global issues of improving the energy efficiency of buildings in Ukraine.

The development of the domestic regulatory framework in the field of energy efficiency of buildings was carried out at the following stages (Fig.2.1). We will focus only on the current stages, in particular, in 2012-2014, the process of harmonization of the national regulatory field with European standards in the

field of energy efficiency and the implementation of European standards in the national system of norms and standards was carried out.

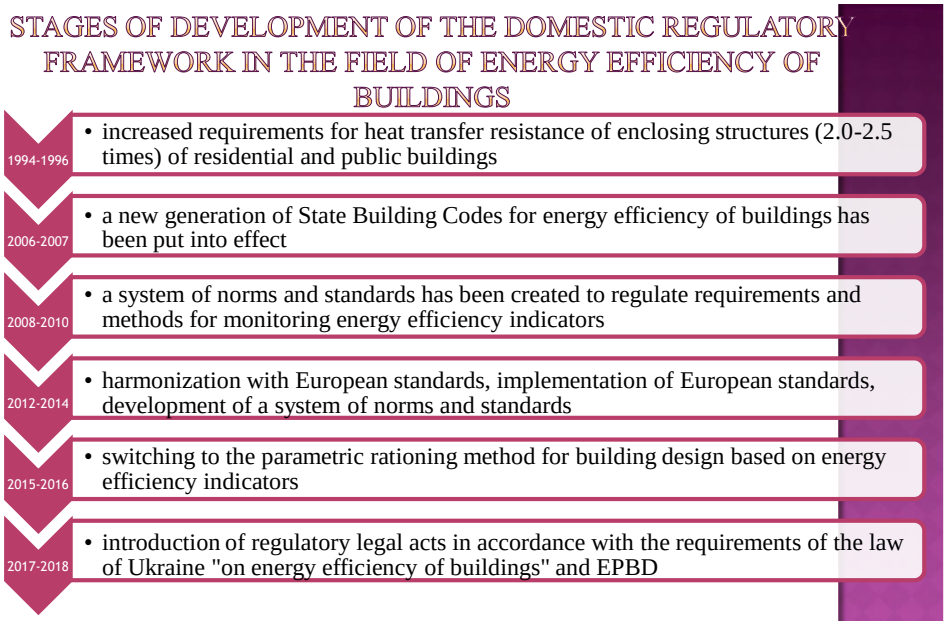

Figure 2.1 – Development of the domestic regulatory framework in the field of energy efficiency of buildings

In 2015-2018, a methodological transition to the parametric rationing method for building design in terms of energy efficiency indicators was started and the process of harmonization with EU standards was continued. According to the legislative documents, definitions of the Terms "energy efficiency" and "energy efficiency of buildings"are presented (Fig.2.2).

In the construction sector of Ukraine, legal relations are regulated by laws and bylaws (resolutions, orders, instructions, etc.), the energy strategy of Ukraine for the period up to 2030; new standards and gos have also been developed and adopted, which are harmonized with the EU approaches to stimulating energy efficiency in buildings, organizing energy audits and energy management. The legislative framework of Ukraine on energy efficiency of buildings is presented (Fig.2.3).

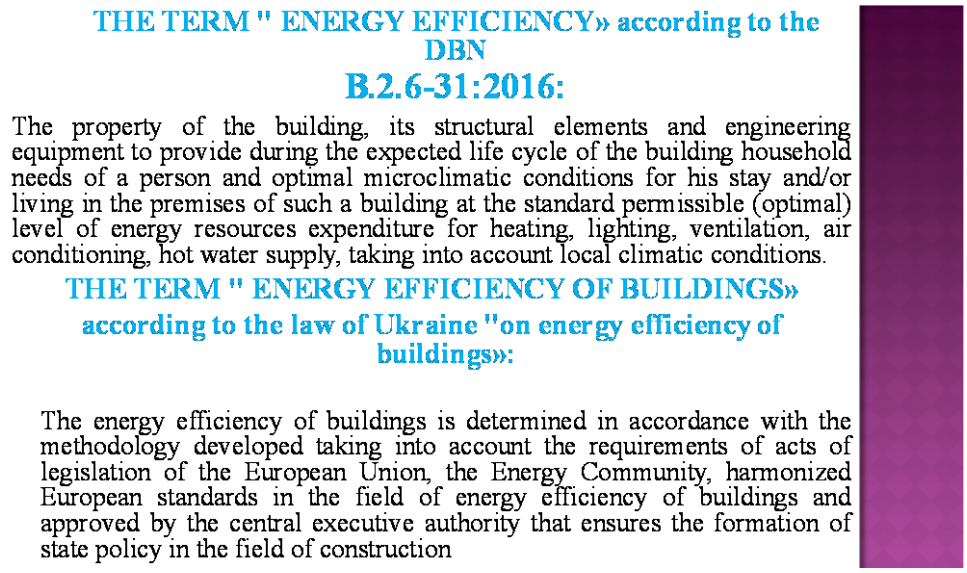

Figure 2.2 – Definition of the terms "energy efficiency" and " energy efficiency of buildings"

Figure 2.3 – Legislative framework of Ukraine on energy efficiency of buildings

The system of standards and requirements is aimed at stimulating the introduction of energy-saving technologies in construction practice. Ukraine has developed a number of standards regulating the requirements for evaluating technical solutions of enclosing structures, requirements for thermal

characteristics, energy efficiency indicators, energy certification and certification of buildings. Numerous state standards have been developed and adopted in various fields (energy labeling; energy consumption assessment, thermal modernization and energy audit in construction, construction of an energy management system in municipalities, indoor microclimate requirements, etc.).

Considering DSTU B A. 2. 2-12: 2015 "Energy efficiency of buildings. Method for calculating energy consumption for heating, cooling, ventilation, lighting and hot water", we note that it is Aimed at meeting the requirements of Directive 2010/31/EU energy efficiency of buildings, which provides for the adoption of a national decision on the energy certification procedure. Provides national solutions in accordance with DSTU EN ISO 13790: 2011 and other European Standards (Fig. 2.4).

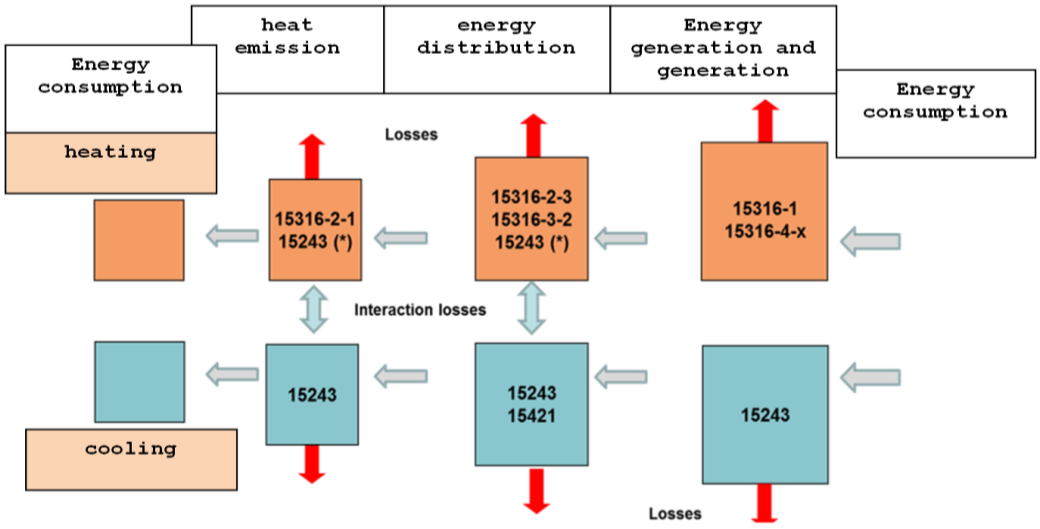

Figure 2.4 – The main directions of the method for calculating energy consumption for heating, cooling, ventilation, lighting and hot water supply

DSTU-N B A. 2. 2-12: 2015 is aimed at meeting the requirements of Directive 2010/31/EU energy efficiency of buildings, which provides for the adoption of a national energy certification procedure and provides a methodology for calculating energy requirements. Connection of the DSTU B

standard A. 2. 2-12: 2015 Energy efficiency of buildings. The method for calculating energy consumption for heating, cooling, ventilation and DHW with other European standards is shown in Fig. 2.5

According to DSTU-N B A. 2. 2-13: 2015, energy efficiency calculations are presented at different levels: energy consumption; energy consumption; energy delivered; primary energy/CO2 emissions. Standard DSTU B V. 2. 2-39: 2016 sets requirements for methods of energy audit of buildings (calculation, calculation and measurement, operational), their engineering systems, the composition of work, analysis of results, registration of reporting documentation. DBN B. 2. 5-67: 2013 sets requirements for engineering systems design, energy efficiency, safety, and environmental protection.

During the monitoring, EU standards were identified that determine the economic indicators of buildings, but are not valid in Ukraine (Table 2.1).

In General this is a General list of European and national energy efficiency standards for building engineering systems (Fig. 2.6).

Taking into account the experience of European countries, in particular the system of existing norms and standards in the field of energy efficiency of buildings (Fig. 2.7), the Law defines the main measures to improve the energy efficiency of buildings and tools for their financing. It is also planned to implement national plans to increase the number of buildings with close to zero energy consumption. The Law provides for the creation of open databases of energy certificates of buildings, reports on the results of surveys of engineering systems of buildings, and a list of certified energy auditors.

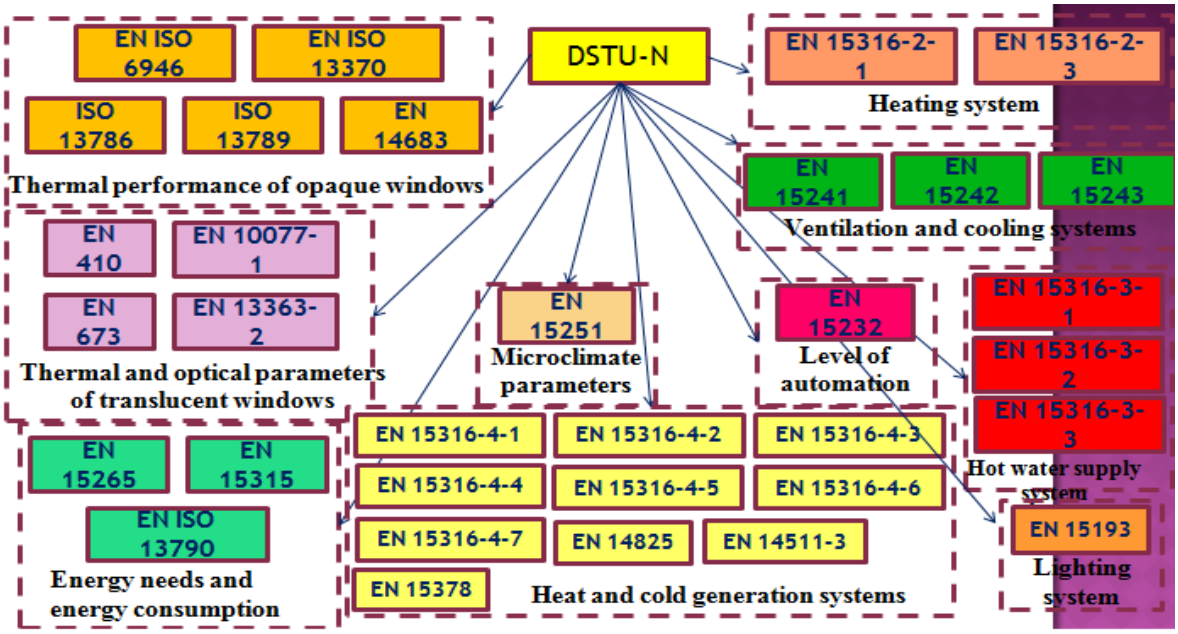

Figure 2.5 – The scheme of the project relationship DSTU B A.2.2-12: 2015 with European standards

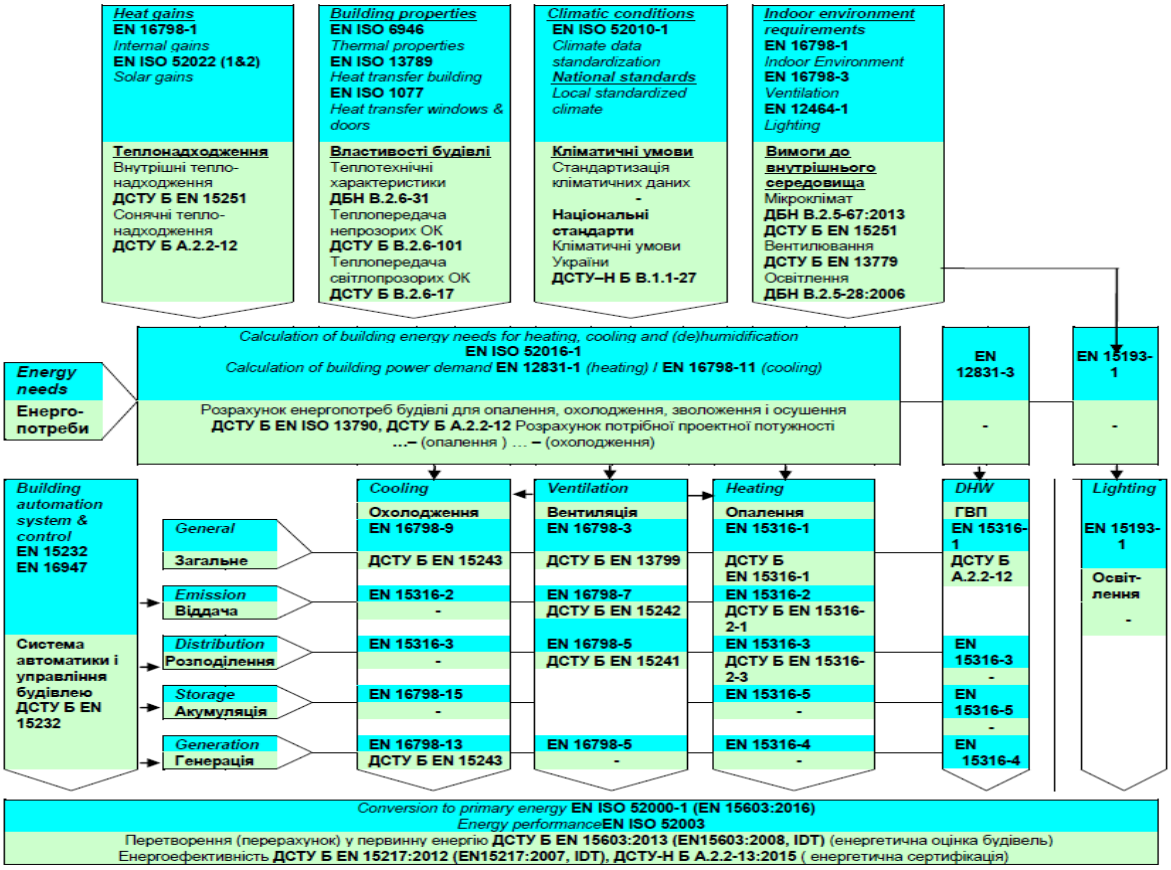

Figure 2.6 – European and national energy efficiency standards for building engineering systems [1]

Table 2.1 – EU standards that determine the economic performance of buildings, but are not valid in Ukraine

Mandate M480, Mandate to CEN, CENELEC and ETSI for the elaboration and adoption of standards for a methodology calculating the integrated energy performance of buildings and promoting the energy efficiency of buildings, in accordance with the terms set in the recast of the Directive on the energy performance of buildings (2010/31/EU) of 14 th December 2010.
EPBD, Recast of the Directive on the energy performance of buildings (2010/31/EU) of 14 th December 2010.
CEN/TS 16628, Energy Performance of Buildings – Basic principles for the set of EPB standards, July 2014.
CEN/TS 16629, Energy Performance of Buildings – Detailed technical rules for the set of EPB standards, July 2014
ISO 13602-2, Technical energy systems – Methods for analysis – Part 2: Weighting and aggregation of energy wares.
EN ISO/IEC 17000, Conformity assessment – Vocabulary and general principles (ISO/IEC 17000:2004.
DIN V 18599 Energetische Bewertung von Gebäuden Berechnung des Nutz-, End- und Primärenergiebedarfs für Heizung, Kühlung, Lüftung, Trinkwarmwasser und Beleuchtung - Ausgabe 2017.
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CEBC, 2006. Building Control Systems in Europe.
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ISO 52000-1:2017 Energy performance of buildings - Overarching EPB assessment - Part 1: General framework and procedures
CEN ISO/TR 52000-2:2017 Energy performance of Buildings — Overarching EPB assessment – Part 2: Explanation and justification of ISO 52000-1, (in preparation).

As of today, Ukraine has implemented about 100 legal acts on energy efficiency and relevant systems of standards, regulatory and methodological documents, created a structure of state management and control in the field of energy conservation; introduced a system of rationing of fuel and energy resources, energy audit and energy management, and state expertise on energy conservation. Appropriate sanctions have also been introduced for violations of legislation in the field of energy conservation.

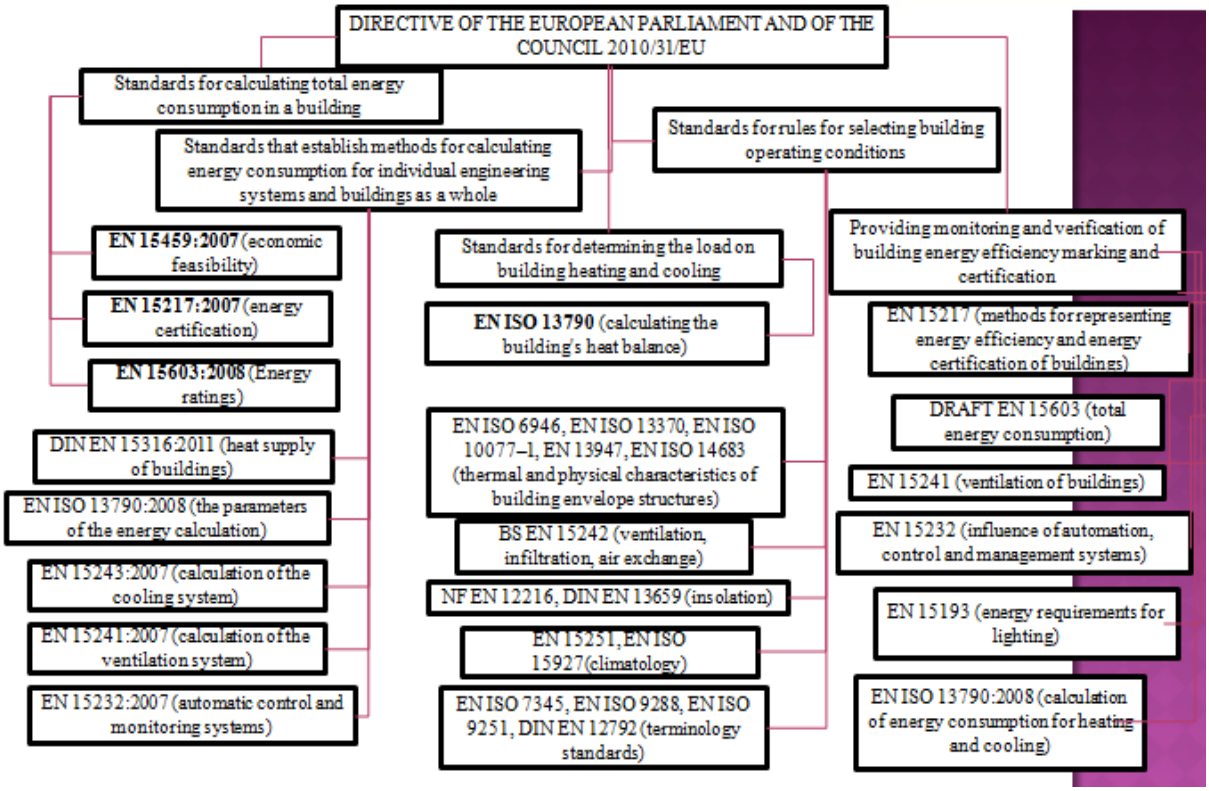

Figure 2.7 – System of current norms and standards in the field of energy efficiency of buildings in the European Union [2]

To date, Ukraine has introduced more than 100 regulatory legal acts on energy efficiency and relevant systems of standards, regulatory and methodological documents, created a structure of state management and control in the field of energy saving; introduced a system of regulation of fuel and

energy resources, audit, Energy Management, State expertise in the field of energy saving.

Appropriate sanctions were also imposed for violating the legislation in the field of energy saving. An urgent task of our time is to adapt domestic energy saving and energy efficiency standards to international and European standards. The association agreement between Ukraine and the European Union provides for the creation of a national standardization body with delegated nationality to international and regional standardization organizations. The introduction of an energy management system helps to solve these problems. The energy efficiency standards and labeling program is a set of procedures and rules that prescribe minimum energy efficiency requirements for manufactured products and materials for energy labeling. Rationing of minimum requirements for energy characteristics for market participants to make informed decisions about the purchase of more efficient goods and gradually abandoning inefficient technologies from the market it should be noted that standards and labeling are the most effective.

The main EU standards in the field of energy management and energy audit in leading European countries are presented (Fig. 2.8).

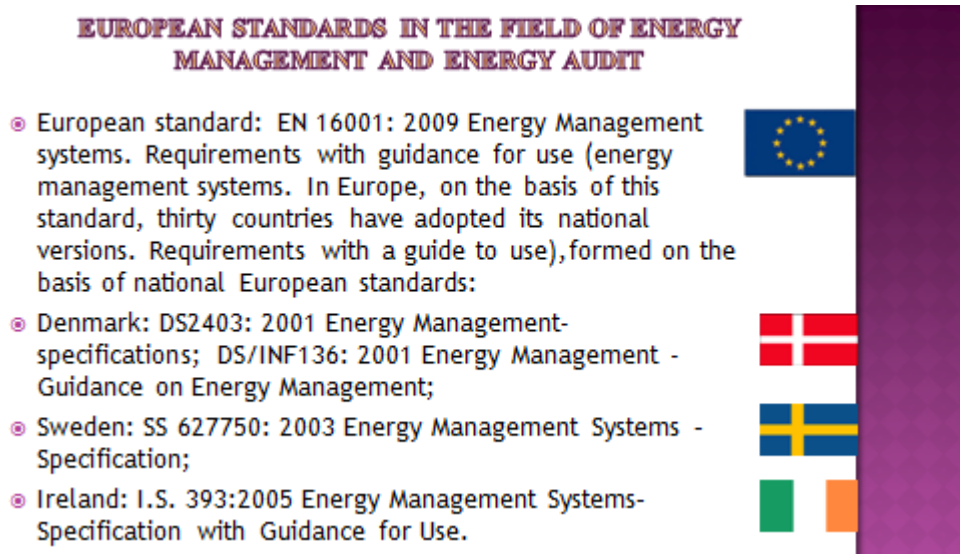

Figure 2. 8 – EU standards in the field of energy management and energy audit

The ISO 50000 series of energy management standards consists of six documents, the requirements of which apply to organizations of any type and size, regardless of the type of energy resources used (Fig.2.9).

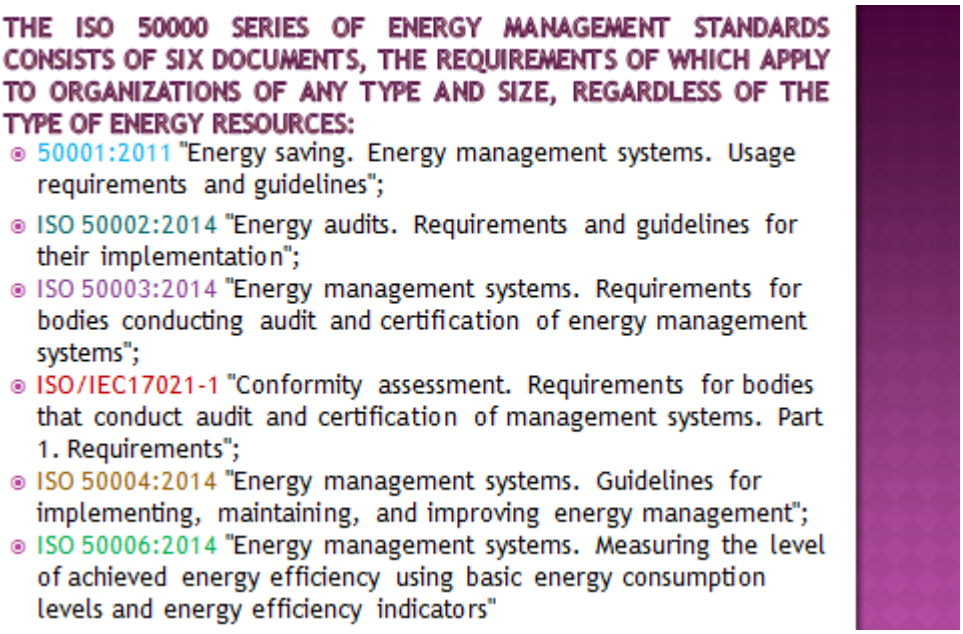

Figure 2. 9 – A series of energy management standards ISO 50000

The Energy Charter of 1991 became an option for cooperation in the energy sector (Fig.2.10), the main goal was to create a European energy community. For many reasons, this did not happen.

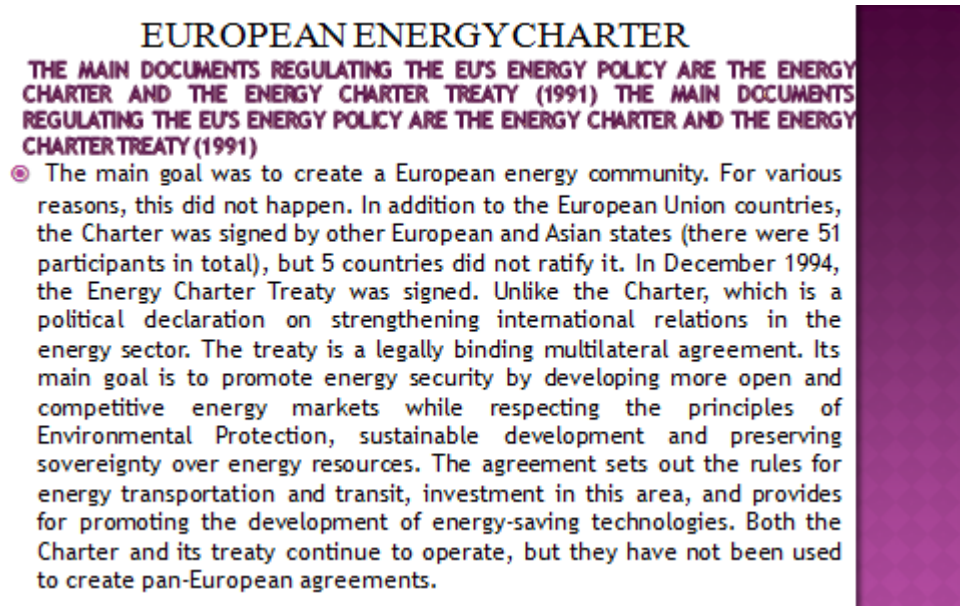

Figure 2.10 – Key positions of the Energy Charter

It was only in 1995 that the EU Council of ministers adopted the so-called "White Paper" (Fig.2.11) on the energy policy of the European Union, which defines its main goals. The fact that after so many years, EU members were able to agree on a common approach and cooperation was determined by internal and external factors. The main ones include the fact that Europe, according to the results of many years of analysis, cannot get rid of dependence on energy imports in the near future. Therefore, it is best to coordinate your methods. The result should be a competitive environment, higher safety and environmental friendliness in the field of energy production, less dependence on the import of energy resources by increasing efficiency and supporting research in this area.

Figure 2.11 – Key cases of the "White Paper" ("White Book")

- In the area of liberalization, the turning point came in 1996, when the EU Council of ministers adopted a new directive. It concerned large electricity consumers who could now choose their own supplier. Thus, 22% of the market in the European Union was liberalized. By June 2000, all EU members were required to conduct an analysis of energy systems in order to carry out the final liberalization of the market by 2006.

At the turn of the millennium, the European Commission formulated its energy policy goals. As the main directions: imported raw materials for total

consumption should not exceed 50%; liberalization, higher competitive pressure and energy efficiency; environmental protection; increasing the share of renewable raw materials to 12% of total consumption. Environmental standardization has been achieved in the field of Environmental Protection. Some states may also impose higher requirements, which, however, cannot violate the rules of the domestic market. Massive power outages around the world have given another impetus to the development of energy policy.

The result of these events was the European Commission's Green Paper (Green Book) "European strategy for sustainable, competitive and safe energy" (Fig.2.12). The modern energy policy of the European Union is based on the Green Book.

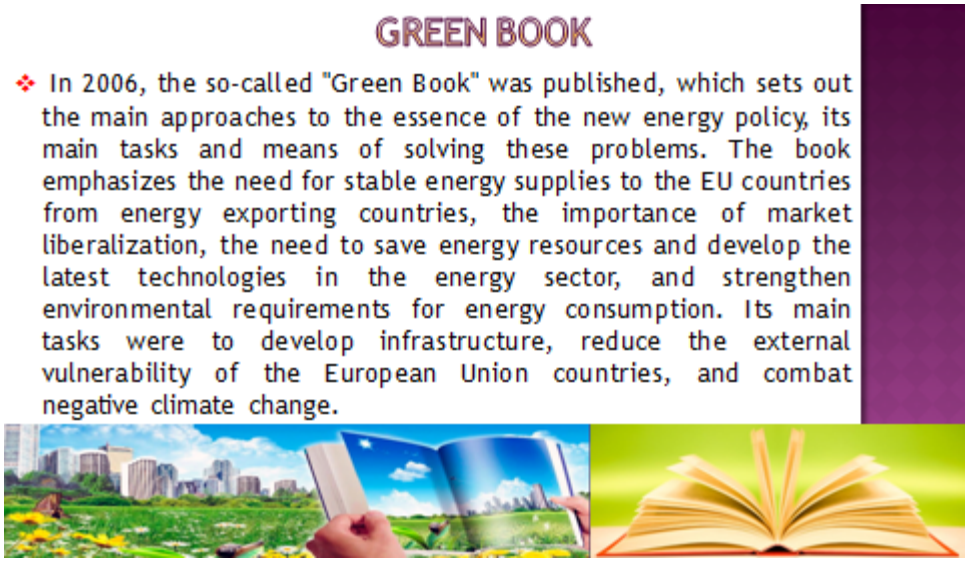

Figure 2.12 – Key cases of the "Green Paper" ("Green Book")

The green book highlights several key areas to focus on:

1) domestic market with energy that will ensure uninterrupted supply;

2) competitive supply;

3) an integrated approach to combating climate change;

4) support for innovation;

5) common foreign policy.

Without an open market, sustainable and competitive energy cannot be provided. Its goal is to transform energy producers from dominant domestic actors into competitors on a pan-European scale. Only in this way will lower prices, a higher degree of supply security and increased competitiveness be achieved. Due to competition, plants that are inefficient from the point of view of energy will be closed, which will help the environment as a result.

In order to create a single market with electricity and gas, it is necessary to combine distribution systems. This can be achieved by establishing general rules and regulations that will affect international trade. Progress in this area is still minimal, as it is the integration of networks into a single system that remains a big problem. Some states, such as Ireland and Malta, are "Energy Islands" cut off largely from other countries. It is also important to increase the capacity of high-voltage power lines, especially between France and Spain.

Huge investments are needed to replace the existing capacity in the next 20 years. This is the only way to cover energy consumption during peak hours and replace volatile energy sources. For these investments to be effective, a functioning competitive market is needed that provides price signals, incentives, stability, and access to finance. Improving cooperation between Power Transmission System Operators (TSO) remains a major challenge. The result should be a trans-European network. The first real step in this direction was taken in 1996, when the directive of the European Parliament and the Council of Europe No. 96/92/ES "On general rules of the internal electricity market"was adopted. It was followed in 1998 by Directive No. 98/30/ES "On general rules of the domestic market with natural gas". Both directives form the first liberalizing package. In 2003, it was replaced by the second liberalizing package, and in 2006 - by the third.

Directives from the third liberalization package and the decision of the European Parliament on trans-European networks regulate the modern energy industry of the EU. The result of implementing all the measures proposed in the

packages should be a single domestic market, which will bring a significant reduction in final prices for consumers due to an increase in supply. In addition to directly "freeing up" the market, the measures provided for in the packages are also purely administrative in nature in order to break the historical advantage of dominant electricity suppliers, as well as to remove uncompetitive production facilities from the market. In this regard, in 2008, for example, the so-called climate and energy package was adopted.

- The third liberalizing package consists of three legal provisions: the regulation "On conditions of access to networks for cross-border electricity trade", the regulation "On the establishment of an agency for cooperation of energy regulators" and the directive "On general rules of the domestic electricity market". The measures contained in this package focus on the following areas: strengthening regulatory oversight, supporting regionalization of cross-border energy activities, further strengthening consumer positions, deeper structural changes within natural monopolies and the so-called Grid Code, a formal management tool for the single European electricity market.

In terms of strengthening supervision, two main trends should be noted. First of all, this is an attempt by the EU to force its members to strengthen the role of state regulators so that in the future they have a wide standardized range of powers and can cooperate more effectively both at the regional and union levels. To this end, on March 3, 2011, the agency for regulatory cooperation (ACER) was established as a methodological unifying institution. Its role is to monitor and coordinate relations between national regulators and the TSO. Strengthening regulatory oversight should simultaneously be ensured by a significant increase in guarantees of independence and transparency of national regulators.

As for the elimination of national monopolists in the field of electricity supply, the third package clearly defines the right of each consumer to choose a supplier, not only from those that are present on the domestic market, but also

from foreign ones. The biggest changes based on the third package affected power transmission system operators. Their regulation by the EU begins with the introduction of a new certification process. In this case, the certificate will serve as evidence of the independence of the operator, which may be associated with the producer or seller of electricity. In this regard, the third package provides for the use of one of the three permitted models of the owner structure of the power grid operator TSO. The first is the complete separation of the operator from the structure of a vertically integrated company, the second is the transition of power transmission control to the so - called system operator (ISO - independent System operator), and the third is the independent transmission operator (ITO - independent transmission operator).

The latter point is considered by the European Commission as the most problematic, since the basis of all directives on electricity is the requirement that all citizens who have the opportunity to use the benefits of the domestic market should be able to have a high level of consumer protection. The problems associated with the implementation of the third liberalization package include the unwillingness of some state monopolists to make structural changes in their energy sectors. For example, the separation of power transmission system operators has not yet occurred in Bulgaria, Cyprus, Luxembourg, the Netherlands, Romania, Slovakia and Spain. In some European countries, there was only a partial restructuring of the industry in accordance with the third package. Only in Germany, the Czech Republic, Belgium, Denmark, France, Greece, Hungary, Ireland, Italy, Latvia, Poland, Portugal and Malta was the process fully completed. After passing all the stages of reform, markets in all EU countries acquire relatively identical forms and structures.

To improve energy efficiency in the field of design and construction, Ukraine should continue to implement high standards of the European Union, implement a number of energy saving measures, increase investment in the modernization and construction of buildings with close to zero energy

consumption through the use of innovative technologies and automated control systems that will monitor energy consumption, analyze and significantly save energy costs. The use of automated systems will make it possible to comprehensively and quickly analyze the state of information on energy consumption and create the basis for implementing a system of efficient energy management of the building and the country as a whole.

Summing up the above, it can be noted that it is necessary to speed up the adoption of the necessary legislative acts on the adaptation of Directive 2009/28/EC of the European Parliament and of the Council and Directive 2012/27/EC of the European Parliament and of the Council on energy efficiency in Ukraine.

Tasks for independent work

1. Build a scheme of differences between legislative acts and regulations of Ukraine and the EU, determine the advantages and disadvantages of existing energy efficiency systems.

2. Provide recommendations for further improvement and implementation of European energy saving standards in the legislation of Ukraine.

Questions to control knowledge

1. What are the main stages of forming legislation in the field of energy saving in the European Union?

2. Provide a list of the main documents and regulatory acts of energy saving of Ukraine and the EU?

3. What are the main positions of the European Energy Charter?

4. Identify trends and prospects for the implementation of European energy saving standards in the legislation of Ukraine?

5. Provide recommendations on how to adapt the legislation of Ukraine to the legislation of the European Union?

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THEME 3

FUTURE CHALLENGES OF ENERGY EFFICIENCY IN UKRAINE AND THE EU

Energy dependence of EU countries: ways to overcome them. External and internal threats to the energy security of European countries. The current state of the energy balance in the EU. The structure of primary energy consumption in the European Union. Overcoming the challenges of energy strategies of the EU and Ukraine. Trends in changes in Ukraine's energy balance in the context of European integration processes.

In the field of renewable energy and energy efficiency in Ukraine there are more than 250 acts of national legislation: Laws of Ukraine; Decrees of the President of Ukraine; decisions of the Government of Ukraine and other bylaws.

The main laws governing relations in the field of renewable energy and energy efficiency in Ukraine are:

Law of Ukraine «On the electricity market»;

Law of Ukraine «On Alternative Energy Sources»;

Law of Ukraine «On Alternative Fuels»;

Law of Ukraine «On combined heat and power (cogeneration) and use of waste energy potential»;

Law of Ukraine «On Energy Conservation»;

Law of Ukraine «On Amendments to Certain Legislative Acts of Ukraine Concerning the Promotion of Energy Saving Measures»;

Law of Ukraine «On Regulation of Urban Development»;

Law of Ukraine «On the introduction of new investment opportunities, guaranteeing the rights and legitimate interests of business entities for large-scale energy modernization»;

Law of Ukraine № 514-VIII of 04.06.2015 «On Amendments to Certain Laws of Ukraine on Ensuring Competitive Conditions of Electricity Production from Alternative Energy Sources»;

Law of Ukraine № 1713-VIII of November 1, 2016 «On Amendments to Article 8 of the Law of Ukraine“ On Alternative Fuels»;

Law of Ukraine №1959-VIII of 21.03.2017 «On Amendments to the Law of Ukraine» On Heat Supply «to stimulate the production of thermal energy from alternative energy sources»;

Law of Ukraine of 22.06.2017 № 2118-VIII «On energy efficiency of buildings».

However, these acts are not documents of direct action, for their application it is necessary to adopt bylaws of various agencies.

By-laws on the construction and operation of renewable energy plants are carried out by national authorities:

- National Electricity Regulatory Commission of Ukraine;
- Ministry of Energy and Coal Industry of Ukraine;
- Ministry of Ecology and Natural Resources of Ukraine;
- Ministry of Regional Development, Construction and Housing of Ukraine;
- State Agency of Land Resources of Ukraine; and local governments in matters of land use change.

Today in the field of renewable energy and energy efficiency in Ukraine there are also more than 50 national standards of the group "Energy Saving".

Depending on the type of energy from renewable sources and the direction of its use in Ukraine, various schemes of their support are implemented, aimed at stimulating the use of energy from renewable sources.

One of the strategic directions of Ukraine's economic development is energy modernization and energy efficiency.

In the light of the implementation of the Association Agreement with the EU and due to the urgent need for energy security of Ukraine, energy saving has become one of the priority issues for our country. Rational use of energy will allow directing more funds to other sectors of the economy and relieve the population from the heavy burden of disproportionate energy costs.

Energy waste management in Ukraine is a consequence of the lack of a real energy saving policy in the administrative-command economy.

Analysis of various definitions of the "energy saving" concept showed that, in fact, most authors as the main feature of the concept highlight the reduction of energy consumption. However, this feature only partially reflects the essence of energy saving. For example, the reduction in the need for energy resources may be not only the result of their savings, but also a consequence of falling product quality and production volumes.

Measures are energy-saving if the economic effect achieved through them exceeds the costs associated with the additional consumption of energy resources.

Implementation of legal, organizational, scientific, production, technical and economic measures aimed at efficient (rational) use (and economic consumption) of fuel and energy resources and the use of renewable energy sources. Energy conservation is an important task for the conservation of natural resources.

Another important category is "energy efficiency". The difficulty of interpreting this term is its homogeneity with energy saving. In essence, energy efficiency is part of energy saving. Unlike energy saving, which is mainly aimed at reducing energy consumption, energy efficiency is a useful (efficient) use of energy resources. It is advisable to define this category as "characteristics that reflect the ratio of the beneficial effect from the use of energy resources to the cost of energy resources produced in order to obtain such an effect."

Beginning with the sixteenth and nineteenth centuries, when a large number of useful scientific discoveries and inventions were made, industrial relations became much more complicated, and man's influence on nature became systematic and widespread. Nature began to be considered by man no longer as an independent reality, but as a source of raw materials to meet human needs.

In the twentieth century, when the planned scientific and technological progress accelerated several times and grew into a scientific and technological revolution, the anthropogenic impact approached a catastrophic level.

In the economy there is the concept of "energy intensity of GDP". This is the ratio of total energy consumption to GDP.

According to the International Energy Agency (IEA), in 2018 the energy intensity of Ukraine's GDP was three times higher than in Poland.

This means that by producing the same product, a Ukrainian company spends three times more energy than a Polish one.

When Ukrainian producers do not invest in energy efficient technologies, this has at least three negative consequences.

Businesses are becoming uncompetitive. An industry that does not invest in energy efficiency today will not be able to sell its product on world markets tomorrow.

The higher the cost of production, the higher will be the final price of the goods for the buyer. Thus, Ukrainian companies become less competitive in foreign markets, so they lose markets to more efficient producers.

The energy intensity of Ukraine's gross domestic product (GDP) is five times higher than the world average and eight times higher than in developed countries, which is mainly due to excessive resource orientation and poor organization of the economy with some technological lag.

A positive economic and social effect in reducing the energy intensity of GDP occurs only when stimulating the real introduction of energy-saving

technologies. One of the goals of modernizing the economy is to implement the government's plans to increase the efficiency of the economy.

The state has to import energy. High energy intensity of enterprises leads to excessive energy consumption throughout the country. As its own energy production is not enough to meet the country's needs, Ukraine has to import it.

At the end of 2018, Ukraine imported 36% of all energy it needed. In modern geopolitical conditions, dependence on imported energy resources means political and economic danger.

According to the State Statistics Service, industry consumes 32% of the country's energy. At the same time, the industry has a 40 percent potential for energy efficiency. That is, productions could consume 40% less energy per unit of output if they upgraded equipment and took care of energy saving.

Climate change. Nowadays, the world of technology (technosphere) has practically become an independent reality (super-modern technical discoveries that have made human possibilities to influence nature limitless, general computerization), and nature is almost completely subordinated to man.

The main problem (and danger) of modern anthropogenic impact is the mismatch between the limitless needs of mankind and the almost limitless scientific and technical possibilities of influencing nature and the limited possibilities of nature itself. As a result, there is an environmental problem - the problem of protecting the environment from the harmful effects of man.

Depletion of subsoil – throughout its history, and especially in the twentieth century, mankind mercilessly and in unlimited quantities extracted minerals, which led to the depletion (close to catastrophic) of the Earth's internal reserves (eg, energy reserves of oil, coal, natural gas may be exhausted in 80 - 100 years); pollution of the Earth, especially water bodies, atmosphere by industrial waste; destruction of flora and fauna, creating conditions under which technical development (roads, factories, power plants, etc.) disrupts the usual

way of life of plants and animals, changes the natural balance of flora and fauna; use of nuclear energy for both military and peaceful purposes, ground and underground nuclear explosions.

Greenhouse gas emissions from the combustion of gas, coal and other fossil fuels are warming the planet. The introduction of efficient clean technologies in production will reduce energy consumption, which reduces CO2 emissions and counteracts climate change.

Unlike the household and budget sectors, the industry does not have any systemic program to support energy efficiency by the state. And what should it look like? Let's see what European countries are doing.

Which tools operate in the EU. In EU countries, the state financially stimulates industry to save energy in two ways. The first is the energy efficiency commitment scheme. The second - support programs: grants, reduced interest rates on loans for energy efficiency measures, tax benefits.

In the first case, the state obliges energy supply companies to achieve a certain level of energy savings from their consumers, including industrial enterprises, through the implementation of energy efficiency measures.

Each country sets its own targets for energy savings, but usually the savings are 0.5-5% of total energy consumption per year.

Energy companies report annually to the state on how they have met these commitments. If the savings plan is not implemented - companies pay a penalty. Its size depends on how much energy they could not save.

This is how energy supply companies reduce energy consumption: they introduce energy efficiency measures themselves, reward consumers for the implementation of such measures, and introduce a system of "white certificates".

Such certificates are issued to those who have achieved a certain amount of energy savings. For example, one certificate is a ton of oil equivalent of energy savings.

If the company has implemented measures, it receives a certificate for the achieved savings and can sell it to the energy supply company directly or on the stock exchange. This stimulates energy savings and reduces its use.

Ensuring energy savings through an EU commitment scheme is regulated by law. It defines the administrator, the responsibilities of energy supply organizations, cost-saving methods, and the government's monitoring and reporting system.

Funds for "white certificates" and the implementation of measures are accumulated due to the investment component in the energy tariff. This is an additional 1.5 - 2% to the tariff. There is a debate that the scheme is dishonest: everyone pays, but not everyone spends. However, every consumer has access to it. Over the years, it has proven to be over-effective.

How this works can be seen in the examples of European countries. So Italy started implementing a commitment scheme in 2001. In 2004, the tool began working. At the initial stage, the scheme operated mainly in the household sector. The share of the industrial sector began to grow in 2009 with a further strong acceleration in 2012.

The not very active participation of industry in the first stage was explained by the fact that the administrative procedures of the scheme were difficult for the industry and time consuming. As a result, in 15 years, 60-70% of the total reduction in energy consumption in the country has been made possible by an industry commitment scheme. Today, this is the main way to stimulate energy savings in the country.

France has two main instruments that stimulate energy savings: an energy efficiency commitment scheme and eco-energy credit.

The commitment scheme in France was introduced in 2005 and formed over 15 years in four stages. Each time we improved the procedure and set stricter requirements for the amount of savings for consumers.

Thus, the liabilities for savings in the fourth stage (2018 - 2020) have tripled compared to the first and second stages (2006-2014).

At present, the commitment scheme in France is a central element of government policy on energy efficiency in consumers. 23% of savings there have been achieved due to the industrial sector.

An eco-energy loan is a loan for small and medium-sized enterprises without collateral at a reduced rate, which must be repaid within five years. Funds are spent on energy efficient equipment. The program has been operating since 2010.

Germany has been implementing energy efficiency programs since 1994. During this time, some of them ended and transformed.

In 2020, the program "Guidelines for Federal Financing of Energy Efficiency in Business - Grants and Credits" was launched. This is the result of the reorganization of several previous programs, which the state has simplified and merged.

The program to support energy efficiency of enterprises in Germany is implemented through two institutions. Low-interest loans are provided by the State Development Bank (KfW) and investment grants are provided by the Federal Office for Economic Affairs and Export Control (BAFA).

In Poland, there is the National Fund for Environmental Protection and Water Management (NFOŚiGW). He has introduced a number of programs to support innovation. They contribute to a resource-efficient and low-carbon economy, including in the industrial sector.

The fund offers loans, subsidies and other forms of co-financing of projects.

In 2011, the Energy Efficiency Law was passed, introducing an energy efficiency commitment scheme. The system started operating in 2013, but at first the procedures were too complicated. In 2016, they were simplified.

Austria's energy efficiency commitment scheme was introduced in 2011. She started working in 2015.

The country also has an environmental funding program, Umweltförderung im Inland, introduced by the Environmental Subsidies Act in 1993.

The environmental support program is one of the most important subsidies for Austrian companies with a focus on climate protection, energy saving, renewable energy sources and the prevention of air pollution. The subsidy consists of a grant that covers up to 30% of investment costs.

Based on the results, it can be concluded that EU countries have accumulated significant experience in implementing energy efficiency measures. They typically start with simple government programs to provide investment grants and low-interest loans.

As knowledge, experience, data, and institutional capacity accumulate, countries move to more sophisticated tools, such as commitment schemes, including trade in "white certificates."

Ukraine is one of the most energy-intensive countries in the world and one of the few countries in Europe where there is no state support for energy efficiency in industry.

10 key sectors of Ukraine's economy:

1. Construction;
2. Agriculture;
3. Industry;
4. Power supply;
5. Fishing;
6. Forestry;
7. Tourism;
8. Transport;
9. Waste management;

10. Water resources management.

Sectoral zones of energy vulnerability of Ukraine:

- coal sector: unprofitable production, technological backwardness, partial destruction of mines and infrastructure, regressive development (digging);

- hydrocarbon sector: dependence on Russia, wear and tear of pipeline systems, dominant influences of oligarchic groups, loss of part of hydrocarbon reserves assets and production prospects (Black Sea shelf), lack of market environment, incl. economically sound network tariffs and market-oriented pricing for energy resources that do not reflect costs, lack of adequate political and financial independence of the national regulator;

- the electricity sector as a whole: outdated, inefficient infrastructure, high market concentration (monopoly) together with a non-transparent system of cross-subsidization and lack of platforms for competitive forms of trade, relatively low regulated prices that do not create any real price signals and incentives for investment, insufficient regulatory framework, high energy consumption and low energy efficiency;

- nuclear energy: fuel and technological dependence on Russia, understated electricity tariffs, subsidies for private heat, the need to decommission part of the generating capacity;

- thermal power: depreciation of fixed assets, dominant influences of certain oligarchic groups, partial destruction of generation facilities and infrastructure;

- RES energy: loss of part of wind and solar energy assets in Crimea, unbalanced development, lack of shunting capacity, inflated tariffs.

Opacity and high levels of corruption remain common problems for the energy sectors.

The financial and economic crisis has become a catalyst for developed countries to develop the latest green technologies, especially energy. They are

considered as a prerequisite for energy independence of countries, development of modern infrastructure, reduction of ecosystem degradation.

Strategic documents of all developed countries also provide for the expansion of investment in the development and development of green technologies.

The challenges of climate change and the limited resources of fossil fuels are forcing the world to make increasing efforts to develop alternative energy sources.

Energy waste leads to the loss of competitive positions in world markets, falling industrial production, job losses, dependence on energy imports, environmental pollution, and greenhouse gas emissions.

Ukraine is one of the most polluted and environmentally problematic countries - the level of load on the environment is 4-5 times higher than in other countries.

In terms of environmental pollution and degradation, Ukraine ranks one of the first places in post-Soviet society - with a share of the state - 2.7%, emissions of harmful substances into the atmosphere reach - 18%, discharge of wastewater into surface water - 12%, annual waste storage - 19% of the all-Union indicators in the recent past.

The answer to all these challenges is one: a consistent government policy to support energy efficiency in industry.

To increase energy efficiency, Ukraine must go at the level of the EU, but catching up with the lost, act effectively and decisively.

According to the Global Competitiveness Report of the World Economic Forum in Davos, Ukraine in 2010-2011 ranked 83rd among 139 surveyed countries in terms of new technologies, and only 100th in terms of business development. The classification of the economy is brown.

Today, Ukraine is implementing certain reforms in the field of energy efficiency, the main purpose of which is to replace the consumption of imported gas.

Exit from the global economic crisis: replacement of the brown economy with a green economy, which leads to an improvement in the quality of human life and does not destroy the natural foundations of life itself.

A green economy is an economy that increases people's well-being and strengthens social justice while significantly reducing risks to the environment and the scarcity of environmental resources.

Barriers to the development of energy efficiency in Ukraine:

- information: lack of sufficient information and understanding on the part of consumers to decide on the rational use and amount of investment;

– regulatory and institutional: energy tariffs do not stimulate investment in energy saving and energy efficiency; the incentive structure encourages energy companies to sell electricity rather than invest in cost-effective energy efficiency; institutional bias towards supply-side investments;

– technical: lack of available energy efficiency technologies, acceptable to local conditions; insufficient capacity to identify, develop, implement and support investments in energy efficiency.

Despite financial difficulties, the EU is trying to meet its commitments to the transition to a low-carbon economy by developing policies and measures to implement it, including: adhering to the 20/20/20 ambitious 20% reduction targets, 20% share of renewable energy sources in energy consumption by 2020 and a 20% increase in energy efficiency by 2020; pricing of emissions through quota trading; tax incentives; creation of a single internal energy market; conducting a coordinated international energy policy. European experts are developing forecasts for the possibility of the EU's transition by 2050 to almost full supply of its energy needs with alternative energy sources. To achieve these

goals, the EU needs to spend € 67.5-80.5 billion on research and innovation over the next 10 years.

EU energy policy is aimed at increasing investment in the development of renewable energy sources and the implementation of energy saving and energy efficiency measures. Priority is given to: investment in wind, solar, hydro and geothermal energy; finding an effective alternative to traditional motor fuel; introduction of strict standards of fuel consumption in transport; "Safe and responsible" development of nuclear energy; introduction of "clean" coal technologies, as well as increasing the innovative component of fuel and energy development.

Energy saving and increasing energy efficiency can have a positive impact on the economy as a whole - including the improvement of the technological base of industrial enterprises with further improvement of the quality of products; market competitiveness of domestic enterprises in the world market; increasing the innovative potential of industrial enterprises and, ultimately, the growth of gross domestic product and improving living standards.

Questions to control knowledge

1. What is the difference between energy saving and energy efficiency?
2. Name the existing steps towards energy efficiency?
3. What is energy efficient consciousness?
4. What is the aimed of EU energy policy?

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THEME 4

FORMATION AND IMPLEMENTATION OF ENERGY EFFICIENCY POTENTIAL IN UKRAINE AND EU COUNTRIES

European practice of managing the potential of energy efficient economy. The impact of technological and structural energy saving on the overall potential of energy efficiency in Ukraine. Technological energy saving: modernization, replacement of energy-intensive technologies, reduction of energy consumption. Formation of structural energy saving: changes to create an energy efficient economy.

The development of the national economy of Ukraine takes place in a difficult period, which is primarily characterized by rising prices for fuel and energy resources, so the issue of gaining the domestic economy if not energy autonomy, then at least diversification of suppliers. To ensure a worthy place in the world community, Ukraine needs scientifically sound development and purposeful implementation of policies to protect its interests in the field of energy efficiency and energy security.

Modern effective energy policy is impossible without taking into account the factors of energy security and its component, such as energy independence. One of the main directions of energy policy in the country is the formation and further observance of the fuel and energy balance (FEB). Among the factors that must be taken into account when determining the balance, of course, should take place and ensure energy independence. It is also clear that research aimed at developing a development strategy cannot be effective without taking into account current global trends and current challenges.

The fuel and energy balance of the state is a system of indicators that characterizes the available fuel and energy resources in the country and their

use. Consider different types of FEB. In the traditional sense, it is considered as the ratio between energy production (production) and consumption of different types of energy resources.

Energy security of the state is the state of readiness of the fuel and energy complex (FEC) of the country for the most reliable, technically safe, environmentally friendly, cost-effective and reasonably sufficient energy supply of the state economy and the population, as well as for guaranteed interests in the field of energy without external and internal pressure.

The energy independence of the state is determined by the level of independence of the state leadership in the formation and implementation of policies that are independent of external and internal interference and pressure emanating from the sphere of FEC activity. The problem of achieving energy independence is an urgent task of energy policy not only for countries with economies in transition, which include Ukraine, but also for many countries, including the EU, the United States and others. It should be noted that for most of these countries the need for such a policy was initiated by the oil crises of the late 70s of the twentieth century, when dependence on a single oil supplier (Middle East) and political conflicts led to a significant economic crisis in these countries. In the current situation, there have been significant changes in energy policy in the industrialized countries of the world.

Among the main directions of energy efficiency policy are the following:

- search and implementation of ways to diversify external supplies;
- comprehensive support of own production and production of energy even in cases of its non-competitiveness in normal conditions;
- creation of strategic reserves of main fuel and energy resources (FER);
- development and implementation of programs for the development of energy efficient technologies;
- use of the latest energy sources.

It is clear that each country has its own FEB, which is formed by the need to meet domestic demand for energy resources, and available in the country's energy resources. The economic development of the world involves the growth of needs for fuel and energy resources. At the same time, there is not only an overall increase in electricity needs, but also some changes in the composition of the required energy resources.

Yes, if the beginning of the twentieth century. could be called the age of coal, then in the middle of the century comes to the fore oil. The end of the twentieth century. and the beginning of the XXI century, despite the dominance of oil, is already called the age of gas (the growth rate of its consumption significantly exceeds the growth rate of consumption of other energy resources). Nuclear, thermonuclear or hydrogen fuels and the latest renewable energy sources (RES) are projected to be the dominant types of energy resources for the longer term. Thus, technical progress largely determines the development of the country's energy sector.

The general balance of used energy resources in the world over the last hundred years and according to the forecast until 2030 is given in table. 4.1.

Table 4.1– Structure of modern and forecast world consumption of primary electricity sources

Year	Total million tones	Including, %				
		coal	oil	Gas	HPP	NPP
1900	700	94,4	3,8	1,4	0,4	-
1950	2536	60,5	26,5	9,6	3,4	-
1970	7038	34,4	41,7	19,4	4,2	0,3
1980	8910	29,5	43	20,6	5	1,9
1990	11085	28,9	36,8	24	5,4	4,9
2000	12417	29,6	34,1	26,5	5,2	4,6
2010	17300	22,3	35,3	23,1	6,2	2,3
2030	23300	22,1	35,4	25,8	4,3	2,2

To analyze the principles of construction of FEB of Ukraine taking into account the factors of energy independence, an interesting example is the construction of FEB in countries with small reserves of energy resources. Thus, gas and coal reserves in countries such as France and Japan are much lower than the world, which is reflected not only in low levels of energy production, but also in the low share of these fuels in FEB of these countries (respectively 14.4% and 12.7% for gas and 5.8% and 15.2% for coal) (Table 4.2).

Table 4.2 – The structure of the use of major energy resources in the world

Country	Used types of fuel,%						
	Oil	Gas	Coal	NPP	HPP	NRES	Others
Canada	30,4	25,3	11,7	5,5	24,8	0,5	1,8
USA	40,7	23,6	23,3	7,8	3,1	1	0,5
Germany	39,8	21,2	23,2	10,8	1,3	1	2,6
Italy	48,5	30,5	5,7	-	5,8	1,5	8
France	39	14,4	5,8	30,2	5,8	0,2	4,5
Great Britain	34,2	34,9	15,7	11,5	0,6	0,9	2,2
Poland	20,9	11,4	66,4	-	1	0,3	0
Russia	18,3	54,9	15,4	3,8	5,8	0	1,8
Ukraine	**11,8**	**43,7**	**28,8**	**11,7**	**2,4**	**-**	**1,6**
China	22,9	2,6	67,3	0,4	5,5	-	1,3
India	32,7	7,6	51,2	1	6,3	0,1	1,2
Japan	50,5	12,7	15,2	13,5	3,8	1,2	3
The whole world	**38,8**	**23**	**22,3**	**6,6**	**7,2**	**1,5**	**0,6**

The next direction of FEB formation is to increase the efficiency of production, transportation and consumption of energy resources. The level of

energy use in Ukraine does not correspond to the world, as evidenced by the comparative characteristics of such an indicator of energy efficiency as energy intensity of GDP (Table 4.3).

Table 4.3 – Indicators of energy efficiency in the world

Country	GDP (PKS), $ billion (95)	Fuel consumption, million tons	Energy intensity of GDP *, tons/$ 1000
World	**41753,21**	**10109,59**	**0,24**
Great Britain	1263,39	232,64	0,18
Denmark	137,17	19,46	0,14
France	1356,48	257,13	0,19
Germany	1910,12	339,64	0,18
Italy	1265,97	171,57	0,14
Norway	118,09	25,62	0,22
Spain	719,11	124,88	0,17
Sweden	203,8	47,48	0,23
OECD countries	24624,05	5316,93	0,22
Poland	348,35	89,98	0,26
Russia	1111,48	613,97	0,55
USA	8986,9	2299,67	0,26
Ukraine	**174,64**	**139,59**	**0,8**

The country's current needs in energy resources are quite significant, which requires large-scale efforts of the state to meet them. The state increases its own production and provides significant volumes of imports of major energy resources. Due to limited opportunities for a significant increase in domestic production, which is typical for Ukraine in the main fuels (oil and gas), the required level of consumption is met mainly by increasing their imports, which determines a significant level of energy dependence on energy suppliers.

The high level of energy consumption of energy resources affects not only the level of its energy dependence, but also the competitiveness of the national economy. The fuel and energy component of the cost of domestic goods is 10-80% of their cost, which is several times higher than in developed countries in Europe and the United States, and at fairly high world and domestic prices for most energy resources, it significantly reduces the profitability of all national production. at a low level of domestic GDP.

Guidelines for energy use in Ukraine are defined in the "Energy Strategy of Ukraine for the period up to 2030 and beyond" (EU-2030).

The analysis of the given data on the use of the main energy resources in the EU and the world allowed to identify the following characteristics.

First, in all economically developed countries of the world there is a significant share of oil use. This is primarily due to the significant use of oil and petroleum products in transport, the level of development of which directly depends on the general economic condition of the country.

Secondly, the structure consumes three or more almost equivalent types of energy resources.

Third, it is possible to meet its own needs in energy resources not by increasing oil and gas imports, but by expanding the use of other resources.

Fourth, the latest sources of electricity can not yet compete with traditional energy resources, as the level of their use is insignificant, which is not the case with electricity from NPPs and HPPs. But the current trends and forecasts indicate a gradual increase in the use of NRES.

In the absence of relatively large reserves of energy resources, countries have the opportunity to use such sources of electricity as nuclear or thermonuclear, the latest renewable energy sources (RES), hydropower, and so on. An illustrative example is the FEB of Canada. With significant reserves of basic energy sources (oil, gas and coal), Canada has one of the world's largest levels of use of such a source of electricity as hydropower (24.8%), which

allows the country not only to meet its own needs in energy resources, but also to export them, which is a significant contribution to ensuring the country's energy independence.

The analysis shows that the current FEB of Ukraine does not correspond to the existing reserves in the country of energy resources and global trends in energy use. Thus, in the balance of energy use, the main place among energy resources is occupied by gas (44%) with the world average level of its use 23%. Conversely, the use of coal in FEB is only 28.8%, which is slightly higher than the global figure (22.3%), although its reserves per capita are several times higher than the world average.

The assessment of the current FEB of Ukraine shows that, despite some positive changes in the direction of compliance with global trends and requirements for energy independence and security, the unrealized potential still remains significant.

It is clear that the levels of own production and use of the main energy resources defined in the EU-2030 are reasonable and realistic. At the same time, the tasks of European integration, which primarily involve the achievement of high world standards of development (including the energy sector), require more decisive and powerful steps to achieve them. It should be noted that the solution of such problems is real, because this path is justified in time and passed by many countries around the world.

To achieve a world-class energy policy in relation to the formation of FEB must take into account the following factors to ensure energy independence:

- achieving world-class efficiency of energy production, transportation and consumption; significant decrease in the share of gas and increase in the share of coal and oil in the country's FEB;

- the need to find and widely implement additional opportunities for energy production of renewable energy sources, hydroelectric power plants,

nuclear power plants, etc .;

- ensuring an acceptable level of diversification of necessary imports of energy resources;

- diversification of consumed energy resources, prevention of the situation of using a certain type of energy resources;

- identification of the main directions and active implementation of the general demand management policy.

The most authoritative organization in shaping world energy efficiency policy is the International Energy Agency (IEA). Interaction with the IEA, without a doubt, creates favorable conditions for the use of international experience in improving energy and environmental efficiency in the country. It should be noted that the IEA is an independent institution that implements a comprehensive program of energy cooperation of twenty-nine member countries of the Organization for Economic Cooperation and Development. The organization includes most countries of the European Union, USA, Canada, Australia, Japan, Korea.

The IEA focuses on four main areas (4E):

1) Energy security: encouraging diversification, efficiency and flexibility in all energy sectors;

2) Economic development: ensuring stable energy supplies to IEA member countries and encouraging free markets to stimulate economic growth and eliminate energy poverty;

3) Environmental awareness: expanding international understanding of possible solutions to climate change;

4) Engagement worldwide: working closely with non-IEA countries, especially the largest producers and consumers, to find solutions to common energy and environmental problems

The IEA proposed a number of energy efficiency policies to G7 summits. The consolidated set of recommendations covers 25 areas of activity in seven

priority areas and includes: intersectoral activities; buildings; home appliances; lighting; transport; industry; power supply systems.

Thus, the recommendations of the IEA on the implementation of policies in the field of energy efficiency are divided into groups:

- cross-sectoral policy measures: measures to stimulate investment in energy efficiency; national energy efficiency targets and strategies; compliance, implementation, control and evaluation of energy efficiency measures; energy efficiency indicators; monitoring and reporting on progress in accordance with the IEA recommendations on energy efficiency;

- buildings: building codes and regulations for new buildings; passive houses and zero energy houses; a package of policy measures aimed at improving energy efficiency in existing buildings; building certification schemes; increasing the energy efficiency of translucent structures;

– household appliances and equipment: mandatory requirements for energy performance characteristics of goods and equipment and their labeling; models of low-power electronic and network equipment, including models with standby mode; TVs, DVD players, receivers and other TV and video equipment for home use; energy standards of industrial tests and measurement protocols;

- lighting: gradual decommissioning of incandescent lamps and transition to lighting in accordance with the requirements of best practices in this field; providing low-cost lighting in non-residential buildings and gradually reducing inefficient lighting;

– transport: efficient tires; mandatory fuel efficiency standards for light trucks; fuel economy by heavy trucks; eco-management;

- industry: collection of reliable data and information on energy efficiency in industry; energy characteristics of electric motors; assistance in the development of energy management capabilities; a package of measures aimed at improving energy efficiency in small and medium enterprises;

- utilities: schemes to increase energy efficiency of final energy consumption in the field of utilities.

According to the Energy Strategy of Ukraine until 2030, the energy saving factor was named one of the determinants for the efficient functioning of the national economy. The Strategy assessed the overall energy saving potential due to technical (technological) and structural factors. The technical factor reflects the impact of technical (technological) condition and level of equipment and facilities on the consumption of energy resources in the production of products (services). The structural factor reflects the impact of structural changes in sectoral or intersectoral activities on fuel and energy consumption. In turn, structural and technical (technological) factors depend on intersectoral and intra-industry shifts in the country's economy.

The goals of increasing the use of energy efficiency potential are:

✓ creating conditions for constant and high-quality satisfaction of demand for energy products;

✓ identifying ways and creating conditions for safe, reliable and sustainable operation of energy and its most efficient development;

✓ ensuring energy security of the state;

✓ reduction of technogenic load on the environment and provision of civil protection in the field of technogenic safety of fuel and energy complex;

✓ reduction of unit costs in production and use

✓ energy products due to their rational consumption, introduction of energy-saving technologies and equipment, rationalization of the structure of social production and reduction of the share of energy-intensive technologies;

✓ integration of the United Energy System of Ukraine into the European energy system with a consistent increase in electricity exports, strengthening Ukraine's position as a transit state for oil and gas.

✓ The main directions of increasing the use of energy efficiency potential are:

✓ Formation of an integrated and effective system of management and regulation in the fuel and energy sector, the development of competitive relations in energy markets.

✓ Diversification of external sources of energy supply, as well as diversification of routes for their transportation.

✓ Development of domestic energy engineering, instrument making and energy complex as prerequisites for competitiveness of Ukrainian enterprises in energy projects, including abroad.

✓ Development of energy export potential, mainly due to electricity, through modernization and renewal of generating capacities, power transmission lines, including interstate ones.

✓ Optimization of production of own energy resources taking into account their offers in foreign markets, price and geopolitical situation, increase of volumes of energy and energy products extracted from non-traditional and renewable energy sources.

✓ Creation of a unified state system of statistics, strategic planning, monitoring of production and consumption of energy products, formation of balances of their supply and demand.

✓ The overall energy saving potential is influenced by technical (technological) and structural factors:

✓ The technical factor reflects the impact of technical (technological) condition and level of equipment and facilities on the consumption of energy resources in the production of products (services)

✓ The structural factor reflects the impact of structural changes in sectoral or intersectoral activities on fuel and energy consumption.

In turn, structural and technical (technological) factors depend on intersectoral and intra-industry shifts in the country's economy.

According to the baseline scenario of economic development and its spheres, the energy saving potential will amount to 318.36 million tons of pts, including:

- industry technical (technological) factor - 175.93 million tons;
- intersectoral technical (technological) factor - 22.13 million tons;
- industry structural factor - 61.65 million tons;
- intersectoral structural factor - 58.65 million tons

According to the analysis, the advantages and disadvantages of Ukraine's positioning in international energy markets are identified

The main disadvantages include:

• limited in own explored resources of natural gas, oil, as well as nuclear fuel of own production;

• lack of diversification of energy supply sources;

• use of the majority of capacities of own hydro resources;

• high man-caused load on the environment;

• unsatisfactory technical condition of some energy facilities, including systems for transportation of energy products.

The advantages are:

• sufficient reserves of coal and nuclear fuel components: uranium and zirconium;

• excess capacity for gas, oil and electricity exports;

• favorable geographical and geopolitical position;

• developed energy infrastructure;

• highly professional human resources.

From the point of view of global energy processes, the favorable geopolitical and geographical position of Ukraine and its related role as a transit state should be taken into account.

The integration of the Ukrainian energy system into the European one is a component of Ukraine's strategic goal of joining the EU. Unlike the countries of

the new wave of EU enlargement, Ukraine has a sufficiently strong and developed gas, oil, transport and electricity networks, combined with the EU transport networks, which allows it to participate in shaping the European energy policy and common energy market, play an important role in energy cooperation. EU countries.

Projects for the participation of Ukrainian companies in the production of hydrocarbons in other countries (Kazakhstan, Turkmenistan, Libya, Iran, Iraq, etc.) and in the construction of power plants and power grids (Vietnam, Cuba) have been launched.

The implementation of the Energy Strategy should ensure the transformation of Ukraine into an influential and active participant in international relations in the field of energy, in particular through participation in international and interstate entities and energy projects. To do this, the government must create conditions for the activities of relevant entities in the following areas: import-export of energy products; realization and development of transit potential; participation in the development of energy resources and construction of energy facilities outside Ukraine, etc.

High energy consumption in various industries is due to the use of old technologies and equipment, the service life of which is often measured in decades, the reluctance of business owners to finance modernization, the irrational use of energy resources in enterprises. Metallurgy began to abandon the consumption of gas in blast furnaces and introduce pulverized coal injection plants, to switch from smelting steel in open-hearth furnaces in favor of converter production with the simultaneous use of continuous casting machines, to replace energy-intensive oxygen units with new generation air separation units.

Gradual modernization took place in other industries as well, but its pace was insufficient. Thus, the energy efficiency of the chemical industry was 51% of the European average, mechanical engineering - 22%. The housing and

communal services sector remains a "black hole" in the use of primary energy resources: losses in district heating systems reach 60%. In Ukraine, the production of a unit of goods and services (ie per unit of GDP) is twice the world average, and the EU average is 3.8 times.

Now Ukraine has a chance to really improve the energy efficiency of the economy through cooperation with the EU.

Procrastination with an effective solution to this problem will slow down economic growth, reduce the competitiveness of industry and investment attractiveness of the country, increase the level of environmental pollution, as well as create additional threats to the country's energy security.

Tasks for independent work

1. Develop FEB of Ukraine taking into account the peculiarities of the EU, the world and Ukraine.

2. Identify barriers to the growth of energy efficiency potential in Ukraine.

Questions to control knowledge

1. Features of the formation of FEB of the EU and Ukraine: a comparative analysis.

2. Goals of the Energy Strategy of Ukraine - 2030.

3. Factors influencing the energy efficiency potential of Ukraine.

4. Key areas for growth of energy efficiency potential of priority industries of Ukraine.

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THEME 5

ORGANIZATIONAL, TECHNICAL AND TECHNOLOGICAL COMPONENTS OF ENERGY SAVING: CONTEMPORARY EUROPEAN PRACTICE

European practice of introducing modern energy-and resource-saving materials, structures, devices and equipment. Rational planning of energy consumption by improving technologies in the EU countries. Analysis of the European energy management system: energy audit and energy control. Expertise of energy saving and energy certification in the EU countries.

Energy saving is the implementation of legal, organizational, scientific, production, technical and economic measures aimed at efficient (rational) use of fuel and energy resources and the use of renewable energy sources.

Energy conservation is the important task for the conservation of Natural Resources. Recently, a new term "energy conservation"has appeared.

Energy conservation is the reducing energy consumption by using fewer energy services.

In general, energy-saving technologies can minimize unnecessary energy losses, which today is one of the priority areas not only at the state level, but also at the level of each individual family. This is due to the shortage of basic energy resources, the growing cost of their extraction, as well as global environmental problems. The introduction of energy - saving technologies in the economic activities of both enterprises and individuals at the domestic level is one of the important steps in solving many environmental problems-climate change, atmospheric pollution, depletion of mineral resources, and others.

The general classification of modern energy-saving technologies is shown in Fig. 5.1.

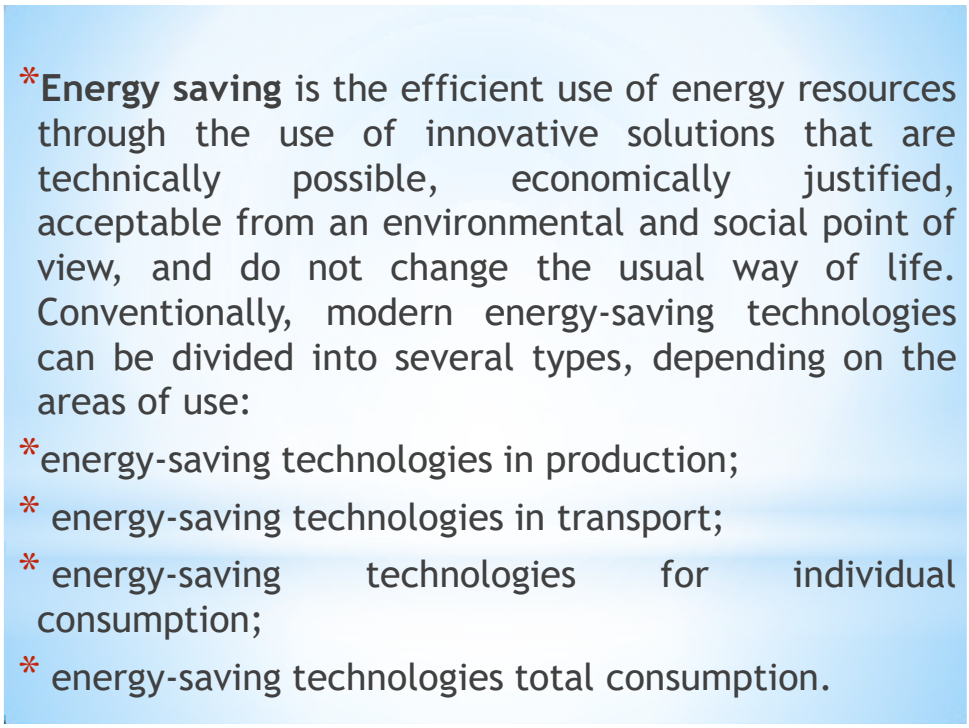
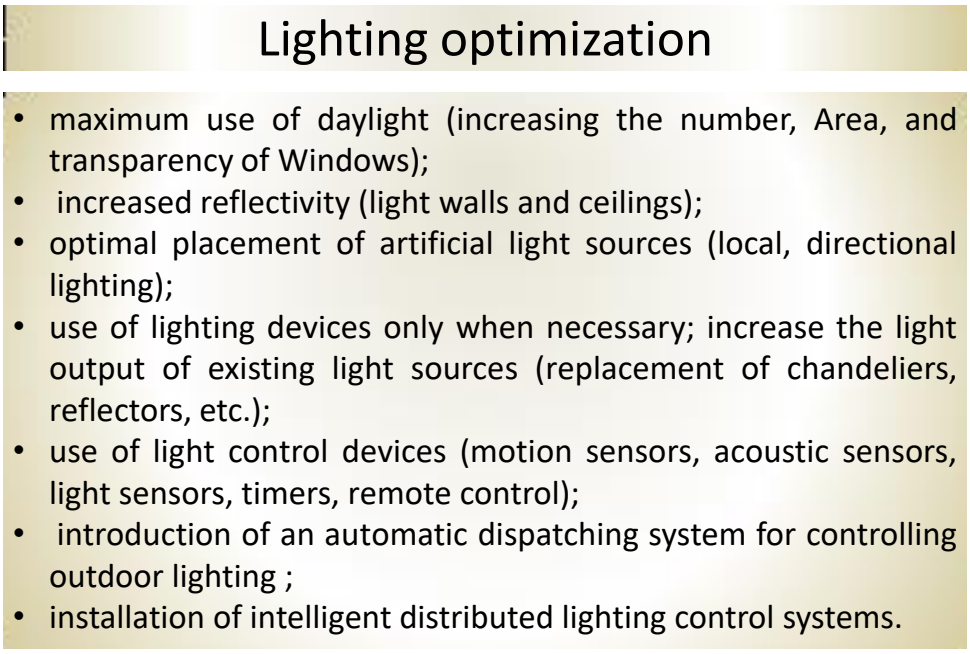


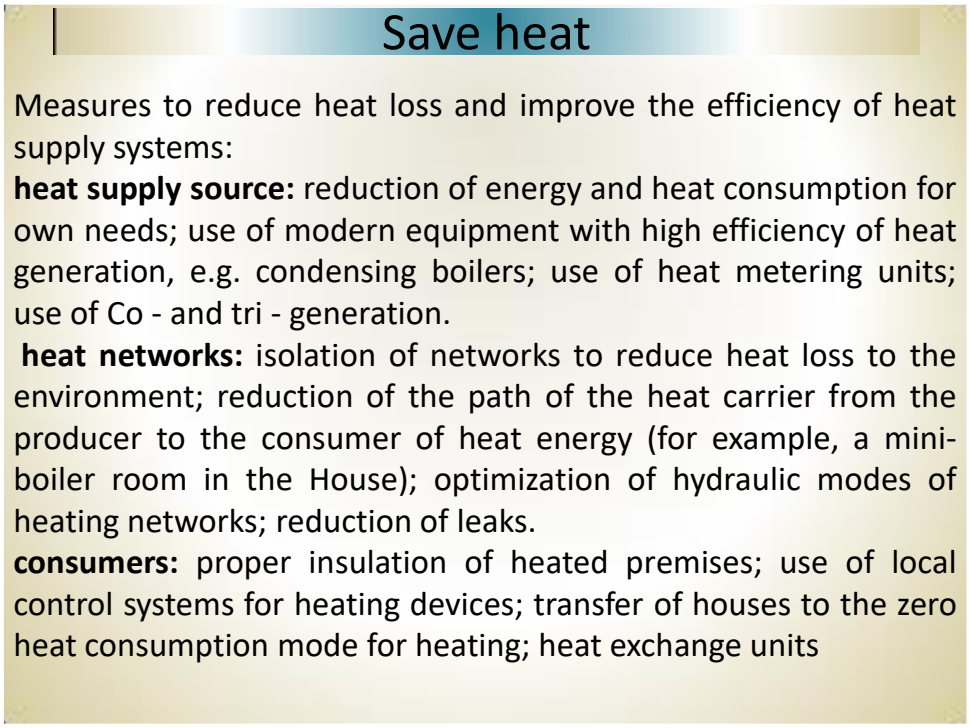
Figure 5.1 – General classification of modern energy-saving technologies

We will consider in detail the European practice of introducing modern energy-and resource-saving materials, structures, devices and equipment, as well as rational planning of energy consumption by improving technologies in the EU countries and Ukraine in separate divisions: lighting optimization, heat saving, water saving, gas saving (fig. 5.2).

a)



b)



c)

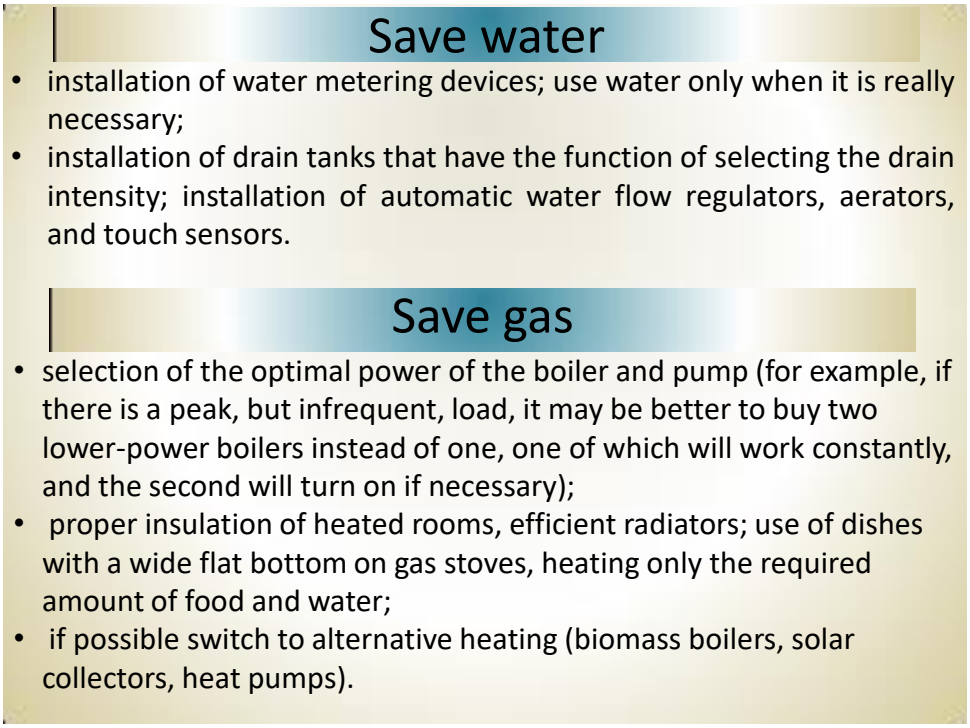


Figure 5.2 – Rational planning of energy consumption by improving technologies in the EU and Ukraine by separate divisions: a) optimization of lighting; b) saving heat; c) saving water and saving gas

Let's consider the existing energy-saving technologies in the EU countries that are being successfully implemented in the energy-efficient market of Ukraine:

- LED lamps;
- Solar panels;
- Solar collectors for hot water supply and heating;
- Heat pumps;
- Foam glass-insulation of a new generation;
- Foam concrete houses;
- Smart homes;
- Heat recovery;
- Maximum use of solar heat and daylight;
- Heat-efficient double-glazed windows (three-layer).

To achieve the desired results in the field of energy saving, it is not enough just to implement the above measures, but also to systematically manage energy consumption, the main task of which is to reduce energy costs with the necessary quantity and quality. For this purpose, in European practice, an energy management system is created at any industrial or commercial facility, the main purpose of which is to systematically, purposefully increase the energy efficiency of management while simultaneously rational use of all other resources.

The development and formulation of Energy Management in Ukraine has been going on for more than a decade and a half. However, today there is still no definitive generally accepted understanding of energy management as a science, as a type of activity, as well as as one of the specific functions of management.

Energy management is an activity aimed at ensuring the rational use of fuel and energy resources and is based on obtaining energy information through

accounting, conducting an energy audit, monitoring and analyzing the efficiency of energy use and implementing energy-saving measures.

Energy management is a methodological science with a practical tool for such needs:

1) implementation of the process of managing the use of energy, namely – the purpose, planning, organization of actions, coordination, accounting and control for the optimal (most rational) use of all types and forms of energy in the case of expedient meeting the needs of the organization and minimal negative impact on the environment, in the conditions of the best use of the resource potential of the energy use object;

2) management of personnel engaged in energy use management to achieve high energy efficiency, based on the material and financial resources of the organization. However, it should be noted that these definitions do not reflect the economic aspect of energy management. In a market economy, the main goal of energy management should be to make a profit through the rational and efficient use of fuel and energy resources for the production of a unit of production, the provision of services or the performance of works. Therefore, energy management is a type of activity, the content of which is to purposefully influence the employees of the organization in order to coordinate their actions to achieve one of the goals set for the organization – to increase profits by increasing the efficiency of using fuel and energy resources while reducing the cost of output. At the same time, the goal of energy management is to increase the efficiency of the organization's use of fuel and energy resources while increasing the organization's profit.

The term "energy management", depending on the scope of its application, can have a number of semantic loads. This concept generally includes an integral approach within the framework of a dedicated energy (production) system, which allows us to distinguish the following stages: planning, production (generation), transmission (transformation), accumulation,

distribution and use of energy carriers. On the one hand, the development of intelligent energy systems according to the Smart Grid concept led to the development of the concept of energy management and the formation of energy management systems from the point of view of optimal management of energy processes in intelligent networks and systems.

The following areas of development of energy management systems are used here: HEMS – energy management systems in buildings, IPMS – energy management systems for industry, PMS – energy management systems in the electric power industry, EMCS – management systems for energy management systems, EMPS – software tools for energy management systems, etc. Organizational and methodological foundations for creating an energy monitoring system at an enterprise, as a rule, include the organization of a controlling Service, determining its place in the organizational structure of the enterprise, analyzing information flows and possible options for implementing controlling at the enterprise. For effective operation and a clear definition of the responsibility of the energy monitoring system at the enterprise, it is necessary to create a special structural division – the controlling service.

The energy audit and energy control service summarizes the work of the accounting department, Finance Department, planning and economic department, departments of the chief engineer, and chief Power engineer. Since the main function of energy monitoring at the enterprise is to analyze and manage costs and profits, form and use energy reserves, the controlling service should be able to receive all the necessary information and turn it into recommendations for making managerial decisions by senior managers of the enterprise.

When organizing an energy monitoring service at an enterprise in order to improve its energy efficiency, the following prerequisites must be taken into account:: - it is necessary to strive for visually simple structures (use a linear, linear-functional, but not a matrix structure); - goal alignment, goal

management, and goal achievement are coordinated only at the first level of management; - methods of managing the energy efficiency of the enterprise's activities within the framework of the overall, main strategy, become effective only when the controller manages to coordinate them between the responsibility centers; - the controller needs to obtain information about economic relationships and reserves, their use and savings; - the controlling service is independent, independent and neutral in relation to management levels.

The implementation of the controlling and energy audit system at the enterprise should take place in three directions: the preparatory stage; the stage of implementing controlling; and the stage of automation. In turn, the second stage consists of the following four stages: changes in the management system; changes in the organizational structure; information flows in the enterprise system; changes in the enterprise culture. Changes in the process of energy saving management of the enterprise during the implementation of the controlling system are carried out in the following areas:

- introduction of responsibility centers based on the principles of functionality, territoriality, compliance with the organizational structure and cost structure;

- distribution of financial responsibility centers to optimize planning (budgeting), accounting and control of the company's activities. Management of the implementation of energy-efficient technologies in the controlling system at the enterprise should be an independent subsystem containing a set of specific tools, rules, structural bodies, information and processes aimed at preparing and ensuring the implementation of plans for the implementation of energy-efficient measures. When managing the implementation of energy-efficient technologies at the enterprise, it is necessary to make a reasonable choice of the main directions of energy saving at the enterprise as a whole and for each structural unit in particular.

The functioning of the controlling system will ensure the implementation of the following areas in the field of energy saving:

- the controlling department develops the main directions of energy saving at the enterprise and brings them to structural divisions (heads of workshops, departments, services);

- subjects of energy saving at the places of occurrence of costs carry out planning of production processes with coordination of the main directions of implementation of energy-saving technologies defined by the company's management;

- motivational measures are being developed for the company's personnel;

- at certain facilities that are sources of energy saving, the enterprise organizes and manages energy saving processes;

- the existing strategy of the enterprise's activities is being adjusted for the results obtained from the measures taken to reduce the energy intensity of products, and so on;

- adjustment of economic processes for enterprises, relative to the available reserves for reducing the energy intensity of products.

Thus, the formation of an effective energy saving management system at the enterprise is a set of measures implemented through the mechanisms of functioning of the controlling system, and ensure a balance between the final results of Labor, characterize the growth of its productivity, rational use of resources and their savings. Energy security and energy efficiency issues have become a new challenge for all countries of the world. Requirements aimed at improving energy efficiency and preserving all types of energy resources are now becoming the basis of national policies and legislation in most countries. Energy saving and energy efficiency policies require the development and implementation of a set of mechanisms, criteria and methods for assessing the

level of energy efficiency in various sectors of economic activity based on appropriate energy audit systems.

Of particular importance is the problem of rational use of energy resources among consumers, the largest of which is industry. Along with the need to contribute to improving energy efficiency indicators at enterprises of all industries, it is necessary to actively develop industrial production focused on the supply of energy-efficient equipment and technologies in order to improve energy efficiency in all sectors of the economy and social sphere. To achieve this goal, National Industrial and energy strategies must be synchronized, interlinked with principles, priorities and pace, reflecting deep internal links in the economy of the energy and industrial sectors.

One of the main reasons for the need to improve energy efficiency and energy saving in EU member states is the depletion of Natural Resources. The relevance of changing attitudes to energy resources is associated with the high energy intensity of products. This problem leads to such consequences as economic inefficiency, low product competitiveness, export costs, closure of inefficient enterprises, and so on. Another important reason for improving energy efficiency and energy saving is environmental pollution, primarily from power plants running on fossil hydrocarbon fuels.

The introduction of an energy management system helps to solve these problems. Energy efficiency standards and labeling programs are a set of procedures and regulations that prescribe minimum requirements for the energy characteristics of industrial goods and supplies, with their energy characteristics marked. Rationing the minimum requirements for energy characteristics contributes to the adoption of informed decisions by market participants on the purchase of more efficient goods and the gradual displacement of inefficient technologies from the market. It should be noted that standards and labeling are most effective if they are part of comprehensive strategies and programs for market transformation.

In 2008, the International Organization for Standardization (ISO) established the technical committee ISO/TC 242 "Energy Management", whose secretariat was headed by representatives of the United States and Brazil (they were the initiators in this matter). Specialists from 40 countries of the world were involved in the work of ISO/TC 242 on an ongoing basis. Of the total number of more than 19,500 international ISO standards introduced, more than 155 relate to the regulation of energy efficiency and renewable energy sources. They cover areas such as energy management and energy conservation, as well as industry-specific solutions for buildings, it and home appliances, industrial processes, and transportation.

In July 2011, the final version of the international standard ISO 50001:2011 "Energy management systems - Requirements with guidance for use" was adopted. According to the head of the ISO/TC 242 technical committee, the new standard will cover up to 60% of global energy consumption, and "it is hoped that the application of the ISO 50001 standard will lead to a broad understanding between all types of energy suppliers and consumers."

The ISO 50001 standard combines the requirements for the energy management system at the international level, which were previously formed by the national standards of a number of countries, in particular:

- **USA: ANSI/MSE 2000:2008** A Management System for Energy;

- **USA: ANSI/IEEE 739:1995** Recommended practice for energy management in industrial and commercial facilities;

- **South Korea: KS A 4000:2007** Energy Management System

- **China: GB/T 23331:2009** Management System for Energy – Requirements;

- **South Africa: SANS 879:2009** Energy Management – Specifications.

European standard: EN 16001:2009 Energy management systems. Requirements with guidance for use:

- Denmark: DS 2403:2001 Energy Management – Specifications; **DS/INF 136:2001** Energy Management – Guidance on Energy Management;

- Sweden: **SS 627750:2003** Energy Management Systems – Specification;

- Ireland: I.S. 393:2005 Energy Management Systems – Specification with Guidance for Use.

The international standard ISO 50001: 2011 creates the basis for integrating energy efficiency into the management practice of an enterprise (organization, institution). The implementation of the requirements of the standard is aimed at ensuring the rational use of fuel and energy resources at enterprises and municipalities, which makes it possible to significantly optimize the volume of energy consumption, determine the priority of introducing new energy-saving technologies, and so on.

The energy management system includes:

- monitoring of energy consumption;
- analysis of existing indicators as a basis for drawing up new budgets;
- development of new low-waste and waste-free technologies;
- development of energy budgets;
- development of energy policy;
- planning of new energy-saving measures;
- development of effective systems and tools for controlling energy consumption and protecting the environment from pollution.

In the practice of economically developed countries, the functioning of energy management systems is based on the application, in particular, of such well-known management concepts as:

- Integrated Resource Planning, IRP;
- Demand Side Management, DSM;

- Supply Side Management, SSM;

- Load Management, DSM;

- End User Consumption Management, DSM.

The main idea of solving the management problem of improving the level of energy efficiency, which is laid down by the ISO 50001:2011 Standard, is to consistently apply a systematic approach to energy management. Additional opportunities for improving energy efficiency can be obtained by applying the standard cycle methodology PDCA (Plan – Do – Check – Act).

The advantages of the system process approach used are as follows: analysis of all aspects that affect energy efficiency, as well as continuous improvement; business processes related to energy management are clearly defined and have the ability to be checked by both internal and external auditors, including the possibility of certification; continuous and planned energy management process, which has certain comparison parameters (baselines) for the results achieved and documented energy goals; an approach based on the best international practice.

According to a similar principle, the main standards for other ISO management systems have been developed, which ensures a high level of compatibility of ISO 50001 with ISO 9001 – quality management systems, ISO 14001 – Environmental Management Systems, OHSAS 18001 – Occupational Health and safety management systems (figure below), which are implemented in the world.

The ISO 50000 series of energy management standards consists of six documents, the requirements of which apply to organizations of any type and size, regardless of the type of energy resources used:

- ISO 50001:2011 "Energy Saving. Energy management systems. Requirements and guidelines for use" – sets requirements for the development, implementation, maintenance and improvement of an energy management

system in order to continuously improve the level of energy efficiency and reduce the harmful impact on the environment. This standard can be used to certify and compare energy management systems of different organizations;

- ISO 50002:2014 " energy audits. Requirements and guidelines for their implementation" – sets out the basic principles and requirements for conducting an energy audit, as well as for harmonizing general audit processes and final documents. The new international voluntary standard for energy audits based on consensus should help specialists of organizations make informed decisions on the most rational use of available energy resources. The procedure discussed in the standard helps to identify opportunities for improving energy efficiency and prioritize them in order to obtain appropriate environmental benefits. As a result of the audit activities, important information is prepared on current energy efficiency, as well as recommendations for improving the situation in a wide range of areas, including operational control, maintenance control, modification and capital projects;

- ISO 50003:2014 "Energy management systems. Requirements for bodies conducting audit and certification of energy management systems" – sets requirements for competence, consistency and impartiality in the field of audit and certification of energy management systems for bodies providing these services. The standard is intended for use in conjunction with ISO/IEC 17021-1 "conformity assessment. Requirements for bodies that conduct audit and certification of management systems. Part 1.Requirements". The new standard describes special technical areas that should ensure the effectiveness of audit and certification, which include additional requirements necessary for audit planning, initial audit, field audit, and audit qualifications;

- ISO 50004:2014 "Energy management systems. Guidelines for implementing, maintaining and improving energy management" provides practical guidelines and examples for creating, implementing, maintaining and

improving an energy management system in accordance with the system approach according to ISO 50001. the ISO 50004 standard defines a system approach for continuous improvement of energy management and energy efficiency indicators. In accordance with the provisions of the standard, the energy management system is an organic part of the overall management of relevant processes and is a long, interactive and continuous process that includes operational actions, financing, Quality Management, Human Resources, Health, Labor and the environment;

- ISO 50006:2014 "Energy management systems. Measuring the level of achieved energy efficiency using basic energy consumption levels and energy efficiency indicators" – provides practical guidelines for compliance with the requirements of the ISO 50001 standard related to the implementation, use and maintenance of energy efficiency indicators and basic energy consumption levels for energy efficiency assessment. An energy efficiency indicator is a unit of measurement that characterizes: the efficiency of energy use and consumption in industry, buildings, equipment, systems and processes.

The basic level of energy consumption is the basis for comparing energy efficiency levels. This is a benchmark against which organizations can evaluate changes in energy efficiency. The basic level of energy consumption determines the organization's energy efficiency indicators before implementing measures to improve them;

- ISO 50015:2014 "Energy management systems. Measurement and verification of the level of energy efficiency of organizations. General principles and guidelines" – defines general principles and guidelines for planning and conducting measurements and verifying the level of energy efficiency in an organization or its components. The standard offers a set of Metrological and monitoring principles and recommendations, thereby increasing confidence in energy efficiency characteristics.

The adoption of the energy management concept by an enterprise (organization, institution) has a positive impact on its organizational and technical procedures, as well as on the behavior model in order to reduce overall operational energy consumption, economic costs of basic and auxiliary materials, and improve energy efficiency. World practice shows that improving energy efficiency is achieved mainly due to organizational changes in the energy management system of an enterprise or city. The introduction of an energy management system makes it possible to achieve significant energy savings of 3-5% in 1-2 years at relatively low financial costs. The first stage in the energy management system is an energy audit.

Energy audit is an Energy Survey of enterprises, organizations and individual industries, conducted on the initiative of the consumer in order to determine the possibility of saving fuel and energy resources, implementing savings measures in practice by introducing energy efficiency mechanisms.

The purpose of the energy audit is to assist economic entities in determining their energy saving policy, the level of efficiency of the use of fuel and energy saving, to provide assistance in the development of scientifically based norms and standards of unit costs, energy balances, the development of energy saving measures, their financial assessment and assessment of the impact on labor protection and the environment.

Based on the results of the energy audit, the customer receives:

- a program for cost-free energy-saving measures;

- energy passport of the enterprise (organization), which includes an instrumentally confirmed fuel and energy balance;

- implementation of a program for energy supply and energy saving, which depends on the technological process of production of the business entity;

- report on the analysis of the energy balance and specific energy consumption, depending on the volume of production;

- feasibility studies and decisions to improve the level of energy efficiency;

- list of necessary energy saving measures in order of priority for each object;

- determining the amount of investment required for each event;

- determination of the amount of savings in energy resources and funds for these resources;

- determination of payback periods for each event;

- determination of reducing carbon dioxide emissions by reducing fuel consumption;

- implementation of the system.

After the introduction of the ISO 50001:2011 Standard, a number of European countries (Great Britain, Denmark, Spain, The Netherlands and others) adopted national versions of this document, later the international standard received national status in Japan, Singapore, India, South Africa, Canada, Brazil and other countries.

To control and reduce the energy consumption of buildings, the EU introduced a mandatory energy assessment of Building Compliance, which provides for energy certification (certification), the main task of which is to demonstrate how much energy is consumed by a particular building to maintain the microclimate in comparison with the average energy consumption of such buildings. The building's energy condition characteristics certificate includes reference values of standard and actual indicators so that users can compare and evaluate the building's energy efficiency, and is accompanied by recommendations for cost-effective improvement of the latter.

Methods for determining the energy efficiency of buildings are described in the European standard EN 15217. it defines: general indicators for the energy characteristics of the building as a whole, including heating, ventilation, air conditioning, hot water supply and lighting systems; energy requirements for the

structures of new buildings or the reconstruction of existing buildings; procedures for obtaining reference values; development of the procedure for energy certification of buildings.

Tasks for independent work

1. Conduct a comparative analysis of existing energy-saving technologies in Ukraine and the EU.

2. Give the advantages of the energy audit and energy control procedure: prospects for Ukraine.

3. Develop a layout of the energy passport for the design solution of the building

Questions to control knowledge

1. What are the most common examples of energy-saving technologies you know?

2. Analyze the concept of "energy management"?

3. Define the concept of "energy audit" and energy control "energy management"? 4. What are the main advantages of the energy passport procedure?

5. What are the possible organizational and technological solutions for energy saving in the EU that can be adapted in Ukraine ?

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THEME 6

SYSTEM OF FINANCIAL AND ECONOMIC PROVISION OF ENERGY SAVING MEASURES IN UKRAINE AND THE EU

European experience in using financial and economic incentives for energy saving. Requirements of European creditors and investors for energy efficiency projects. Economic and financial levers for the implementation of energy efficient projects at Ukrainian enterprises. Structure, sources and tools of financial and economic support of energy efficient projects in EU countries. Assessment of the possibility of adapting the instruments of financing energy saving projects of European countries in Ukraine (international organizations, ESCO companies, lessors, financial institutions, collective investment institutions).

Key countries in the world - the United States, the EU, China, India - have recognized the need to phase out fossil fuels and fully switch to renewable energy by 2050. They demonstrated their decision by signing the Prague Agreement in 2015, which has now been ratified and entered into force. According to the conclusions of this World Energy Forum, the future of world energy lies in decentralized energy sources, "smart" networks and "smart" transport. The world is crossing the threshold of a new technological revolution, at the center of which - solar and wind energy, innovative technologies for energy storage and distribution [1].

In the context of Ukraine's European integration, the EU's experience in shaping the state policy of energy saving and energy efficiency and mechanisms for its implementation deserves due attention. It is the experience in the field of EU energy efficiency that is of the greatest interest to Ukraine. This is due to the fact that our country has established close trade relations with the EU, and the

volume of trade with the EU (excluding our still relevant energy dependence on Russia) exceeds the volume of trade with Ukraine and other countries and regions of the world.

In the early twentieth century. The main directions of energy efficiency policy in Europe were related to the introduction of energy-saving technologies and equipment in all institutional sectors, intensification of the use of alternative energy sources, reduction of technological and commercial losses during energy production, transportation and consumption. [2].

Increased attention of EU countries (primarily Germany, Italy, France, Sweden, Denmark and Poland) to addressing the challenges of further improving the efficiency of energy resources is due to the following reasons: the current geoeconomic format of cooperation requires constant strengthening of their competitive position in the globalized economic space; the continuing deterioration of price conditions in European energy markets; the EU has the potential to increase energy efficiency in its domestic energy sector. EU policy in the field of energy efficiency is favorably distinguished by the presence of a strong program and legislative and regulatory framework; application of a number of adequate tools and initiatives for policy implementation, functioning of an effective system of monitoring and control over their application; comprehensive combination with other areas of state regulation, primarily with environmental and economic policy [3-5].

The European Council summit held on 22 May 2013 noted a change in the priorities of the EU's energy policy: instead of "sustainable energy", "competitive energy" comes to the fore. The main item on the agenda of the summit was the issue of high energy prices and their impact on the competitiveness of the EU economy [1].

European energy efficiency legislation has been adopted on the basis of decades of success and failure by many countries [6].

The implementation of energy efficiency measures began with the mandatory accounting of electricity, gas, heat and water consumption, with the verification of compliance of buildings with the minimum requirements for energy efficiency and state aid for thermal modernization [6].

On November 30, 2016, the European Commission announced a course to develop decentralized renewable energy as a strategic priority. A new set of regulatory measures and policies combined in the Clean Energy for All Europeans program is aimed at this. [7].

It should also be noted that today for each country the World Energy Council (WEC) annually calculates the energy resilience index. The index is assigned on the basis of a comparative analysis of the energy situation in a particular country, based on three indicators: "energy security" (energy security), "energy capacity" (energy equity), "environmental sustainability" (environmental sustainability), taking into account a balanced approach between the relevant indicators. This indicator is the most important in determining the level of energy efficiency of any country.

Energy security is effective management, supply of energy from internal and external sources, diversification of the energy market, reliability of energy infrastructure, as well as the level of satisfaction of current and future demand for energy resources.

Energy capacity is the level of energy costs per unit of GDP, as well as the availability and accessibility of consumers to energy resources.

Environmental sustainability characterizes the efficiency of energy resources and the share of renewable energy sources in the hall.

Depending on the success in each direction, the country is assigned a rating from A to D in alphabetical order, where each letter is assigned a scale from 0 to 10:

- A - the highest result, corresponds to a scale from 8.01 to 10.00;
- B - average result, corresponds to the scale from 5.01 to 8.00;

- C - below average, corresponds to a scale from 2.51 to 5.00;

- D - the lowest, unsatisfactory result, corresponds to a scale from 0 to 2.5.

Yes, Ukraine's rating in 2019 is ACC (Table 6.1).

Table 6.1 – Energy Sustainability Index of Ukraine (2016-2019) [8]

Indicator	Rating			
	2016	2017	2018	2019
energy security	A	A	A	A
energy equity	B	B	B	C
environmental sustainability	D	D	C	C
Overall estimate / total number of countries	63/125	48/125	57/125	61/128

According to calculations and comparisons, Ukraine in 2016-2019 rose by 47 positions, in 2016 took 63rd place among 125 countries, in 2017 also tended to improve the position of the warrior by 15 positions, but in 2018 year lost them by 9 positions, and in 2019 still lost 4 positions.

According to the WEC analysis, the reason for the deterioration of energy security in Ukraine is: political instability; low percentage of renewable energy in total; energy dependence on imported energy; inefficient use of energy resources.

The low level of energy capacity and environmental sustainability, largely due to the high energy intensity of GDP and the lack of clear steps to reduce the negative impact on the environment, which is a consequence of inefficient government policy in the energy sector [9].

According to the same rating, the best results in 2019 have the following countries: Switzerland, Sweden, Denmark, Great Britain, Finland, France, Austria, Luxembourg, Germany, Norway, Canada, the Netherlands and the United States.

World experience shows that effective energy efficiency measures can reduce the growth of national demand for energy resources, which will reduce energy imports and, consequently, remove the energy problems of countries with economies in transition. At the same time, a properly developed energy strategy of the country, effective projects of international cooperation in the field of energy efficiency will contribute to energy efficiency, economic development, environmental and national security of the country [10].

In industrialized countries, in contrast to the former focus on large-scale increase in energy production, the highest priority of the energy strategy is to increase energy efficiency.

Many countries have developed national targeted programs to save fuel and energy resources, which include a wide range of measures to improve the structure of energy consumption, development of material and technical base, more complete removal of useful components, collection and use of secondary raw materials, control and accounting of energy consumption.

For example, in Western European countries, where market relations predominate, energy efficiency issues tend to avoid legal regulation, preferring information programs and programs that increase the level of technical awareness. The main principle they adhere to is that the higher the energy intensity, the less regulation in this area. For example, in industry, the market itself will force to increase energy efficiency, reduce energy consumption of manufactured products in order to increase its competitiveness. In addition, coercive measures are often used in the economic regulation of energy efficiency, which include statutory norms and initiatives implemented from above. These solutions are most popular in European countries, where law-abiding people and manufacturers support mandatory government programs.

Otherwise, incentives are often implemented that have a direct impact on the manufacturer. In countries that actively use this method, financial incentives

and PR tools are in use. It is more difficult to calculate the economic efficiency of such decisions than in the case of coercive measures [11].

Thus, we can say that the energy efficiency policy of the leading energy saving countries is based on three main principles [12]:

I. incentives to save energy.

II. coercion to save energy.

III. educational programs in the field of energy saving.

Consider in more detail the experience of leading countries in the field of energy efficiency.

Indicative at the European level is the state policy on energy efficiency in Norway, which is based on encouraging flexibility in energy supply procedures, reducing direct dependence on electricity used for heating purposes, increasing the share of renewable energy sources in the overall energy balance of the country [13].

Norway's experience began with the development of energy efficiency programs in the late 1970s, with the preparation of several plans in the form of reports to the Norwegian Parliament (energy efficiency plans). Norwegian energy efficiency policy is based on: promoting flexibility in energy supply procedures, reducing direct dependence on electricity used for heating purposes, increasing the share of renewable energy sources in the overall energy balance of the country. Although Norway is the largest exporter of oil and gas in Europe, its energy system is based on hydropower, biomass and waste recycling. 63% of its energy comes from renewable sources. To date, Norway has overfulfilled its National Renewable Energy Action Plan to 2020. Back in 2016, the share of "clean" energy in Norway's final energy consumption reached almost 70%. At the same time, 99% of all electricity in the country is produced by hydroelectric power plants.

Norway has liberalized the electricity market, declaring the main principle of energy efficiency - high electricity prices, which reflect its real value, can

make investments in the energy efficiency sector profitable, while low prices make it impossible to implement most programs in this area. Thus, the refusal at the state level to underestimate the price of electricity best stimulates owners to implement energy efficiency in enterprises. Otherwise, companies are unable to compete in the market, which eventually leads to their bankruptcy. Norway's energy efficiency policy is strict, but as practice shows, it is effective [14].

The Norwegian government has paid special attention to the efficiency of energy-intensive industries, reducing the use of electricity for heating, the development of renewable energy and environmental protection. To achieve these goals, the Royal Norwegian Ministry of Petroleum and Energy established ENOVA SF, the main purpose of which was to stimulate market participants, based on financial instruments, to produce and use energy in an environmentally safe and rational manner. Combining policy implementation functions within a single flexible and market-oriented organization is designed to stimulate energy efficiency by motivating market participants to make decisions about investing in cost-effective and environmentally sound projects.

To achieve the goals of ENOVA SF, the Norwegian Parliament has established a specific Energy Fund. The source of financing of the fund is the tax on electricity distribution tariffs. Industrial enterprises that have energy efficiency projects can apply for investment support. Businesses must submit energy consumption data and production figures to ENOVA SF at least five years after the project is completed. As part of the program, the company collects energy consumption and production indicators in a database. The recipient company must report its data once a year in the form of web reporting. Based on them, the specific energy costs in different industries are calculated. The data can be used to compare the energy performance of a particular company with other similar companies [14].

Consider the experience of managing the finances of energy companies in Sweden. The government is actively using economic incentives to promote the use of alternative and non-traditional energy sources, namely [15]:

- exemption for a period of 5 years from the energy tax;

- state subsidies for the reconstruction of old houses (replacement of boilers, insulation, etc.);

- simplified obtaining permits for the construction of wind power plants.

The state also uses administrative management methods. This applies to large gas stations, where it is mandatory to sell alternative fuels in addition to traditional gasoline and diesel fuel. The main emphasis is on economic management methods - taxes, subsidies and subsidies, trade in quotas and electrical certificates.

Another feature of the Swedish energy sector, in particular municipalities, is central heating and cooling of premises, including public office spaces (supermarkets, exhibition halls). All this is realized due to the operation of heat pump stations. The raw material in this case is the potential of land and water. An example is the station in Stockholm, which provides central heating and cold to 400 thousand people. In Sweden, there is a growing interest in heat pumps with a capacity of 25-40 kW for apartment buildings or offices. They are quite energy efficient and reduce the harmful effects on the environment. There are now more than 500,000 heat pumps in the country [16].

In addition, Sweden has continued its energy efficiency program in the energy-intensive industry.

The total amount of funding from the state budget in the field of energy efficiency was about 530 million Swedish kronor (61.4 million euros) per year [17].

Also in 2015, the Swedish government achieved the goal of becoming the first country to abandon fossil fuels. In particular, state funding was allocated [17]:

- 390 million kroons per year for the period 2017-2019 for solar power generation, with plans to invest 1.4 billion kroons in total;

- 50 million kroons for the study of electricity storage technologies;

- 10 million kroons on Smart grid;

- 1 billion kroons for the modernization of residential buildings and improving their energy efficiency;

- subsidies and investments to support the development of "green" transport;

- increase in funding for climate change projects in developing countries, with an increase in the fund to 500 million kroons.

Energy saving in Germany was initiated by the Renewable Energy Priority Act, adopted in 1991. The tasks of improving energy efficiency in Germany are solved through the Ministry of the Environment and partly by the Ministry of the Economy, the Federal Ministry of Transport, Construction and Urban Development. Each of the ministries has its own tasks and respective powers [18].

The specificity of solving the problem is that the emphasis is on specific aspects of the problem in the absence of such a separate document as the energy concept. At the same time, it is necessary to note the existence of unity in general views on energy development. Such unity exists to reduce carbon dioxide emissions, preserve the environment, develop renewable energy, strengthen the safety of existing ones and ban the construction of new nuclear power plants.

According to the existing views, specific work is being done to save energy and increase the energy efficiency of systems, machines, devices and mechanisms. The government is actively attracting private capital to participate in new projects, using such tools as organizing and conducting competitions for the sale of energy-saving loans, providing tax benefits and obtaining loans. The German Energy Agency (DENA), a limited liability company, takes an active

position in conducting energy saving tenders. The founders of DENA are the state and the Credit Agency for Renewal and Development (KfW). The agency deals with a wide range of tasks such as energy consumption monitoring, analysis of the country's fuel and energy balance and dynamics of energy prices, develops a strategy for construction of electrical installations on renewable energy sources, plans modernization of existing power plants, trades emission allowances, organizes joint projects. bodies for energy efficiency, conducts active advocacy and outreach work among the population.

Wind energy and the use of solar energy are becoming widespread in the country. In Germany, solar power plants generate more than 3,000 million kWh of electricity annually. In Berlin, it is planned to convert all swimming pools to solar energy. Private investors are given the opportunity to place on the roofs of public buildings more than 100,000 square meters. m of solar panels and supply the received energy to the city network. Since 2007, the Berlin administration has only purchased cars with reduced petrol consumption for urban transport. Electrical appliances and equipment are marked depending on the level of energy consumption. The order of gradual displacement from the use of devices and equipment that have a level of costs outside the established standards [19].

Today, the share of renewable energy sources in electricity production in Germany reaches 11.5% (Fig. 6.1). Germany is one of the countries of the European Union, where the most actively used modern energy-saving technologies and alternative energy sources of solar energy, wind energy. Germany does not have a single energy concept, there are different views on what the country's energy concept should be.

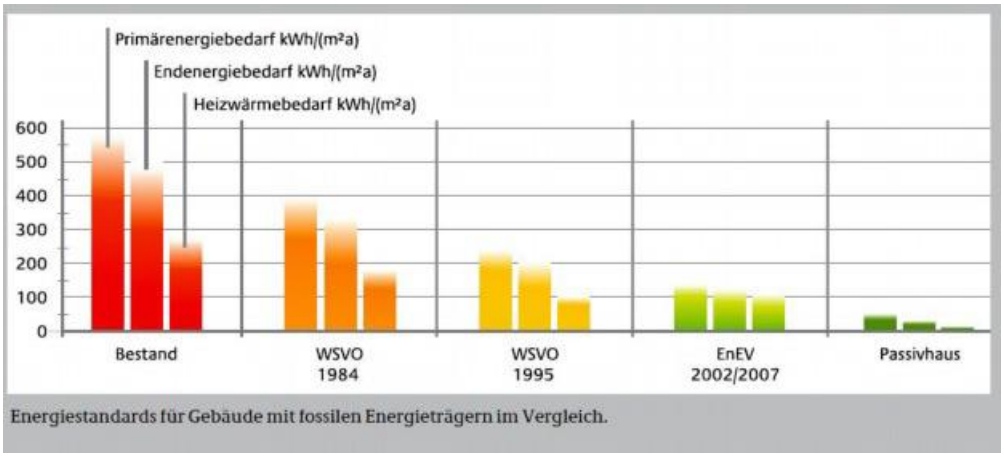


Figure 6.1 - The share of renewable energy sources in electricity generation in Germany [20]

German legislation and regulations state that the implementation of energy saving is financed by banks and large corporations, not the state. In recent decades, the country has tried to use the instrument of contracting (energy service agreements) as an element of public-private partnership. It stipulates that in conditions when the owners of the enterprise are financially incapable or do not have sufficient information to implement energy efficiency policy at the enterprise, the solution is undertaken by a contractor who conducts energy audits of structural units of the enterprise, evaluates the efficiency of the production process. Then, on the basis of the received data, the contractor makes the appropriate decision and ensures the implementation of the planned action plan in the direction of energy efficiency and takes over the financing of the project. [11].

Germany, a world leader in energy efficiency, finds new challenges to reduce energy consumption, including through the planned closure of all nuclear power plants by 2022 and the production of 80% of renewable energy by 2050 [21]. In addition, according to the state concept of "energy turn" Energiewende, in Germany by 2025 the share of electricity generated from renewable sources should be about 40-45%, and by 2035 - at least 55-60%. The fact that solar and wind power plants are becoming increasingly competitive with traditional energy sources, such as coal and gas, is evidenced by the results of the latest

tender for the construction of four offshore wind farms in Germany. As a result, three of the four projects will be implemented without government subsidies.

Denmark is one of the European countries whose experience in energy saving is the most systematic and long-lasting. In the 60s of last century, the Danish economy experienced a significant recovery. The basis of energy potential was oil and petroleum products, the share of which was almost 90%. The energy crisis of the 1970s and the sharp rise in hydrocarbon prices forced the country's authorities to rethink public energy policy and make significant adjustments. The first step in this direction was the creation of a nationwide energy supply planning system. The task of energy supply was solved in stages with the accumulation and use of the potential of previous stages. At the first stage, an energy plan was developed and put into effect in 1976. The main task of implementing this plan was to ensure a reliable energy supply. Implementation of the task involved the implementation of measures to diversify energy supply, create a legal framework for energy supply, the introduction of energy taxes, mapping and energy supply schemes in some regions of the country [22].

In 1981, the second energy plan was put into effect, aimed at consolidating the achieved results and developing energy saving. Given the high oil prices, government agencies are consistently reducing its share in the country's fuel balance, increasing the consumption of biogas, straw, sawdust, household and industrial waste, and by-heat of industrial enterprises.

Practice has shown that the most efficient from an economic point of view was the combined production of heat and electricity, as well as the use of district heating networks with high-tech insulation. Today, Denmark is one of the leading countries in the world in terms of central heating. Almost all cities have central heating, which covers about 50% of Danish homes.

In 1990, the third energy plan was adopted, which was a continuation of the previous stages and taking into account the aggravation of environmental

problems. As the country's heat supply structure was quite developed at this time, the main efforts were focused on reducing carbon emissions. This task is being solved at this stage within the European Union.

The peculiarity of Danish heat supply is that the owners of the heat supply company through the municipality are all consumers who are connected and use the system. Due to this, the population is interested in increasing the efficiency and reliability of heat communications, as well as in reducing the price for the provision of thermal energy services.

Danish law stipulates that heat supply companies must have equal income and expenditure in their annual balance sheet. If the company made a profit at the end of the year, then next year's budget adjustments are made so as to restore the balance by reducing the price of heat. If there is a shortage, the price of heat rises.

Ensuring reliability and affordability is fundamental to Denmark's heat management system. This is defined as the main purpose of any heat supply company. The realization of this goal is facilitated by the fact that consumers have ample opportunities to account for and regulate heat consumption, which in practice leads to significant energy savings.

It is also important to note that enterprises - producers of thermal energy are technologically able, depending on market conditions to move from the consumption of one type of energy to another. This provides flexibility in the system, its reliability and efficiency. In addition, the presence in the heating system of "peak" boilers allows in case of accidents or any serious problems to switch to a backup source without disrupting the supply [22].

From the technological point of view, the operation of heating networks in the mode of relatively low temperatures and pressures is of interest, which significantly reduces energy costs. The temperature of direct-flowing water makes 80 ° C, return flow 40-50 ° C. The considerable part of heat supply systems works in a mode of direct inclusion, than simplicity of management is

reached. Reliability and efficiency of heat supply contributes to a stable demand for such a service, and therefore is a stable factor in the development of the industry in the future.

Denmark is effectively shaping its fuel and energy balance, with oil at 43%, gas at 24%, coal at 21% and renewable energy sources (renewable energy sources) at 12%. Of the renewable energy sources, the use of wood sawdust is - 44%, wind energy - 27%, straw burning - 27%, biogas production - 6%. In addition, geothermal installations and energy from waste incineration (GTE) are used.

The efficient use of electricity is facilitated by the property system operating in the industry. Power plants and infrastructure are controlled by transmission line companies, as well as large E2 and Elsam companies.

Electricity distribution companies are controlled by large and small consumer groups, municipalities, and in some cases private investors. The development of small and medium-sized stations with a capacity of up to 100 MW has led to the emergence of some independent producers in the country's energy market, such as IPP - Independent Power Producers. Wind turbines are in most cases owned by farmers or cooperatives [22].

Energy saving is also facilitated by the system of energy consumption regulation, which includes the state and municipal system of development of planning and regulation of heating, gas and electricity structures. Large heating systems are owned by municipalities, and small ones by consumer associations organized on the model of cooperatives where consumers elect the board. A consumer who buys an apartment in a certain area receives central heating or natural gas heating. The homeowner cannot change his choice after the building is purchased. Such planning, according to the authorities, provides a more rational use of energy.

The Green Transition for Danemark bill was first introduced on March 22, 2012. The law came into force and provides for a number of energy policy

initiatives for the period 2013-2020. The main goal is a 100% transition for alternative types of energy in the spheres of electricity and heat supply, in the private sector, industrial and transport industries by 2050 [22]. The main tasks at the first stage are to reduce total energy consumption by 12%, increase the use of renewable energy sources to 35% and increase the share of wind energy to 50%.

Since 2013, it is forbidden to install gas and liquid fuel boilers in new buildings; since 2016 - liquid fuel boilers in houses that are heated by the district heating network. To increase the share of alternative energy sources in district heating systems, the state has allocated 5.6 million euros by 2015. For environmental heating, the government will allocate additional funds of 4.6 million euros for new technologies in the field of geothermal energy and high-capacity heat pumps [23].

In twenty years, the production of the Danish wind industry has reached 1 billion dollars. During the same period, the number of people working in this field has increased from several hundred to 20 thousand people. In the country, 5,000 wind turbines now provide 20% of residents' electricity needs. In addition, in 2001, Denmark was the first to open offshore wind energy, installing the world's first Middlegrunden wind farm near Copenhagen. Its capacity is 40 MW, and the operation of one turbine for 25 years of operation has saved about 60 thousand tons of coal or 180 thousand barrels of oil.

Later, two more 160 MW stations appeared - Hornsv and Nysted - which made Denmark one of the world leaders in offshore wind power. The country has a flexible heating system with simple technology that runs on almost any type of fuel and can switch from one fuel to another. Denmark's incinerators, which are integrated into the city's heat and power supply system, save millions of barrels of oil and gas: 1 tonne of waste equals approximately 200 liters of diesel fuel. In Copenhagen alone, about 30% of annual heat consumption is covered by energy from recycling [23].

According to forecasts made by the European Wind Energy Society (Denmark) [23]:

- the world's energy potential of wind is 4 times greater than the total demand for electricity was in 1998;

- by 2020, a 100-fold increase in wind power capacity is projected compared to 1999, amounting to 1.2 million MW;

- the largest growth is forecast in Europe, the United States and China;

- the annual increase in investment in this sector will increase from $ 3 billion to $ 80 billion. in 2020, which will create 1.7 million new jobs.

Poland has been implementing an energy saving system since 1991. There are several aspects of this country's energy saving policy. First of all, it should be noted that the Polish authorities have harmonized national legislation with EU regulations. There are almost no contradictions between national and local regulations. Institutional and organizational support of energy saving policy is being successfully formed.

The country has established effective and purposeful work of state and local authorities, financial and commercial structures, economic entities on energy saving measures in the housing sector, efficient use of local resources and electricity, implementation of solar energy, biogas production, waste disposal, heat and electricity energy from burning straw and other vegetable waste [24].

Poland has a positive experience of mixed financing of energy projects (EU funds, international donor funds, environmental foundations, budget), where the system of tax benefits is skillfully used.

The government is trying to use government leverage to expand the range of creditors to carry out such energy-saving measures that require significant funds and are designed for the long term. In Poland, there is a special utility fund, the funds of which are accumulated through fees from the population and

are used to implement low-cost energy saving projects, improve the quality of heating, maintenance.

Energy consumption is based on signing and fulfilling the terms of the contract. This avoids the bureaucratic red tape associated with the licensing system, prevents monopolization of the sphere, improves the quality of services through competition, reduces prices, and simplifies auditing.

Today, to continue the process of reforming and implementing energy efficiency projects in all sectors of the economy, the Fund - "Thermal Renovation and Overhaul" was established, which operates within the state bank - Bank Gospodarstwa Krajowego (BGK). BGK is obliged to: 1) provide in its financial plan the Financial Plan of the Fund, developed in consultation with the Minister of Finance, the Minister of Environment, and the Minister of Construction and Housing; 2) compile a separate balance sheet and accounting of income and losses of the Fund, which must be included in the financial statements of the bank [25].

Incentive payments are made by BGK from the Fund. BGK provides incentive payments in amounts not exceeding the free funds of the Fund and within the limits provided (in the financial plan of the Fund) for each type of incentive payments. The Fund's funds are managed by BGK, and loans are provided by creditor banks that cooperate with BGK. Investors apply for repayment of part of the loan to BGK through the bank that provided the loan.

The fund is replenished at the expense of: 1) state budget funds in the amount provided for in the Law on the State Budget; 2) interest on the Fund's deposits in banks; 3) income from the Fund's investments in securities of the State Treasury or the National Bank, as well as in bonds and promissory notes guaranteed by the State Treasury or the National Bank, and stock market securities; 4) charitable donations and inheritance; 5) other income.

The Fund's funds may be spent for the following purposes: to cover incentive payments; covering the costs of energy audit verification and

renovation audit; coverage of the Fund's operating expenses; covering the advertising costs of the Fund.

The practice of the Czech Republic is interesting in the implementation of energy efficient projects. Stimulation of projects to increase energy efficiency and the use of renewable energy in the buildings of the public sector and housing and communal services is organized by the state program "Green Savings".

The program is divided into three main areas of support: A. Energy saving in heating (A1. Complete thermal insulation; A2. Partial thermal insulation). B. Construction in accordance with the energy passive standard. C. Use of renewable energy sources for heating and hot water treatment (C1. Replacement of heating systems for the use of low-carbon biomass energy and introduction of efficient heat pumps; C2. Equipping new buildings with low-energy energy sources ,, and efficient heat pumps; C3. Installation of solar collectors). Additionally provided for: D. Subsidy to the subsidy for a combination of measures - it is desirable to combine some measures and it is worth subsidizing such combinations (but only in the current use and not more than once for the object, even with many such combinations) [26].

The State Ecological Fund of the Czech Republic was established to finance this program. The Foundation is a state organization administered by the Ministry of Environment. The Fund has a separate bank account, the disposal of the Fund's funds is determined by the Minister [27].

The Fund is managed by a director, who is appointed and dismissed by the Minister of Environmental Protection.

The main functions of the Fund include the provision of consulting and advisory services, reception and evaluation of applications, preparatory work for approval of funding, provision of funding to beneficiaries and ongoing audit of the use of funds, assessment of end use of funds and environmental goals.

Proceeds to the Fund are mainly provided by: fees for wastewater discharges into surface waters; fees for emissions of harmful substances into the air; fees in accordance with the Law on Waste; fees for the withdrawal of agricultural land from the land fund (60% of the total); fees for the actual consumption of groundwater (50% of the total); payments to the state budget for mining; fines imposed by the Fund and the Ecological Inspectorate for violation of rules and measures for environmental protection; sanctions imposed on applicants who use or store the Fund's funds improperly; subsidies from the state budget; share of tax revenues; loans to legal entities; contributions of domestic and foreign legal entities and individuals; other receipts defined by the obligatory legal norms regulating various components of environment.

The Fund's income also includes income from funds held on time deposits. The Fund's revenues do not belong to the state budget. The fund receives financial resources from the EU, in particular from the Cohesion Fund and the European Regional Development Fund.

The Green Savings Program in the Czech Republic aims to provide financial support for the insulation of existing housing, as well as the installation of heating using renewable energy sources and construction in accordance with the standard of energy-passive houses. Financial support for the implementation of energy saving and renewable energy projects is focused on residential buildings of all forms of ownership and public sector buildings. The incentive mechanism allows to compensate the owners or managers of housing or buildings of the public sector part of the cost of implementing measures that have achieved a reduction in energy consumption by at least 20% when heating or limiting it to 70 kWh / m 2 per year. As a result, investment support for energy efficiency in the housing and utilities sector is mostly focused on existing buildings [27].

It is estimated that 89% of funds for energy saving in the Czech Republic have been allocated for the insulation of existing housing, subsidies for the use

of renewable energy amounted to 10%, and 1% of financial resources have been allocated for passive construction.

Thus, world experience shows the existence of such types of investment mechanisms used in financing energy efficient projects, such as credit financing and partial guarantee schemes; use of energy service companies; use by companies of heat supply of Demand - Side - Management schemes; other types of financing.

It should also be noted that in the light of world experience, the International Energy Agency identifies the following mechanisms for energy efficiency policy at the state level: price; regulatory and controlling; financial and fiscal incentives; promotional (information) mechanisms; technological, commercial and financial development [135, p.300-311]. Table 6.2 groups the mechanisms (price, regulatory, controlling, informational and motivational) of energy efficiency management on the basis of the analysis of the best experience of European countries.

Table 6.2 – Systematization of elements of energy efficiency policy [27]

Country	Elements of energy efficiency policy				
	Price	Regulative	Supervisory	Informative	Motivational
Norway	+	+	+		+
Sweden		+			+
Germany				+	+
Denmark				+	+
Poland	+		+		+
Czech Republic				+	+

The obtained data on the experience of the world in energy efficiency are combined in a table to compare them with each other (Table 6.3).

Thus, we can say that each country has made a significant contribution to the development of energy efficiency. Note that according to European experts, the most reliable tools for energy saving are financial and economic regulators and incentives, such as prices and tariffs, preferential taxation, public financial

support. The leading role in energy saving is played by qualified energy management, which works creatively in compliance with the requirements of international standards.

Table 6.3 – International experience in financing energy efficient projects [27]

Country	Experience
Norway	Their experience is characterized as a process of energy efficiency taking into account all aspects of liberalized markets, targeted planning and environmental protection.
Sweden	A clear system of control over the use of "ENOVA SF" energy resources has been established. There is a five-year exemption from the energy tax, a state subsidy for the reconstruction of old buildings (replacement of boilers, insulation, etc.), simplified obtaining permits for the construction of wind farms.
Germany	Energy production through the use of coal and alternative energy sources. Use of government subsidies to promote environmentally friendly alternative energy and lignite and coal production. The introduction of energy efficiency in Germany is financed by banks and large corporations.
Denmark	Green Transformation for Denmark Bill. The main goal is a 100% transition to alternative energy in the electricity and heat supply, in the private sector, industry and transport by 2050.
Poland	Obtaining loans from commercial and state-owned banks to modernize the housing stock with a low interest rate (2-10%) under the guarantee of repayment through tariff policy. Establishment of the Thermal Renovation and Overhaul Fund, which became the main financial donor.
Czech Republic	The state program "Green Savings" was organized. The State Ecological Fund of the Czech Republic has been established, which receives funding from international organizations.

The following traditional sources of funding are also used in Ukraine today, such as: donor organizations, local budgets, community members and businesses.

Donor organizations.

1. Loans through Ukrainian banks.

2. Non-refundable funds for preparatory work (business plan, energy audit, consultations, etc.).

3. Non-refundable (grant) funds for the implementation of individual projects.

The largest providers of credit resources for energy saving projects are international financial institutions. International financial and technical cooperation with states and international organizations is a powerful source and effective tool for Ukraine's economic development.

Ukraine seeks to effectively use the full potential of such cooperation through mutual understanding and equal partnership, developing common approaches to cooperation priorities, joint responsibility and accountability for the results of assistance, ensuring its effective use to address the most pressing social and economic problems.

One such powerful international organization is the EU (European Union: Eastern European Partnership for Environment and Energy (E5P)), the EBRD (European Bank for Reconstruction and Development), the European Investment Bank (EIB), and the Global Environment Facility (GEF).) (including the EBRD, UNDP, UNEP, UNIDO, IBRD), the Northern Environmental Finance Corporation (NEFCO), the Northern Investment Bank (NIB), the Global Climate Partnership Fund (GCPF), the Dutch International Housing Guarantee Fund DIGH), World Bank - Subnational Finance from IFC and IBRD, World Bank, US Agency for International Development USAD, German State Development Bank KfW, German Society for Technical Cooperation (GIZ) and others.

It is also worth noting that Ukraine adopted the Law “On the Energy Efficiency Fund” in 2017, the purpose of which is to support energy efficiency initiatives, implement tools to stimulate and support the implementation of measures to ensure energy efficiency of buildings and energy saving, mainly in the residential sector. taking into account national energy efficiency plans [30]. The creation of the Energy Efficiency Fund will allow Ukraine to receive funds from the European Union to solve the problem of energy saving. Funds from the state budget of Ukraine and donors should become sources of filling the Fund.

The program of the Cabinet of Ministers of Ukraine "Warm Credits" deserves special attention. According to it, the amount of funds aimed at issuing loans to the population for the purchase of energy efficient materials and equipment in 2015 amounted to UAH 1.57 billion, in 2016 - UAH 900 million, in 2017 - UAH 400 million, in 2018 - UAH 400 million, in 2019 - UAH 400 million, in 2020 UAH 400 million is planned. [31].

Reimbursement provided to participants in this program is:

- 20% of the loan amount (but not more than UAH 12,000) for the purchase of non-gas / non-electric boilers for individuals;

- 35% of the loan amount (but not more than UAH 14,000) for the purchase of energy efficient equipment / materials for individuals;

- 40% of the loan amount (but not more than UAH 14,000 per apartment) for the purchase of energy efficient materials and equipment for condominiums (except for households that receive subsidies);

- 70% (but not more than UAH 14,000 per apartment) for the purchase of energy efficient materials and equipment for condominiums (only for households receiving subsidies) [31].

Such loans to support energy saving were issued by such agent banks as Oschadbank (Savings House program), Ukrgasbank (Warm House program), Ukreximbank and Privatbank.

The next group of sources of funding for energy efficient projects is unconventional. It includes such sources as: ESCO mechanism, crowdfunding, P2P, revolving fund.

ESCO is an energy service company that performs work on the implementation of energy efficiency measures (for example, insulation of facades, replacement of windows and doors with energy efficient ones, modernization of the heating system, installation of ITP, etc.). Thanks to these measures, the customer begins to save resources and, consequently, money, part of which is received by ESCO as payment for its services and returns the investment. Also, due to recent

changes in the legislation, it has become possible to implement the so-called "first out" principle, when all the savings go to pay for ESCO services. In this case, the term of the energy service contract is reduced [32].

The first classic ESCOs appeared more than 100 years ago, and their rapid development occurred in the 70s of last century, when due to the "oil embargo" the Arab countries significantly reduced oil production and sales, the price of which in just one year rose by almost 2, 5 times. At the beginning of the 21st century, ESCOs began to gain popularity in Eastern Europe and the post-Soviet states.

According to the legislation of Ukraine, energy service contracts can be concluded for a period of up to 15 years. During the validity of such an agreement, the amount of expenditures of the budgetary institution for the payment of fuel and energy resources (hereinafter - FER) and housing and communal services (hereinafter - housing and communal services) does not change. At the same time, the comfort of staying in thermo-modernized buildings increases significantly immediately after the implementation of energy efficiency measures, ie at the beginning of the contract. During the validity of the energy service contract, the customer of the energy service can receive a benefit in the form of a percentage of the achieved savings (usually 10-20%), and after the end of the contract energy costs for the building of the budget institution are significantly reduced.

A separate issue is the provision of financing for energy efficiency measures - this can be both the energy service company's own funds and funds raised through loans from banks or other financial institutions, grants or international technical assistance projects.

There are also models in the world where energy efficiency measures are financed by the customer. ESCOs, in turn, are required to guarantee the achievement of an agreed level of energy cost savings, as well as the management of improvements (energy-efficient equipment, facilities, materials, etc.) installed during the energy service.

However, given the Ukrainian realities of lack of specialists and funds for the implementation of energy efficiency measures, the main advantage of the energy service mechanism is the transfer of financial risks (and finding investment in an energy efficient project) to ESCO.

It should be noted that the concept of "energy service company", defined by the order of the Ministry of Housing and Communal Services of Ukraine "On approval of Guidelines" to create a system of economic incentives for energy saving measures in housing and communal services "from 26.01.2011 № 9:

"An energy service company is an economic entity that implements energy saving measures in whole or in part at the expense of its own, borrowed or borrowed funds and ensures guaranteed achievement of fuel and energy resources and water savings during the implementation of energy saving measures."

ESCO members are:

1. Initiator - a body of state or executive power that has the right to distribute budget allocations (in the case of energy savings and energy efficiency in the budget sphere).

2. Customer - an enterprise or budget organization that orders a certain quality of service (comfortable temperature and humidity, the ability to use cold water, electricity, etc.), and not a certain amount of a resource.

3. Contractor - an organization that provides energy services.

4. Investor - a bank that provides the Contractor with services to provide additional funds.

5. Consumer - groups of people who use the improvements achieved in the performance of their direct duties (in educational institutions - staff and students), in medical institutions - staff and patients, in preschool institutions - staff and children, etc.).

6. Expert - an independent organization that acts as an observer for strict compliance by all parties to the terms of the contract.

Given that the energy service contract includes elements of various contracts (contract, services, financial lease or leasing, surety, loan agreement, exploration agreement, etc.), ie by its nature is a complex and multi-component contract, the mechanism should be considered financing of an energy saving project based on an energy service contract.

If a tripartite loan agreement is concluded, under which the borrower is an energy service company, and the purpose of the loan is to implement an energy saving project at the customer's facility, the mechanism for financing energy saving measures will be as follows (Fig. 6.2).

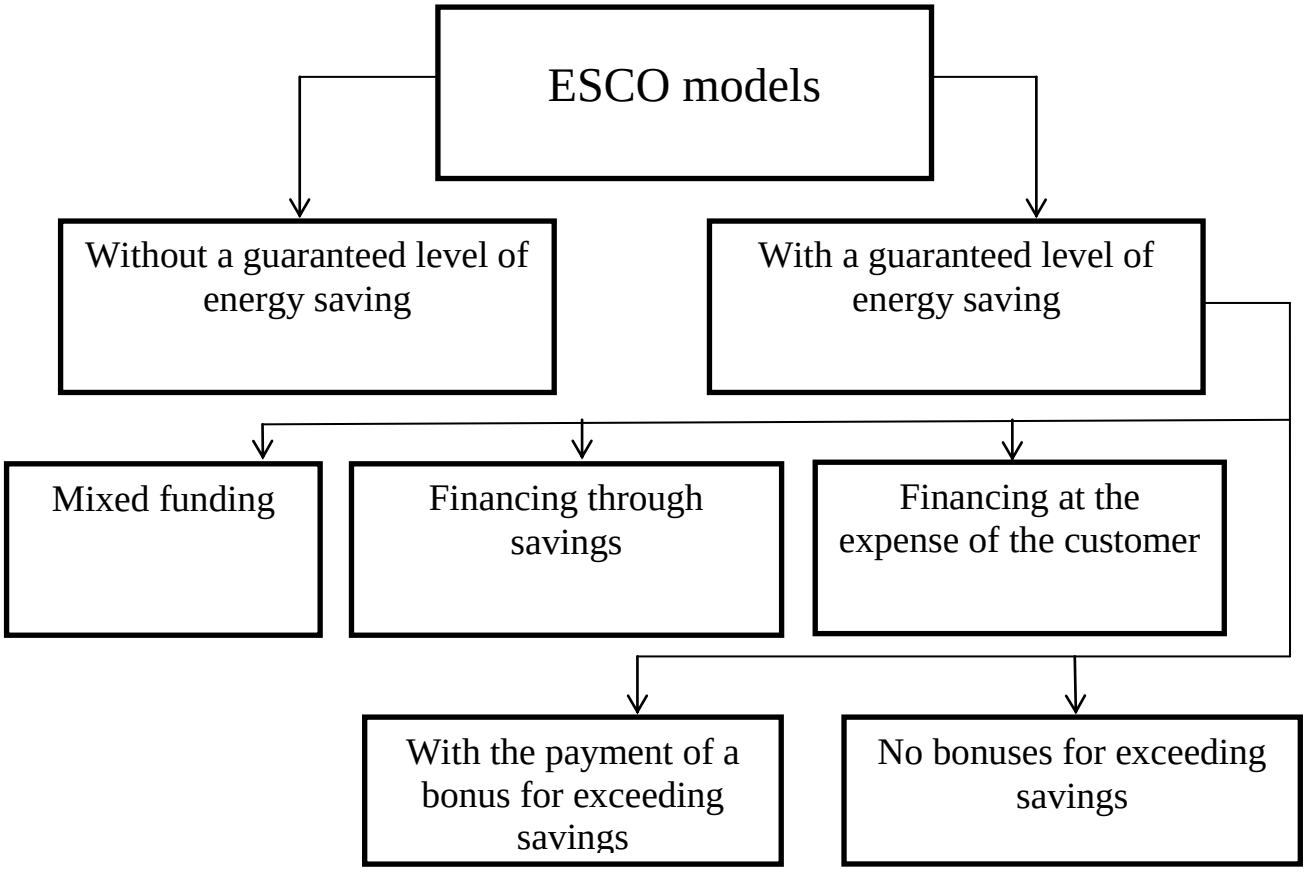


Figure 6.2 - Basic ESCO models

It is considered expedient to use both options when implementing energy saving projects in Ukraine, depending on the functions assigned by the financial institution and the terms of the energy service contract. The application of

another financing scheme common in the world, based only on the interaction of the customer and the energy service company at the present stage in Ukraine is almost impossible, as the energy service company usually does not have the funds to carry out the whole set of energy saving measures.

Another unconventional source of funding for energy efficiency projects is crowdfunding: the collaboration of people who voluntarily pool their money or other resources together, usually over the Internet, to support efforts of other people or organizations. Crowdfunding can perform a variety of functions - creating free free software, financing start - up companies and small businesses, and more. The use of crowdfunding involves raising funds to begin with. The goal must be declared, the amount of funds needed to achieve it must be determined, and an estimate of all costs and the collection process must be available and open to the public [33].

The main idea of his work is:

- as a rule, fundraising takes place among Internet users on special web-sites (crowdfunding platforms);

- the platform assumes the provision of many aspects, including financial and legal, as well as helps to promote and facilitate the interaction of all participants;

- an agreement is concluded with the platform;

- the platform is paid a percentage of the amount (5-10%).

Ukraine has implemented great ideas that have raised hundreds of thousands of dollars on Kickstarter. The projects were created by Ukrainians. There is its own fundraising platform called Big Idea. Crowdfunding can also be considered as a promising type of funding to address energy efficiency and energy saving through IT, such as: green IT and alternative energy sources.

Green IT is a set of approaches that address environmentally friendly computing and information technologies. It is the science and practice of

designing, manufacturing, using and disposing of computers, servers and their subsystems - efficiently and with minimal or zero environmental impact.

Alternative energy sources are inexhaustible sources of permanent energy or appear periodically in the natural environment, such as solar, wind, geothermal, wave and tidal energy, hydropower, biomass and biogas energy.

The next type of financing is P2P lending. P2P stands for peer-to-peer or person-toperson lending, which means lending to equals or person to person, in other words it is lending by an individual to an individual.

In P2P lending, equal parties enter into credit relationships and enter into an agreement with each other on the loan value through an intermediary - a microfinance organization or a bank. This type of activity is usually conducted in electronic form and is a form of microcredit, in which the issuance and receipt of loans by individuals is carried out directly, without the involvement of banks.

The traditional platform for providing P2P loans is the Internet [34]. This can be a standalone site (for example, services Fingooroo, Loanberry, Webtransfer), and a service within the existing site for another purpose (for example, a credit exchange on WebMoney, a service of profitable investments).

P2P investing should not be confused with P2P lending, because in this case, there is a direct interaction with the borrower.

"P2P investing" is the practice of investing money by borrowers who have guarantees that request a loan without resorting to the services of a traditional financial intermediary and which are unknown to the investor. The investment takes place online through an investment / investment company through a P2P investment company. There is an individual investor and a separate borrower. Guarantees (promissory notes) can be sold as collateral and thus, investors can withdraw from the investment before the borrower repays the debt.

The P2P lending service is a platform that brings together lenders on the one hand and borrowers on the other. The platform does not assume credit risks - all loans are issued at the expense of creditors.

The service scores borrowers, provides services for the collection of overdue debts and convenient payment on loans.

Interest rates are either set by lenders (lenders) competing for the lowest rate in a reverse auction, or determined by the intermediary company based on the results of the borrower's loan analysis.

Borrowers who are more likely to default through higher valuations are assigned higher rates.

Lenders mitigate the risk that borrowers will not repay the money received by choosing which of them can be granted a loan, as well as varying their investments depending on the characteristics of the borrower.

Lenders' borrowing costs are not covered by any government guarantees. Bankruptcy of an equity loan company can also jeopardize creditors' investments.

Credit intermediaries are commercial entities; they generate income by charging a one-time fee to borrowers for lending, as well as setting a fee for investors to service the loan, which is either fixed and charged annually, or expressed as a percentage of the loan amount. As a result of the automation of many services, the overhead costs of intermediary companies are reduced, and their maintenance is cheaper than the provision of services by conventional financial institutions. Thus, borrowers can receive money at a lower interest rate, and lenders - to receive higher incomes.

Equal lending does not fit into any of the three categories of traditional financial institutions: depositories, investors, insurers, and is sometimes classified as an alternative financial service.

Financing at the expense of the revolving fund. The revolving fund is a popular financial instrument in the world, which allows you to raise funds for various projects. Unlike funding from local or state budgets, revolving fund funds are much more mobile: they can be disposed of not only within one financial year, but also to avoid additional bureaucratic restrictions in the form

of funding programs and others. The revolving fund provides for the repayable provision of funds for the implementation of certain projects. If the project financed from the revolving fund has become profitable or managed to save on it, these funds are returned to the revolving fund and used to finance the following activities [35].

A revolving fund can be either a financial institution or a regular current account in a bank. In both cases, its funds are used to support activities in a certain area of activity (culture, education, energy efficiency, etc.). The funds are provided for a certain period of time and are reused upon return. Thus high efficiency of use of money is reached.

The revolving fund can provide loans on favorable terms to finance important activities for the owners of the fund. Fund loans can be provided subject to the fulfillment of certain criteria (energy audits, installation of meters, staff training, etc.), the implementation of which enhances the effect of the loan, or even exceeds it.

The revolving fund can finance activities within the local budget, industry, organization or structure. Then the fund is a separate target entity, the funds of which are accounted for in a separate bank account (sometimes virtual), from which the targeted financing is carried out. This account is often replenished with savings. Experience in the use of revolving funds in the world shows that it is a convenient tool for financing energy efficiency measures, especially if you can return the money through savings.

The activities of the revolving fund may apply to all potential users (government and utilities, condominiums, businesses and individuals) and to certain categories (owners of apartments with central heating in houses where such apartments are not more than 10%, owners of individual houses, bicycle users, etc.). In addition, a revolving fund can be created to finance projects in a particular industry (street lighting, heating, energy efficiency in buildings, etc.).

The main stakeholders of the revolving fund are:

1. Financial donor (s) who provide funds for the initial filling of the fund:

• the actual local government;

• international financial institutions and donors;

• potential users of the fund's services (condominiums, for example);

• private investors (including in order to increase sales of their own goods and services).

2. The fund operator, which organizes the process of issuance and refund:

• public organization;

• utility company (separately created or existing);

• local government;

• bank;

• a separately created legal entity.

3. City / settlement / village council as a body - the initiator of the fund and the guarantor of transparency of all processes.

4. Fund user - recipient of funds for the implementation of measures. Users can be both individuals and legal entities (condominiums, children's schools, schools, other utilities, etc.).

There is no special legislation in Ukraine that regulates the activities of "revolving funds" in general and those working in the field of energy efficiency, in particular. The standard documents at the end of the brochure on the establishment of the fund are developed on the basis of the Laws of Ukraine "On Local Self-Government in Ukraine", "On Energy Conservation", "On Public Associations", "On Housing and Communal Services", Tax Code of Ukraine, Budget Code of Ukraine , statutory documents, other bylaws. The documents developed by us have been tested in practice and allow to ensure the activity of the revolving fund in the current legal field of Ukraine.

By its civil nature, repayable financial assistance (revolving fund funds) is a loan and does not have the effect of making a profit by the lender or any other persons who provide funds for the loan. However, in case of granting a loan to an individual for more than a year according to the current Tax Code of Ukraine,

the amount of such loan is included in the total annual taxable income of the individual as other income and is subject to personal income tax at rates of 15/20 percent. Art. 167 of the Tax Code of Ukraine, and the military tax (1.5 percent). In this case, the specified income is reflected in the column "Other income" of the annual tax return on property and income.

When providing loans, for example, condominiums, tax liabilities do not arise in the case of using a loan for home maintenance (current and major repairs, arrangements, etc.). That is, when using the entire loan amount for measures to insulate the house taxes will not have to pay.

In the case of the creation of a fund by a local government to finance activities at facilities located in their department (utilities, subordinate budget institutions, etc.), tax liabilities do not arise under any circumstances. The fund will exist in the form of a bank / treasury account, which is necessary to have funds to finance energy efficiency measures.

The decision to establish a fund must take into account the purpose, objectives of the fund, local conditions and restrictions. In addition, the stated objectives of the revolving fund must meet the amount of funds received by it (the size of the fund).

Most often, the revolver fund is created by the decision of the city council. However, similar decisions can be made by associations of condominiums, cooperatives or commercial organizations.

The purpose of setting up a fund is usually to provide support for energy efficiency measures that have limited support through other financial instruments and / or are in significant demand from recipients.

The tasks / results of the revolving fund can be to stimulate the use of desired technologies in the city (solar water heaters, ITP, LED lighting, etc.), increase the availability of financial resources for energy efficiency measures (the fund is cheaper than market analogues), stimulate the implementation of

certain energy efficiency measures. lighting), reduction of energy consumption and emissions, etc.

Initial investments are determined based on available resources, they must be commensurate with the objectives of the future fund. Participation in the fund of third-party sources (international institutions, private donors, etc.) often leads to better performance of the fund, as it allows to attract additional resources and reduces the percentage of administrative costs in the total costs of the fund covered by the above sources.

There are four main ways to replenish the fund, which can be used simultaneously:

• funds raised by the local council (budget, donor, others);

• funds of financial institutions (development banks, charitable foundations, international technical assistance projects);

• funds received from users of the fund (% for use, contributions to finance the administrative work of the fund, etc.);

• funds received by the fund as savings from the implemented measures (actually or by calculation).

In today's Ukrainian economy, it is difficult to achieve the sustainability of the fund only at the expense of the fund's borrowers, because then it will have interest rates not lower than the level of commercial banks. Therefore, it is advisable for municipalities to allocate an additional amount to the fund from the local budget each year to increase its size.

An important aspect of the work of the incentive fund is to learn more about energy efficiency, to independently implement small projects in the field of energy saving. Also, the fund prepares the ground for more complex financial mechanisms with larger amounts of funding, such as ESCOs.

The adopted Law of Ukraine "On Commercial Accounting for Public Utilities" allows for clear monitoring of energy savings as a result of project implementation.

Tasks for independent work

1. Develop an energy saving project "Save electricity in the house, save payments."

Step 1 (1 week)

1. Record the meter readings in a table every night for a week. It is important that indicators are recorded at the same time each day. It is better to do this work with parents.

2. Build a graph of 1 electricity consumption per week.

Step 2 (2 weeks)

1. Fill in table 3, where you write down the names of all electrical appliances in your apartment, indicating their power (information about the power of appliances is on the nameplate, or in the technical data sheet of the appliance).

2. Calculate the electricity consumption of each appliance per week and record the data in Table 3. (Each appliance is characterized by power, this is the amount of energy consumed per hour. Power is measured in watts or kilowatts, 1 kW contains 1000 watts. On each appliance on the reverse side there are technical characteristics of this device - type of current, frequency, power, maximum voltage in the network.

How to calculate the energy consumption of each device?

Consider a simple example. Chandelier in the hall, has five light bulbs of 60 watts. On average, this chandelier burns 6 hours a day. Let's calculate how much electricity this chandelier consumes per day, per week.

5 lamps · 0.060 kW = 0.3 kW per hour

0.3 kW · 6 years = 1.8 kW per day

1.8 kW · 7 days = 12.6 kW per week

1 kW = _, _____ UAH, so 12.6 · ___, _____ UAH = _____ UAH.

Step 3 (2 weeks)

1. Discuss ways to save electricity. See a list of electrical appliances in your home.

2. Ask friends or acquaintances how they save electricity.

3. Write down all the options and make an action plan in Table 4.

Step 4 (2 weeks)

1. Next week, in accordance with the specified action plan for saving electricity, record the indicators in Table 2, as you did before the application of the saving mode.

2. Plot a graph of 2 electricity consumption per week.

3. Write the results of two weeks in a summary table 5. Compare. How much energy and money did you manage to save from the budget?

4. If you see that the difference in the third column of your table is negative, try to find out during the discussion why you failed to save.

Energy saving project

"Save electricity in the house, save payments"

Name _____

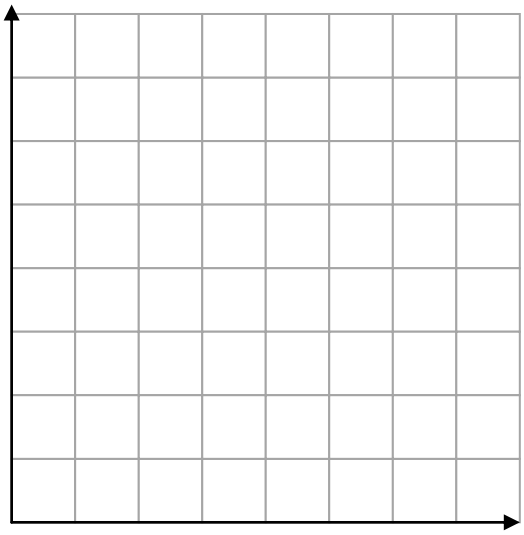
Table 1

Days of the week	**Date**	**Meter readings**	**The difference between the following indicators and the previous ones**	**Cost of consumed electricity in hryvnias**
Sunday				
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				
Total				

Table 2

Days of the week	Date	Meter readings	The difference between the following indicators and the previous ones	Cost of consumed electricity in hryvnias
Sunday				
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				
Total				

Schedule 1



Schedule 2

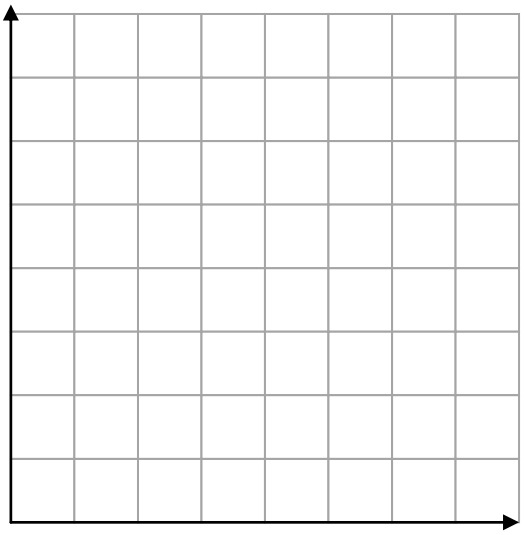


Table 3

№	Name electrical appliance	Power	Electricity consumption of the appliance per week
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Table 4

№	Ways to save electricity	The cost of possible energy savings in UAH
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Table 5

	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Total
1 weeks								
2 weeks								
Difference saved energy								
The cost of energy saved in UAH								

Questions to control knowledge

1. What is the difference between "sustainable energy" and "competitive energy" ?

2. Name the main indicators of the energy resilience index ?

3. Name the basic principles of energy saving ?

4. Describe the international experience of financing energy efficient projects ?

5. What are the tools for financing energy efficiency ?

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THEME 7

EUROPEAN EXPERIENCE IN ASSESSING INVESTMENT ATTRACTIVENESS AND RISK-RESPONDING TO ENERGY SAVING

Criteria for economic efficiency of investing funds in improving the energy efficiency of European countries. The practice of European institutions to assess and compare the investment attractiveness of energy efficiency projects. European experience in project risk management and approaches to reducing the risks of energy saving projects. Prospects for increasing the investment attractiveness of energy saving projects in Ukraine in the context of European integration.

The increase in the number of projects in the field of energy efficiency and renewable energy, which is currently observed in Ukraine, indicates a significant change in the consciousness of citizens in relation to energy independence and their views on the rational use of energy resources in the future. The positive dynamics is evidenced by the fact that over the past two years in the ranking of energy efficiency among European countries, our country has managed to rise from last place to a completely European level. Further development of energy efficiency is currently a priority for Ukraine. To achieve this goal, it is necessary to implement new projects that require additional investment. In order to facilitate this process, a unique information web resource - UA MAP was created. It is a reliable communication platform between all parties interested in energy efficiency and renewable energy projects. In addition, the interactive investment map clearly demonstrates to each of us that Ukraine is really making progress in these areas.

In European countries, the assessment of the level of efficiency of an energy saving project is assessed using certain methods that are used in Ukraine

today. In the modern scientific literature it is possible to meet an estimation of various kinds of efficiency of investment and innovative projects on energy saving, - economic, budgetary, power (technological), ecological, social, public. However, in normative methods, methods of international financial organizations and numerous alternative methods, considerable attention is paid to determining the economic efficiency of projects. At the same time, scientists use a different number of different economic indicators to assess it, which can be calculated without taking into account the time factor or based on discounting cash flows; some of these indicators may have, albeit different names, the same essence.

The analysis shows that the current methods of assessing the effectiveness of innovation and investment energy saving projects at the level of a particular region, city, and at the level of a particular enterprise and individual home is based on the cost principle, according to which energy efficiency is reduced mainly to reduce energy consumption. Therefore, today all energy efficiency projects are primarily determined by the economic efficiency of the project. Evaluation of economic efficiency of investment proposal, investment project is carried out by the Ministry of Economic Development according to the criteria specified in Fig., Which are defined by the Resolution of the Cabinet of Ministers of Ukraine of July 18, 2012 № 684 "On approval of the Procedure and criteria for economic efficiency projects ".

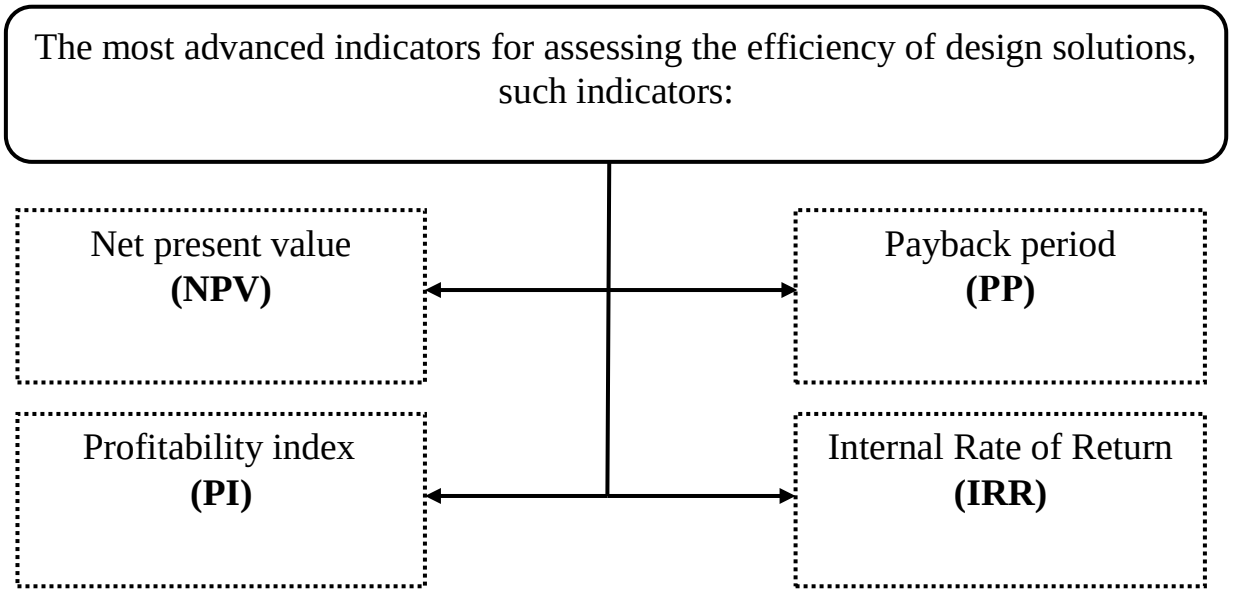

Figure 7.1 – Performance indicators of design solutions

Table 7.1 – The essence of the main indicators of economic efficiency

№	Indicator	The essence of the indicator	Calculation	Components of the calculation
1	2	3	4	5
1	Net present value **(NPV)**	Under (NPV) is the difference between the amount of net cash flow reduced to the current (present) value for the period of operation of the investment project and the amount of investment costs for its implementation.	$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+i)^t} - \sum_{t=0}^{n} \frac{IC_t}{(1+i)^t}$	*CFt* – the amount of net cash flow at certain intervals of the total period of operation of the investment project; *IC* - the amount of simultaneously invested costs for the implementation of the investment project; i - discount rate used; *n* - is the number of intervals in the total calculation period *t*.
2	Profitability index **(PI)**	Under (PI) means the ratio between the reduced to the current (present) value of the amount of net cash flow for the period of operation of the investment project and the amount of investment costs for its implementation.	$PI_0^A = \frac{\sum_{i=1}^{n} \frac{CF_t}{(1+i)^n}}{\sum_{i=1}^{n} \frac{IC_t}{(1+i)^n}}$	

Continuation of table 7.1

3	Payback period **(PP)**	Payback period (RI) is the time interval from the beginning of the project implementation, during which the equality of total project revenues and total project costs is achieved and beyond which the reported profit remains positive.	$PP = \frac{IC}{\frac{\sum_{i=1}^{n} \frac{CF_t}{(1+i)^n}}{n}}$	
4	Internal Rate of Return **(IRR)**	The internal rate of return (IRR) is defined as the discount rate at which the amount of reduced sales proceeds is equal to the amount of reduced project costs. IRR characterizes the rate of return on capital invested in the project.	$IRR = i_1 + \frac{NPV_1 \times (i_2 - i_1)}{(NPV_1 - NPV_2)}$	NPV_t – the amount of net cash flow at certain intervals of the total period of operation of the investment project; n – is the number of intervals in the total calculated period t.

Informal procedures should be used to select project options and decide on its feasibility in order to take into account the values of all factors and relationships, which allows us to conclude on the feasibility of the project.

When selecting a project, the investor must define its own system of priorities, which may include the following possible options:

- social significance of the project;

- impact on the image of the investor company;

- compliance with the investor's purpose;

- market potential of the created product;

- compliance with the financial and organizational capabilities of the investor;

- environmental friendliness and safety of the project;

- level of risk, etc.

Table 7.2 – Criteria for selecting projects in terms of economic efficiency

№	Indicator	Selection criteria	Possibilities of application
1	Net present value **(NPV)**	According to this criterion, the project is approved under the condition of its positive value (more than 0), and when comparing several projects, the project with the highest value of this indicator is selected.	This indicator makes it possible to determine the effect of project implementation in value terms, which is formed in comparison with the net benefits of project implementation and the costs of its formation.
2	Profitability index **(PI)**	According to this criterion, the project is approved when the value of this index is greater than one, and when comparing several projects, the project with the highest value of this indicator is selected.	This indicator makes it possible to determine the effect in relative terms, as a result of comparing the benefits and costs of the project, but does not reflect the actual results of the project. This indicator is not acceptable for ranking independent or mutually exclusive projects.
3	Payback period **(PP)**	This criterion is used to compare several projects and when comparing select the project with the lowest payback period.	This indicator characterizes the duration of the return on invested capital by obtaining current cash flows from the project.
4	Internal Rate of Return **(IRR)**	This criterion is a benchmark for comparing the opportunity cost of invested capital, the actual discount rate that is acceptable for the project if it pays off. Used to compare several projects when comparing select the project with the lowest value of this indicator.	This indicator characterizes the maximum interest on borrowed capital that can be repaid in a period equal to the project life cycle. Some properties of this indicator limit its application, namely that for a project there may not be a single IRR value, especially in projects with a large time horizon; ranking according to this criterion is not acceptable for mutually exclusive projects.

During the evaluation of the criteria at the first stage, expert-analytical methods are used: construction of the goal tree, problem tree, analysis of the adequacy of organizational structures.

At the second stage preliminary programs of realization of a problem as a whole or its increased components are formed.

At the preliminary stage, the upper limit of possible costs is usually estimated, which could further be a benchmark for the relevant criteria for evaluating projects and developments.

In the process of forming investment programs, quality criteria can be: completeness of measures included in the program, complexity, efficiency, level of knowledge, degree of manageability or reliability, availability of resources, connection with related industries, infrastructure improvement, employment support and potential investors , the possibility of further diversification.

For the implementation of the program can be created organizational and institutional structures, the task of which is the accumulation of resources, creating a motivational environment for potential participants, combining the efforts of production and scientific and technical units, the organization of work management.

In some cases, project selection may be on a competitive basis. The competition of projects provides:

- development of competition conditions;
- creation of competition councils and expert groups;
- clarification of the system of criteria;
- systematization of replenishment and updating of the database of promising projects and developments;
- conducting competitions;
- analysis of the completeness of the coverage of problems by the winners of the competition and development of requirements for additional projects.

The project selection procedure is based on the principles that the state can:

- perform the functions of an intermediary and organizer of investment activities, create the appropriate infrastructure;
- provide direct and indirect support to investors, if it is in its interests, or participate in joint ventures;

- to be the founder of new organizational forms of innovation and investment policy, as well as the initiator of the creation of special investment funds for the concentration of funds from various sources in order to implement priority projects for the state.

To receive financing, the developer of an energy-efficient investment project must develop it on the basis of the approved form of the Order of the Ministry of Economic Development and Trade of Ukraine dated 19.06.2012 № 724 “On approval of the form of project (investment) proposal state support, the Procedure for development and forms of investment project, for the implementation of which state support may be provided". According to it, the form of the project (investment) proposal, on the basis of which the investment project is prepared, for the development of which state support can be provided, has the following form.

1. The name of the project (investment) proposal, on the basis of which the investment project is prepared, for the development of which state support may be provided (hereinafter - the investment proposal).

2. Information about the subject of investment activity.

2.1. Full name and contact details:

- full name;
- location;
- USREOU code;
- contact person data:
- name and surname;
- position;
- e-mail address;
- telephone number;
- fax number.

2.2. Description of the subject of investment activity:

- a brief history of the subject of investment activity;

- organizational structure of the subject of investment activity;

- experience for the last three years in the implementation of such investment proposals or in their management;

- main activities, products, including innovation, or services;

- market position.

3. Description of the investment proposal.

3.1. The purpose and objectives of the investment proposal.

3.2. Measures and schedule of their implementation.

3.3. Technical and / or technological analysis of the investment proposal.

3.4. Innovative orientation of the investment proposal.

3.5. Investment costs.

3.6. Sources of funding

3.7. Other investment proposals submitted.

3.8. Preliminary technical and economic calculations.

3.8.1. Economic efficiency:

- ✓ net present value (NPV);
- ✓ internal rate of return (IRR);
- ✓ payback period (PP).

3.8.2. Budget efficiency.

3.8.3. Social efficiency.

3.9. Identify alternative ways to achieve the goal and arguments about the advantages of the selected method.

3.10. Risks and possible ways to reduce them

4. Legal aspects related to the investment proposal.

4.1. Compliance with the legislation of Ukraine.

4.2. Availability of certificates, licenses and other permits.

5. Mandatory appendices:

- duly certified copies of the document on state registration of the investment entity and its constituent documents;

- schedule of loan repayment and servicing;

- financial report of the investment entity as of the last reporting date and financial statements for the previous year;

- the results of the financial audit of the investment entity;

- information on the allocation of land, the state of development of design and estimate documentation and state examination in the case of inclusion in the investment project of construction projects;

- certificate on previously received loans and long-term loans of banks, including foreign ones, as well as on the absence of overdue debts for more than three months for their repayment and servicing;

- information on the absence of the subject of investment activity overdue for more than three months of arrears to the state budget for the payment of taxes and fees (mandatory payments).

At the same time, "energy efficiency is not only a production-technological and economic process associated with reducing energy consumption and reducing their cost, but also social. The social aspect of energy efficiency is to meet the needs of society in energy resources in a way that meets the needs of today's generation and does not jeopardize the ability of future generations to meet their needs "[12]. The need to determine the social efficiency of investment projects is determined by the results of the study of the effectiveness of social factors on the energy efficiency of the national economy. They showed that the socio-cultural component by 14.9% affects the aggregate indicator (energy intensity of GDP) and ranks third in the importance of spheres of influence after the political and economic (48.3%) and structural (24.3%) factors [13]. Energy saving programs funded by international financial organizations are also aimed at improving the social environment. In particular, the goal of the international financial institution "Northern Environmental Financial Corporation (NEFCO)" is to increase energy efficiency and reduce harmful emissions by implementing energy saving measures on social

infrastructure - schools, kindergartens, hospitals, sports facilities, modernization of street lighting systems [9]. Projects implemented under the Alternative Energy Financing Program in Ukraine (USELF) also have positive social results, which are to increase jobs. However, in the scientific literature there is still no substantiated clear system of indicators for assessing the social effectiveness of investment projects.

Thus, in the "Procedure for expert evaluation of the project proposal", approved by the Ministry of Economic Development and Trade of Ukraine in 2010, social efficiency is characterized by an increase in sales; the number of saved or newly created jobs; improving working conditions of employees; introduction of innovations; improving (creating) infrastructure, etc. [5]. In addition, preliminary technical and economic calculations provide for the determination of economic and budgetary efficiency. In particular, the economic efficiency of the project is calculated using indicators of net present value (NPV), internal rate of return (IRR) and discounted payback period (PP). Budget efficiency is assessed by identifying planned revenues to the state budget, including through: revenues from taxes, fees and other mandatory payments; funds from payment for obtaining licenses, conducting tenders and tenders for exploration, construction and operation of facilities; loan repayment; fees for the provision of credit and / or state guarantee of fulfillment of obligations of business entities; dividends.

A single attempt to determine the social efficiency of energy saving projects was made in the methods [12; 14]. Thus, according to the method of assessing the effectiveness of the energy saving mechanism of the enterprise, the integrated indicator is defined as the ratio of the sum of results (effects) obtained from the implementation of energy saving measures to the costs incurred for their implementation [19, p. 51-52]. The result of the implementation of energy saving measures is expressed by various effects - economic, resulting from the resulting savings of energy resources; social, which is reflected in the

improvement of working conditions, and environmental, which can be obtained by reducing contaminated soils and other harmful emissions into the environment. The costs of implementing energy saving measures will consist of current production costs and energy management costs. At the same time, characterizing the social component, the author of the method notes that as a result of the introduction of energy-saving equipment and technology there may be a negative social effect, which will be to reduce (release) employees.

Fokin V.M. proposes to improve the current methodology for assessing the effectiveness of investment in energy by adapting it to the international commitments made by Ukraine on environmental protection [12]. His formula for calculating the social effect of energy efficiency projects is to reduce harmful emissions from the combustion of fossil fuels by setting a normative benchmark of the social effect (average annual emission reductions in accordance with Ukraine's international obligations). Of course, the amount of harmful emissions affects the health, working and leisure conditions of the population and, on the other hand, this indicator characterizes the ecological condition of a particular region, ie determines the environmental performance of the project. In addition, it is necessary, according to the author, to determine the social effect of energy saving measures by determining the part of the profit generated by the implementation of measures and should be aimed at reducing electricity tariffs or investing in further energy efficiency.

Thus, the above methods usually contain qualitative indicators (improvement of working conditions, social infrastructure), quantitative indicators or represented by the number of saved (newly created) jobs, or they are adopted indicators of environmental efficiency. At the same time, if we take the health of the population as a general indicator of anthropogenic pressure on the environment, we can identify indicators that characterize the impact of environmental factors, including the use of various energy sources, on the physical potential of society. We believe that such indicators are:

− the level of morbidity of the population, including occupational diseases. The calculation of this indicator to determine the social efficiency of the energy saving project is due to the fact that in recent decades there has been an increase in diseases caused by the Chernobyl disaster, consumption of poor quality drinking water and food, as well as air pollution (lung, cancer);

- the level of occupational injuries and mortality rates. In particular, these indicators should be calculated for projects planned to be implemented in regions with developed coal industry, where there is the highest rate of fatal accidents due to depreciation of fixed assets, low levels of social protection and labor protection.

In general, it should be agreed with domestic scientists that the social efficiency of innovation and investment energy saving projects will be achieved if the population develops habits of economical energy use. Dissemination of information on the importance of energy-saving technologies, economical treatment of energy resources, measures to promote energy efficiency policy, training of energy managers and auditors in higher education and training of engineering specialists, their focus on stimulating the efficient use of energy resources. paradigm, will contribute to the formation of energy-saving type of public consciousness and the use of energy saving as a resource for the development and formation of an efficient energy market [15; 16]. Thus, the indicators for assessing the effectiveness of financing innovation and investment projects for energy saving by type of efficiency can be presented in Fig.7.2.

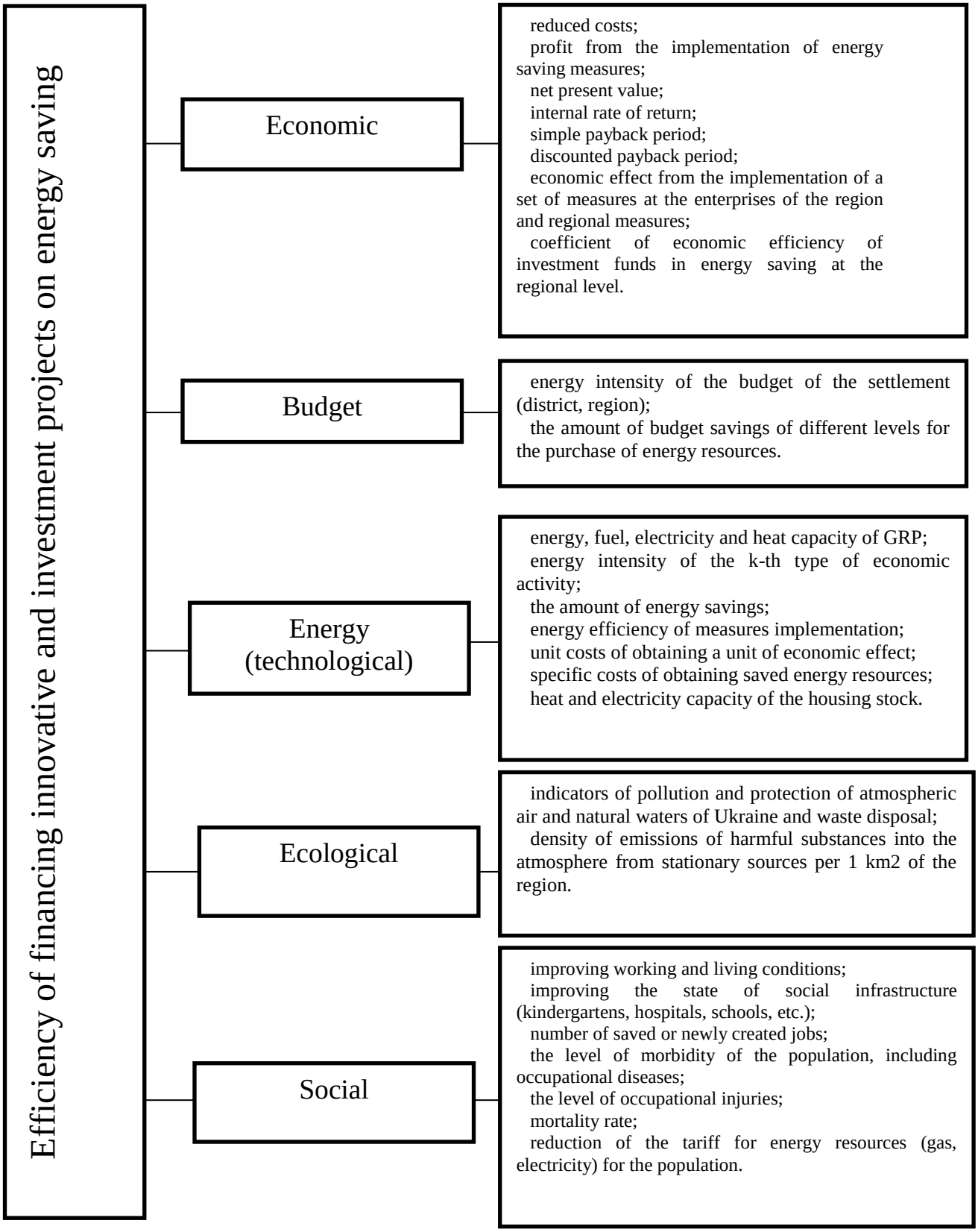

Figure 7.2 – Indicators for assessing the effectiveness of financing innovation and investment projects for energy saving

As already mentioned, today the most acceptable for financing energy efficiency projects may be the financing from the Energy Efficiency Fund and bank loans. Consider in more detail the mechanism for financing energy efficient projects from these sources.

The State Energy Saving Fund is established to provide funding for measures for the efficient use of fuel and energy resources.

The sources of formation of the State Energy Saving Fund are [1]:

- funds received for the issuance by the central executive body that implements state policy in the field of efficient use of fuel and energy resources, permit documents;

- voluntary contributions of enterprises, institutions, organizations and citizens.

Energy saving funds are used to finance measures for the rational use and saving of fuel and energy resources, including research and development work in the field of energy saving, equity participation in the implementation of economic restructuring programs aimed at energy saving, development and implementation of energy saving technologies and equipment. , providing credit benefits and subsidies for the development and implementation of energy saving measures and programs.

The funds of these funds are also used for the development of non-conventional energy, production of alternative fuels, state energy expertise, organization of training and retraining, development of energy standards, norms and standards, participation in equipping enterprises with metering, control and management of energy use.

The key participants in the fund's program are condominiums. In Ukraine, 180 thousand 456 apartment buildings. Of these, as of January 1, 2019, there are 26,603 associations of co-owners of apartment buildings in 30,188. Which is 16.7% of the total number of houses. The next step is to control consumers' own energy consumption. High tariffs have forced Ukrainians to think about it, but,

unfortunately, it is impossible to set up the system at once. For many years, the problem has been kept quiet: it is convenient and profitable for the supplier to write off costs that cannot be verified.

Today, the cost of equipping houses with heat meters and their maintenance is included in the tariff for the service of central heating. Namely - as depreciation and profit (if any) in the tariff for heat supply. Tariff for district heating / heat supply service is the sum of tariffs for heat energy production (94.5%), its transportation (4), supply (1), as well as service provision (0.5%). According to data collected under the USAID Transparent Energy project, the average tariff for heat transportation at the beginning of 2019 was UAH 41.83 / Gcal. Depreciation deductions in it amounted to 13%.

If we imagine that during the heating season the average family will pay 12,000 hryvnias for heat, then about 53 hryvnias will be provided for the installation and maintenance of common meters.

In fact, communal meters would already be in our homes if heat supply companies implemented their investment programs on time. Unfortunately, for objective and subjective reasons, the funds collected from consumers of the enterprise are often spent for other purposes.

The cost of the meter is not allocated in a separate line in the payment, therefore, the consumer does not understand who, how and when should be engaged in the installation of the meter, its replacement or maintenance. But even a fair payment of these costs does not guarantee that the funds raised will be spent by the heat supplier on the meters in your home. For them, you can install a meter in the next house, and yours will not have enough money. In addition, if you and your neighbors have installed a heat meter for the house yourself, because they did not want to overpay according to regulations, the tariff is not reduced (in fact, you pay for the meter twice).

In addition, by their nature, heat suppliers may not be interested in full accounting. After all, heat losses in heating networks can be transferred to

consumers without accounting. And repair and modernization of networks is the main task for local authorities. By the way, the vast majority of suppliers belong to the consumers themselves - as the property of the local community.

In addition to heat meters for condominiums, a number of energy saving measures are also offered. Therefore, the creation of an energy efficiency fund is aimed at performing certain functions:

- Financial. Currently, most families do not have effective financial instruments to invest in energy efficiency. Given current interest rates on consumer loans (25-30%), households cannot repay investments by saving on heating bills. In addition, the existing state program to support "Warm" loans, provides only compensation for the body of the loan for materials. Therefore, due to the high interest rate and the added cost of construction and installation work, financial support does not provide the necessary tool to increase household investment in energy efficiency. With this in mind, the development of the Fund's financial products was aimed at creating tools to repay energy efficiency investments from savings on heating bills;

- Stimulating. Second, most families, especially those living in high-rise buildings, have no incentive to invest in energy efficiency measures. One of the main reasons is that such investments will not reduce consumer bills, as most high-rise buildings currently have neither heat meters nor tools to regulate heat supply. Therefore, in the early stages, the Fund should focus on activities that provide tools for measuring heat consumption and regulating its supply, thereby reducing heating costs, such as the installation of heat meters and individual heating points for multi-storey buildings. This is expected to give a boost to households for further energy efficiency measures.

- Expert. Third, most families and even construction companies do not have sufficient knowledge and capabilities to develop and implement energy efficiency projects. Thus, the Foundation should provide expertise and advice on standard projects (solutions) for the house, provide technical advice on project

development and training for construction companies and energy auditors. In addition, the Foundation should help build the competencies and expertise of construction companies.

- Educational. Also, a large proportion of the population does not have an understanding of the concept of energy efficiency, the benefits of energy efficiency measures, the reasons for tariff increases and a lack of awareness of tools for investing in energy efficiency. Thus, the Foundation should explain these issues to Ukrainian households through special communication campaigns. This campaign will work best with the Foundation's attractive products and technical recommendations.

Taking into account the current situation, the following goals of the Fund were envisaged:

1. Large-scale and rapid savings of gas and, consequently, subsidies and budget funds.

2. Creating financial instruments for households that will allow them to invest in energy efficiency and also reduce their heating bills.

3. Attracting large-scale external financing and experience in energy efficiency in Ukraine.

4. Creating conditions for the formation of the energy efficiency market.

5. Implementation of Articles 7 and 20 of EU Directive 2012/27.

6. Creation of a new effective, transparent and free from corruption institution as a tool of the Government's policy.

7. Provision of expert services and consultations related to energy efficiency to households and implementers of energy efficiency measures.

One of the key principles of the Fund's model is the prevention of corruption. That is why in Fig. the mechanism of transparent use of the Fund's funds is depicted.

The description of management and organizational model can be divided into three parts:

1. The mechanism of financial flows

2. Management and organizational structure

3. Legal institution of the Fund

On the part of the Government, the funds are transferred to the Fund through annual budget allocations. These appropriations should be provided for in the Budget Law. Also, they should be directly related to the reduction of subsidies and / or reduction of gas consumption, heating bills, etc. The sustainability of the Fund's funding from the State Budget should be ensured by making certain amendments to the Budget Code, which will determine the amount of annual allocations. Budget funds are allocated to the treasury account of the Ministry of Regional Development, which in turn contributes to the capital of the newly created legal entity.

On the donor side, the grants are located in the International Finance Organization (IFI), which acts as the donor fund manager. MFIs provide grants to the Fund (State Legal Entity) or directly to the project's bank account with a commercial bank. These funds are distributed on the basis of a future investment plan or after the completion of certain projects and / or the implementation of certain key performance indicators.

The funds are transferred to the Fund's accounts and then allocated to individual projects in the form of grants and subsequently, possibly, as liquidity for banks. In any case, funding is provided only after consideration and approval of the project by the Fund.

During the project implementation there are certain stages of its management. Peculiarities of submitting an investment application, peculiarities of contracting contractors of condominiums, peculiarities of receiving grants after project implementation, condominiums to receive financing of measures, energy efficiency fund products, package "Easy", package "Complex", calculation of economic feasibility for condominiums are shown in the figures.

The next source of funding is warm loans and local programs.

Since 2014, the Warm Credit program has been operating in Ukraine within the framework of the State Targeted Energy Efficiency Program. It can be attended by both individuals and associations of co-owners of apartment buildings (condominiums) or housing cooperatives (HBC). Loans under this program are issued by state banks (Oschadbank, Ukrgasbank, Ukreximbank), and in 2017 they were joined by Privatbank. But in 2019, Ukreximbank suspended the process of issuing loans under the program "Warm Credit".

During the program, the total amount of compensations issued to individuals and condominiums / housing and communal services on energy loans exceeded UAH 4 billion, of which UAH 832million was issued in 2017.

However, by the end of last year, the funds allocated for this program from the budget had run out, and the partner banks had virtually stopped issuing "warm loans" with state compensation.

On December 1, 2017, the Cabinet of Ministers of Ukraine decided to extend the energy efficiency program until 2020 and the budget for 2018 provided UAH 400 million for compensation with "warm loans", including UAH 190 million for condominiums. The same amount for compensation is included in the 2019 budget. Given that for individuals the amount of credit is up to 50 thousand UAH for up to 3 years, and for condominiums / HBC - up to 2 million UAH for up to 7 years, the allocated amount is quite small.

Those who still plan to take advantage of this opportunity should contact one of the partner banks with a package of documents, which will be determined there. For an individual it is usually a passport, a certificate of assignment of a tax number, a certificate of income for 3-6 months, an invoice from the supplier. The list of equipment and materials for which state compensation is provided is approved by the Cabinet of Ministers, and the range of suppliers was previously determined by the bank, recently the supplier is determined by the borrower, the main thing is that the goods in the invoice correspond to the list. If the borrower receives a subsidy for housing and communal expenses, he is obliged to provide

copies of documents confirming the purpose of the subsidy. As for Privatbank, its main requirement is that the borrower has a Privat card, which has the option to pay in installments. It is important not to exceed this amount, otherwise you may lose compensation.

Within 1-2 days, the bank makes a decision, and if the documents and goods meet the requirements of the program, the borrower pays a down payment of 10% of the value of the goods and a bank fee, and the bank transfers money for the goods to the supplier. The latter supplies the goods in accordance with the invoice and issues an acceptance certificate or an invoice for the bank, thus confirming the intended use of credit funds.

The bank then enters it in the register of borrowers, which it submits to the State Agency for Energy Efficiency for consideration of the application for compensation. Finally, the State Agency for Energy Efficiency transfers the relevant funds of the bank for their further transfer to the borrower's account, these funds are automatically used to repay the loan. In general, the refund process takes up to 2 months, and if done correctly, there are almost no failures. Refusal to provide reimbursement is usually due to problems with primary documents: at the stages of registration of a "warm loan" and confirmation by the bank of the intended use of credit funds.

Compensation is: - 20-35% of the loan amount (but not more than 12 or 14 thousand UAH) for the purchase of solid fuel boilers, energy efficient equipment and materials for individuals; - 40-70% of the loan amount (but not more than 14 thousand UAH per apartment) for condominiums / HBC, and the more apartments receive a subsidy, the higher the percentage of compensation.

If you consider the terms of the loan under this program, then those who plan to get a small amount or take a short-term loan, the best terms and the simplest procedure offers "PrivatBank" (the amount is divided into payments and deducted monthly from the client's account, monthly fee 2, 9%). At the same time, for longer periods and for significant amounts, the amount of its

commission is higher than the payments of rival banks. You can compare the terms of loans on the basis of the following data.

According to the State Agency for Energy Efficiency, the program was used by about 160 thousand families, issuing 111 thousand "warm loans" worth over 2.3 billion UAH. The government paid almost UAH 820 million in compensation.

The largest number of citizens' applications for "warm loans" is observed in Oschadbank, where more than 63,000 loans worth almost UAH 1.4 billion were issued.

The second place in this rating is occupied by Ukrgasbank, where almost 17,000 "warm loans" worth over UAH 528 million were issued.

Fewer loans were raised from Privatbank and Ukreximbank, which have recently joined the program.

In addition to national energy efficiency programs, 151 local programs to reduce the cost of "warm loans" have been developed and are being financed in the regions of Ukraine.

City programs

Lviv, Cherkasy and Ivano-Frankivsk regions. Under the agreement with Oschadbank, local authorities partially reimburse residents for the amount of loans taken for the purchase of energy-efficient equipment, materials and non-gas boilers.

Dnipropetrovsk. Competition of mini-projects on energy efficiency and energy saving for condominiums and HBC.

Vinnytsia. The program to stimulate the implementation of energy saving measures in the buildings of condominiums "Energy efficient house. Step by step".

Kamianets-Podilskyi. Energy saving program in residential buildings "WARM HOUSE" in Kamianets-Podilskyi.

Kiev. Competition of projects for the implementation of energy efficiency measures in residential buildings in Kyiv, in which associations of co-owners of apartment buildings, as well as in cooperatives.

Lviv. The program of reimbursement of part of the loans received by condominiums, HBC for the implementation of energy saving measures, reconstruction and modernization of apartment buildings.

Rivne. Municipal program of sustainable development in the city of Rivne. The program of arrangement of apartment houses with modern devices of the account and regulation of water and thermal energy in Exactly. Program "Insulation of residential buildings of Rivne City Council".

Ternopil. Program of energy efficiency, energy saving and thermal modernization of Ternopil housing stock buildings.

Cherkasy. ACMH support program in Cherkasy. "Formation of a responsible homeowner".

Khmelnytskyi. Program of partial reimbursement of interest rates on loans for energy efficiency measures.

Tasks for independent work

Project plan

Develop the project "Energy saving - a step towards the future".

Preparatory. Defining goals, objectives, methods. Teamwork planning.

Motivational. The project participants conduct educational work among students, residents of neighborhoods, disseminate knowledge about the possibilities of energy conservation and the possibility of participation of everyone in the conservation of natural resources of Ukraine. The experience of the European Union in the field of energy saving is presented.

Practical. Conducting promotions, flash mobs, lessons with elements of the game, creating and demonstrating presentations for students,

Final. Registration of the received data and definition of recommendations on energy saving.

Questions to control knowledge

1. How to calculate the economic feasibility of implementing energy saving measures?

2. Name the main products of the energy efficiency fund?

3. What are the main steps of condominiums to obtain funding?

4. What are the features of submitting an investment application from condominiums?

5. What are the main stages of implementing an energy efficient project?

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THEME 8

EUROPEAN PRACTICE OF FORMING ENERGY EFFICIENCY CONSCIOUSNESS

Promotion of energy saving and European practice of educating the culture of energy consumption in Ukraine. European principles of training and conducting a targeted information campaign on energy saving European system of financial, administrative and behavioral incentives for energy saving and its adaptation to Ukrainian realities.

The formation of a conscious and energy efficient society is one of the main goals of Ukraine's Energy Strategy.

This is, first of all, raising public awareness of modern ways of economical and efficient use of energy and greater involvement of renewable energy sources in line with the pan-European policy to combat global climate change.

Today our task is to change the culture of energy consumption in general.

To do this, first consider the concept of what is energy efficiency and energy saving.

In general, these concepts are often used interchangeably. However, in reality, energy efficiency is only one aspect of energy saving.

Unlike energy saving (energy conservation), which is mainly aimed at reducing energy consumption, energy efficiency (the benefit of energy consumption) is a useful, efficient energy consumption.

When we talk about energy efficiency, we mean not only "energy saving", ie energy savings in everyday life. We are talking about the rational and conscious use of energy resources available to everyone, in order to carefully preserve them for the environment and our descendants.

Energy efficiency is a field of knowledge at the intersection of engineering, economics, law and sociology. Means the rational use of energy resources, achieving economically feasible efficiency of the use of existing fuel and energy resources at the actual level of development of machinery and technology and compliance with environmental requirements.

The term "energy efficiency" means achieving a certain result, such as heating a house, using less energy than usual. Those who use energy efficiently prevent the misuse of resources and protect the environment.

Most people have a very rough idea of how their daily activities at work and at home affect energy consumption and the environment. Meanwhile, the achievement of the goals set by the city energy policy depends on the awareness, commitment and skills of all city residents, regardless of age, profession and position. That is why the tone of educational work in the city should be set by the city authorities (represented by the city energy manager), maximally enlisting the support of energy agencies, energy suppliers and utilities, NGOs and activists, condominiums, media and more.

Consider the current state of energy efficiency in Ukraine.

Ukraine is one of the energy-deficient countries in providing the main types of primary energy, which necessitates significant volumes of their imports. The level of energy dependence of the country (over 51%) is largely determined by inefficient use of energy resources.

Industry has reduced gas use by more than 3 times, and the population by only 1/3.

Inefficient consumption of fuel and energy resources increases the level of import dependence of the country's economy and deepens the problems of its energy security with unrealized, according to the Institute of General Energy of the NAS of Ukraine, energy saving potential and energy efficiency to 48%.

One of the main indicators in determining the energy efficiency of each country's economy is the energy intensity of GDP. Today, Ukraine is the most

energy-intensive country in Europe in terms of a significant level of import dependence. Low efficiency of fuel and energy resources causes a high level of energy intensity of GDP in Ukraine, which at purchasing power parity (PPS) in 2019 exceeded the energy intensity level of GDP of the EU by 3.12 times; Great Britain - 4.3 times; Germany - 3.1 times; France - 2.8 times; Turkey - 2.7 times; China - 1.7 times, and the average value of the world - 2.2 times. In particular, in Poland, with more than 2.6 times lower energy intensity of GDP, its volumes are 3 times higher than the level of GDP of Ukraine [2].

According to international standards, Ukraine's economy is one of the most energy-intensive economies in the world due to a large share of energy-intensive sectors, obsolete and inefficient technologies, extremely depreciated fixed assets, inefficient energy transformation and supply systems and energy-inefficient building stock [3].

According to expert estimates, only in the residential sector of Ukraine the specific consumption of thermal energy is 2-3 times higher than in the EU countries, in particular, in apartment buildings from 150 to 264 kWh / m2; in European countries the specific heat consumption in similar houses is up to 90 kWh / m2, in particular, in Germany - up to 70 kWh / m2. In budget buildings, thermal energy consumption is from 130 to 250 kWh / m2, in the EU this figure is from 50 to 80 kWh / m2. Reaching the European level of energy consumption in the country's buildings will save up to 11.4 billion m3 of natural gas [2].

Given the high level of energy intensity of the economy and import dependence of the country and inefficient use of energy resources, energy efficiency is today the most important resource for energy security of the country, reducing import dependence and guaranteeing the necessary potential for further economic development.

According to statistics, of the total energy consumed in the home, 70% goes to space heating, 15% of energy is spent on cooking, 10% of energy is consumed by household appliances and another 5% of energy is spent on

lighting. Of course, the figures are averaged and largely depend on the area of the house or apartment, heating system, stove, etc. [4].

According to the Ministry of Regional Development of Ukraine, the annual heat loss in the country's residential sector reaches 60%, equivalent to $ 3 billion. The largest energy losses occur in apartment buildings, which account for 98% of the country's housing stock and consumption of up to 58% of the total [2].

To solve this problem, it is necessary to start implementing the practice of European countries: mechanisms for co-financing energy efficiency measures, energy service, energy management, etc.

Today there are 3 categories of awareness-raising activities:

- preparatory activities (consisting of providing information),
- further measures (interactive, based on specific actions),
- measures with social impact.

Preparatory activities:

In turn, they can be divided into measures without feedback on consumer behavior and those in which the consumer receives feedback on how he consumes energy. However, in both cases, the measures are not interactive and do not monitor whether their implementation has led to changes in energy consumption behavior.

The first subgroup of preparatory activities includes:

- websites with information on various aspects of energy saving, y TV commercials and cartoons on energy issues,
- educational materials for different target groups (eg students),
- CDs with short films on energy consumption
- brochures and booklets,
- posters and advertising in public places.

The second subgroup of preparatory activities is represented by energy audits and consulting. These activities provide personalized information or

directly answer consumer questions. Thus, an energy audit, if it is based on actual consumption, can to some extent inform the consumer's behavior. However, unlike periodic measurement, which allows you to judge the dynamics of change, the audit only assesses the baseline of the object at the time of the audit and does not reflect changes in behavior. Similarly, counseling does not reveal changes in consumption stereotypes. It is up to the consumer whether he uses the information obtained during the energy audit / consultation and changes his behavior in accordance with the received recommendations or makes an investment in the proposed set of energy efficiency improvements.

Preparatory measures are based on the assumption that providing relevant information can in itself change consumption stereotypes. Unfortunately, raising awareness does not always lead to the desired changes in behavior. Therefore, despite the fact that preparatory activities are relatively cheap and easy to apply to large groups of people, they are the least effective. It is best to use them not alone, but as a supplement, in combination with other activities.

Further measures:

Unlike preparatory activities, they provide feedback to the consumer and may include rewards or an incentive system. Follow-up measures are more interactive and more effective because they allow you to assess the direct impact of consumer behavior. The consumer has the opportunity to see a direct link between changes in their own behavior and a decrease in energy consumption and expenditure. Further measures require an individual approach to each consumer, respectively, they take more time and more expensive. The most typical follow-up measures are:

- competitions and contests for individual measurement of energy consumption (in a separate building or part thereof, such as an apartment),

- Public demonstration of own energy consumption and related expenditures (for example, participation in the European program of voluntary

certification of energy performance of Display® buildings or in the citywide program of apartment-by-apartment monitoring of utility costs).

Activities with social impact:

This category of measures best meets the needs of residents to raise their awareness of energy efficiency and has the greatest impact on their behavior. Activities with a social impact are based on the involvement of smaller groups, and they involve voluntary commitments that combine self-interest with the interests of the community. This approach is extremely interactive and communicative, and, as a rule, immersed in everyday life.

Activities with social impact include:

- good examples for the city authorities to follow (disclosure and free access to relevant information),

- "energy" neighborhoods (eco-teams in a house, institution, quarter, etc.),

- energy passports for public and residential buildings.

- reports of residents on their experience,

- "energy" forums on the Internet (in particular, under the guidance of the city energy manager).

In general, in the development of tools for raising public awareness on energy saving, there is a tendency to gradually replace measures to simply provide information to large target groups with socially influential activities that target smaller audiences and form an active and responsible attitude to energy consumption.

When developing an awareness-raising strategy for ordinary citizens on "energy" issues, it should be remembered that stereotypes of energy consumption are closely linked to habits. Accordingly, to overcome them and replace them with new, better, in addition to reliable information, it takes effort and time. In order to make the community doubt the expediency of its current behavior and gain mass support from it in reforming the urban energy sector, it is necessary to:

- eliminate motivational incentives that support old stereotypes of consumption,

- to help consumers realize the perniciousness of old habits and the need to develop new ones,

- enable residents to prevent and control possible negative consequences and provide them with positive alternatives.

However, a number of objective and subjective factors stand in the way of these tasks (Table 8. 1). Fortunately, there are also ways to overcome them.

For ordinary citizens and taking into account the practices that already exist in European countries, all the measures that a citizen can take to improve their lives under the new conditions can be divided into four areas:

1. Saving resources: water, gas, heat, etc. To do this, you just need to adjust household habits and take simple measures, such as setting up taps and installing heat-reflecting screens behind the radiators.

2. Warming of the room. For example, replacement or sealing of windows, thermal insulation of the roof, modernization of the ventilation system, etc.

3. Installation of meters. This will allow you to pay only for the resources consumed.

4. Transition to more modern, energy-saving and alternative energy sources and communication systems.

Table 8.1 – What prevents residents from optimizing their own energy consumption, and how to earn it [5]

Obstacles to achieving ultimate energy savings	Tips on how to overcome obstacles
There is a lack of timely and understandable information that would attract attention, teach and encourage residents to be energy efficient.	To inform the residents of the apartments about the current energy consumption of household appliances, install individual meters of gas, electricity and water, and in the case of central heating - home heat meters. At the end of the month to post in residential buildings information about the per-apartment consumption of basic energy sources. For low-income families, provide assistance in installing meters. This will encourage the replacement of old equipment or its more thoughtful use. Regularly inform citizens during the annual City Days of Sustainable Energy about ways to use energy more efficiently in the home and the associated benefits, as well as the experience of residents of typical apartments, who managed to reduce their own energy consumption while providing a high comfort.
Residents with very low incomes are particularly affected by the increase in energy bills. After meeting the most basic household needs, they have no money left for energy-efficient re-equipment of their apartments, which would allow them to significantly reduce their own energy consumption and reduce the burden on the family budget.	With the participation of city councils, energy agencies, public organizations, etc. to organize free professional advice on saving energy in the home and finding funds to purchase energy-efficient equipment and materials. Energy consultants can also visit residents to assess the energy performance of their apartments free of charge. At the same time, take care of special lending programs for energy-efficient modernization of apartments and residential buildings for low-income people and the construction of social housing with the highest energy performance.
Employees of companies that install energy-efficient equipment and equipment running on renewable energy sources, often immediately offer the customer their technical solution, instead of first identifying all the possibilities for energy savings and choose the most appropriate set of measures.	Ensure the appropriate qualification level of these specialists through the application of appropriate accreditation / certification schemes and the organization of training courses and vocational training.
There is insufficient involvement of utilities in the development and implementation of measures to improve energy efficiency and energy efficiency.	Given the steady rise in world prices for traditional energy, utilities must focus primarily on reducing energy demand, rather than increasing its supply. In this way, they could finance the replacement of household appliances with more energy-efficient ones (for example, conventional incandescent lamps for energy-saving ones) or elevator units with individual weather-controlled heating stations. The return on investment can be organized at the expense of savings received by users as a result of the modernization.

The basic tips for the rational use of energy in the home can be grouped as follows:

1. Monitor energy costs. Electricity, gas, hot and cold water meters make it possible to control energy consumption, regulate their consumption and record the results of economical use.

2. Insulate windows and doors. In cold weather, 24% of heat is dissipated through carelessly sealed doors and windows, 26% - through walls, 11% - through ancillary rooms (basements, stairwells, etc.) and 39% - through vents and chimneys.

3. Do not emit heat. Close curtains and blinds at night to reduce heat loss through the windows. Insulate the radiators of the heating system from the outer walls - install heat-reflecting foil behind them. This will reduce heating costs by 4%.

4. Do not overheat your home. If you pay for heating with a heat meter, or have autonomous heating, remember: raising the temperature in the room by 1 degree increases the consumption of thermal energy by 6%.

5. Do not block a warm road. Heating radiators, covered with curtains or nearby furniture, heat the street more than your home.

6. Do not spend your money on street heating. Apartment windows open for many hours give you not only fresh air, but also significant heat loss. It is better to ventilate more often, but only for a few minutes with the window wide open. During this time, the walls do not have time to cool.

7. More light at lower power consumption. If instead of four light bulbs in the chandelier there should be four sconces, then local lighting will provide economical and comfortable lighting in the place where you work or rest. This saves up to 25% of electricity.

8. Wash sparingly. Make the best use of the washing machine. It is advisable to wash at a lower temperature and without a pre-wash program.

9. Use less hot and cold water. When faucets leak in the kitchen and toilet, it leads to significant losses of water, which is becoming increasingly difficult to supply. Think about how much water you will save if: you do not wash the dishes with a stream of water, but in the dishes and with the use of detergents.

10. Take a shower instead of a bath - the motto of those who save. The cost of water and heat for the bath is about four times the cost of a shower. A family of four can save a significant amount of money during the year if the bath is changed alternately in the shower.

11. Use the refrigerator wisely. Always remember that when you open the fridge and think about what to take there, you lose as much as what you eat.

Regarding savings at home and at work, the following measures can be identified:

1. Pour only the required amount of water into the kettle. Many people use electric kettles every day, without thinking about the fact that a kettle filled with water to the top with a capacity of 1.5 kW for 10 minutes, increases electricity consumption by 0.25 kWh. Try to pour the required amount of water into the kettle - this will save electricity and time to heat the water. Also, it is important to clean the kettle from scale in a timely manner. Scale is formed as a result of repeated heating and boiling of water and has low thermal conductivity, so the water in the kettle with scale is heated more slowly.

2. Use the right utensils. When using electric stoves, it is necessary to choose utensils, the bottom of which corresponds to the size of the burner, as when using utensils of larger diameter, 5-10% of electricity is lost. Utensils with a curved bottom can lead to 40-60% of electricity consumption. When cooking, it is desirable to cover the dishes with a lid, as the rapid evaporation of water increases the cooking time by 20-30%. After boiling the food, it is desirable to switch to low-temperature cooking.

3. Do not keep the refrigerator near the stove. The refrigerator should be placed in the coolest place in the kitchen, preferably near the outer wall, but in

no case near the tile. If you put the refrigerator in a room where the temperature reaches 30 degrees, the use of electricity will double. The old-fashioned refrigerator consumes 90-150 kWh of electricity per month. The new, energy-saving model of the refrigerator (with the symbol "A"), which has the same volume of the camera, requires no more than 30 kWh per month. The amount you will save in 5 years by purchasing a new model refrigerator will be the cost of such a middle class refrigerator.

4. Fully load the washing machine. When the washing machine is not fully loaded with laundry - 10-15% of electricity is lost. With the wrong washing program - up to 30% of electricity is lost. To save a little during ironing, the laundry must be moisturized.

5. Change the dust bag in time. A third-filled bag for collecting dust from the vacuum cleaner impairs the absorption of dust by 40%, respectively, the same amount increases the cost of electricity.

6. Disconnect home "helpers" from the network. Do not leave appliances in standby mode - unplug them. First of all, it's safer, which is something to keep in mind. Secondly, disconnecting devices from the network, such as TV, VCR, music center - will reduce the use of electricity to an average of 300 kWh. The charger plugged in heats up even if it does not have a phone, because it still consumes electricity. 95% of electricity is wasted when the charger is constantly plugged in. The TV with a medium screen size - 20-21 inches in standby mode consumes 16.5 watts. If you watch TV 6 hours a day, its standby consumption is 297 watts per day, and almost 9 kW per month. The music center will pull about 8 kW per month, VCR - 4 kW per month. If you count, then only three appliances, we lose almost 21 kW of energy per month.

7. Replace incandescent bulbs with compact fluorescent lamps. The use of the latest lighting fixtures (compact fluorescent lamps) saves from 60% to 80% of electricity. There should be enough light in the house, because it provides us with comfort, which has a positive effect on health. A modern energy-saving

lamp works for 10,000 hours, while an incandescent lamp lasts an average of 1,500 hours. Its only drawback is the cost, which is an order of magnitude more expensive than a traditional incandescent lamp. However, the compact 11-watt fluorescent lamp replaces the 60-watt incandescent lamp. The brightness of the lighting will not deteriorate, but you will consume 4-5 times less electricity. The payback period of such a lamp is about a year, and its service life is 3-4 years.

So home appliances can save a lot of money.

Regarding water saving, several specific measures should be identified. Water is a source of life, it must be saved.

First of all it is an arrangement of bathroom equipment and all equipment of water supply. If:

- water drips from the tap, then its losses are 24 liters per day, 720 liters per month;

- water flows from the tap - 144 liters per day, 4000 liters per month;

- flows in the toilet - 2000 liters per day, 60,000 liters per month.

Approximately 2,000 liters of water flow from a poorly turned tap, from which water drips (10 drops per minute). If each of the three members of your family leaves the water tap open for only 6 minutes. daily, then in total you waste 7 kWh of energy, ie throw to the wind 1 hryvnia, and if each of you leaves hot water to flow unnecessarily for 6 minutes. every day, you lose 200 hryvnias every year.

If you consider the thermal balance of our apartment, it becomes known that most of the thermal energy of the heating system is spent on covering heat loss. If your house has central heating and water supply, it looks like this:

- losses through window and doors - 40%;

- losses through window glass - 15%;

- losses through the walls - 15%;

- losses through the ceiling and floor - 7%;

- losses when using hot water - 23%.

Not only utilities, but also ourselves should prepare for the winter. The first is to make cracks in window and door openings. Compacted them, you can raise the temperature in the room by 1-2 degrees. Next, insulate the exterior walls. Now there are many good technologies for insulation of walls of houses by various methods.

Keep in mind that closing heaters with decorative plates, panels and even curtains reduces heat dissipation by 10-12%. Painting radiators with oil paints reduces heat transfer by 8-13%, and zinc paints increase heat transfer by 2.5%. It is useful to stick a sheet of foil behind the radiator. In this case, the heat flow will be directed to the inside of the room.

Optimal for the human body is the air temperature in the room 18-20º C. To heat the room to 20º C requires 20% less energy than to achieve - 24º C. By reducing the heating temperature by only 1º C, we save 5% of energy that goes for heating.

The temperature in the room depends on the internal temperature of the walls. If this temperature is only 13º C, then in a room heated even to 22º C, you will be cold. Walls, windows and doors should be insulated with foam boards, wood panels, aluminum foil, drywall, etc., because:

- internal insulation is not affected by weather conditions;
- the warmed rooms heat up quickly and keep heat for a long time.

All the above energy efficiency measures have been implemented in all European countries. We have selected for analysis two countries of the European Union - Germany and Poland. The choice of these cranes is explained by the fact that they are close to Ukraine in area and population. Germany is also the country with the best economic development in the European Union, and Poland is the country that has recently begun its economic development.

The German experience in implementing energy saving policies and implementing energy efficiency standards has been successful and a role model for EU member states and other countries. Germany began active action on

energy conservation in the 1978 Law on Modernization and Energy Conservation. The task of improving energy efficiency in Germany is solved through the Ministry of the Environment and partly by the Ministry of the Economy, the Federal Ministry of Transport, Construction and Urban Development. Each of the ministries has its own tasks and respective powers. In addition, the Renewal and Development Credit Office (KfW) was established to finance the above institutions for development and energy efficiency in the country.

Germany's current energy efficiency policy is based on laws and programs developed by the European Commission for the energy sectors of the economies of the EU member states.

Today, Germany is one of the five largest energy consumers in the world. At the same time, the share of energy exported by the country, according to statistics, is about 80% of its own needs.

The issue of energy security in the country is solved through energy efficiency and a policy of stable energy supply, government incentives for the development of alternative energy sources, increasing production and combustion of lignite and hard coal with the introduction of modern environmental measures.

In Germany, ambitious tasks have been set at the state level to save energy and increase energy efficiency. In particular, by 2020 the total consumption of primary energy compared to 2008 should decrease by 20%. The cost of energy per unit of value added in the country has been brought to its lowest level since its reunification in 1990. In 2016, the total GDP in Germany amounted to 3643.4 billion dollars. The US despite the fact that during the financial crisis in 2008, value added in industry decreased by 15% with a further resumption of growth from 2010. For 2000 - 2016, there was a decrease in energy intensity of GDP by almost 29% with GDP growth at 21% for the same period, thanks to the successful implementation of the National Energy

Efficiency Action Plan in the country. Germany's energy concept defines a common goal to increase energy efficiency - to reduce primary energy consumption by 20% by 2020 (by 50% by 2050).

Germany managed to get such a result due to a number of areas. Thus, today in Germany there are a number of training programs for children and youth in the field of energy efficiency, energy saving and environmental protection. Including:

Berliner Klima Schulen – a competition for all schoolchildren in Berlin, funded by the Berlin Senate for Science and Research, the Senate for Health, Environment and Consumer Protection, the General Association of German Insurance (GDV) and the World Wide Fund for Nature (WWF).

What can we do in everyday life for climate and energy saving? What technologies can help us in the future? Through creative ideas and activities, children answer these questions, realizing their important role in climate protection. The competition is a great success among Berlin schools, last year more than 2,000 students took an active part from different schools and ages. This competition is a great opportunity for high school students at an early age to take part in climate protection.

Die Freie Universitat Berlin offers a program developed in collaboration with the Berlin Energy Agency, consisting of interactive lectures, seminars and round tables on key energy and climate change issues.

The program trains not only students but also teachers, in order to further exchange information between professionals and colleagues. Participation in the events is free. Students get the first knowledge about where heat and electricity are produced and how they appear in their homes. The implementation of such programs contributes to the formation of a new worldview in the efficient use of energy resources and the education of a new generation with respect for natural resources and the environment.

Die Renewables Academy AG (RENAC) offers seminars and trainings for technicians and engineers based on energy efficiency and energy saving.

In addition to the technical aspects, the seminars also provide information on economic evaluation, financing and project management. To fill the modern labor market with qualified personnel, RENAC covers training in the fields of energy efficiency, energy saving and renewable energy sources, providing professionals with professional skills.

Thrifty and efficient use of energy should become part of life and a habit, become part of the morals of society. Because, as is well known, only morality that is profitable and effective is viable. In the same way, man should be proud of what is given to him by nature and God - energy from natural sources, that nothing is wasted in the economy. That it saves a lot of heat and light and does not depend on centralized systems. And most importantly, it preserves the nature of the country, preserving it for their children and future generations.

The highest contribution to energy conservation and reduction of CO2 emissions is expected through the initiative to create "energy efficiency training networks" (LEEN). Since the launch of the LEEN initiative, 50 energy efficiency networks have been set up, covering more than 500 companies. The federal government and the association of companies have set the task of "LEEN 100 plus" to create more than 100 training networks on energy efficiency by 2020.

Under the auspices of the German Energy Agency (dena), a focal point has been set up to act as a contact point for initiative participants and potential initiators. The focal point also registers and verifies new energy efficiency training networks, organizes coordination processes between the partners funding the initiative, and coordinates public relations activities. Businesses can access the information on the website about the subsidized measures, the amount of funding and the application rules. Depending on the activities carried out and the implementation of programs, applications for funding of relevant projects up to 1.5 million euros are accepted.

The federal government has prepared a work program to further consolidate efforts: the National Energy Efficiency Action Plan. In accordance with the objectives of the Plan, funding programs, legal advice and information centers on energy efficient technologies have been developed at the Federal level to support municipalities, enterprises and private households in their work aimed at the projected increase in energy efficiency.

Great importance is attached in Germany to the implementation of energy efficiency projects at the land level. Developed by the German energy agency DENA, the concept of “Das kommunale Energie- und Klimaschutzmanagement” (“Municipal energy and climate change management”) promotes not only the introduction of energy-saving technologies in specific cities and communities, but also regular monitoring of energy consumption and implementation. other projects in order to find optimal solutions to improve energy efficiency.

Another important event is the public bidding in the field of energy efficiency - "STEP up!". Under this program, energy companies and companies from various fields of activity are invited to participate in the competition for state financial support by submitting applications with individual proposals for energy conservation measures. Under the terms of the tender, state support is allocated for projects with the maximum energy saving effect.

The "Race Leader" program to stimulate the production of energy efficient products - to increase the energy efficiency of household appliances: refrigerators, stoves, TVs and many others. The program sets clear minimum requirements for the technical characteristics of household appliances in order to reduce energy consumption. In addition, it requires the application of a color scale of efficiency on products, which indicates the amount of energy consumption by a technical device (equipment). With the Race Leader program, the Federal Government at the national level defines a set of measures for producers, trade organizations and consumers aimed at improving the energy efficiency of goods, thus supporting the pan-European program "Race Leader" (Top Runner).

The next step in Germany is to increase the energy efficiency of homes. The start of energy-efficient and energy-passive construction in Germany is quite interesting. The first energy-passive houses were built precisely because customers set such requirements for architects. They wanted their homes not to consume energy. And such a private initiative lasted several years. It happened that at the beginning of the development of this area, developers knew about energy-passive construction even more than architects. We can say that innovations in the construction industry in Germany have generated demand for them. At first there were quite big problems with the builders. Passive house requires very high accuracy and quality of work. And ordinary workers often could not understand why do certain things this way and not otherwise. Instead, today, strict adherence to all the smallest requirements of technology is already the standard.

Energy supply of buildings is crucial for the implementation of Germany's new energy policy. In the country, about 40% of total energy consumption in Germany is accounted for by the energy supply of buildings. With this in mind, the Federal Government has set a goal to achieve by 2050 almost complete transition to the construction of buildings with a "zero carbon footprint". To do

this, by a certain period it is necessary to reduce the consumption of primary energy (oil and gas) by 80%. For these purposes, the Federal Government annually allocates funds in the amount of about 2 billion euros.

The country has a program to support KfW Bank in the modernization and construction of buildings through the provision of soft loans. At the same time, the terms of lending by KfW Bank's program significantly exceed the minimum requirements set at the governmental level.

In Germany, energy-saving buildings are buildings that meet the energy saving standard, ie have an annual energy consumption of 30 to 70 kWh / m2. In addition to "passive" buildings, there are also the following types of energy-efficient buildings and structures in Germany: energy-saving house KfW 60 (provides an annual energy consumption not exceeding 60 kWh / m2), energy-saving house KfW 40 (annual energy consumption no exceeds 40 kWh / m2). According to regulations in the country, by 2020, new buildings should use neither fossil fuels nor energy produced from them.

Due attention is also paid in Germany to energy saving in the transport sector. Mobility and movement are an important element of our society that meets individual and societal needs. But along with a positive and important role, the transport system has a negative impact on the environment, in particular the CO2 emissions of Germany's transport sector account for 25% of the country's total greenhouse gases.

Transport is a large consumer of energy, but with a high potential for energy efficiency and the use of renewable energy sources. Climate change, declining oil reserves and, at the same time, increasing traffic are a particular problem for Germany as a transit country. About 90% of all German vehicles use crude oil. Estimating the future availability of oil is a big question, but the shortage and growth of oil products is now a reality.

The volume of traffic in both freight and passenger traffic has grown rapidly compared to energy consumption, due to structural changes in the transport sector.

The transport sector is of great and growing importance for all countries with developed economies. Energy consumption of the entire transport sector has increased.

That is why there are five directions for further reduction of energy consumption in the transport sector:

1) Optimization of the transport system through targeted planning, which will reduce costs without compromising the functioning of the overall system, profitability and efficiency. Transport planning should always take into account social and individual factors, traffic parameters, energy consumption, the legal framework of environmental legislation. In this way, transport planning will be coordinated with other local, regional and national plans. This applies to development (urban development, energy, climate, etc.) projects or integrated sustainable development strategies.

2) The development of transport technologies today makes it possible to reduce energy consumption and CO2 emissions. Through the EfficientDynamics program, the BMW Group has reduced its average fuel consumption and CO2 emissions by 10.2%. Modern car models use fuel-saving technologies and demonstrate the optimal balance between low fuel loss and high power. This is achieved through functions such as brake energy regeneration, automatic engine stop and start, gearshift indicator, active ventilation control, low rolling resistance tires and on-demand auxiliary systems.

3) Energy consumption depends not only on the car, but also on the driving style. With an energy-efficient driving style, you can reduce energy consumption by up to 30%. Here are some tips to make it cheaper: check the trunk - car manufacturers have calculated that the overuse of fuel for every 50 kg of excess weight is 5%; start smoothly - if you press the pedal "on the floor"

at 1500 rpm, you will not achieve anything but a significant overrun; switch correctly - the optimal mode is one in which the crankshaft speed is between 2500 and 3500 rpm (there are engines with other settings - select the economy mode experimentally); reduce speed - if the car consumes about 7-8 liters per 100 km at a moderate speed of about 80 km per hour, then at a speed of 100 km per hour, its appetite will increase to 9-9.5 liters, and at 180 km / h it will already "eat" as a small truck - 16-18 liters per 100 km .; close the windows - fuel consumption while driving a small car at a speed of 110 km / h with the air conditioning on and the windows closed is about 8 liters. But open windows with the air conditioner turned off will cost 10.5 liters. The phenomenon is explained simply: the included conditioner "brakes" the engine less, than aerodynamic resistance of open windows.

4) Introduction of electric motors. Work has long been underway to create electric vehicles that run on both batteries and solar panels, but still electric cars are significantly inferior to gasoline. The main problems in this direction - the dynamics (low speed and poor acceleration), a short distance that can be traveled without recharging. All the shortcomings are being actively worked on and at the moment the most successful solution is to create hybrid engines. Thus, fuel savings and reduction of harmful emissions have been achieved. But hybrid engines are only a transitional link from gasoline to electric motors.

5) Use of alternative fuels (bioethanol, biodiesel, biogas, vegetable oils, etc.). Therefore, we can conclude that if oil runs out in the near future, it will not be a big surprise for humanity. But how painlessly our civilization will be able to move from oil to new energy sources depends on active improvements and developments in this area.

As for Poland, it should be noted that it has been implementing an energy saving system since 1991. There are several aspects of this country's energy saving policy. First of all, it should be noted that the Polish authorities have harmonized national legislation with EU regulations. There are almost no

contradictions between national and local regulations. Institutional and organizational support of energy saving policy is being successfully formed. The country has established effective and purposeful work of state and local authorities, financial and commercial structures, economic entities on energy saving measures in the housing sector, efficient use of local resources and electricity, implementation of solar energy, biogas production, waste disposal, heat and electricity energy from burning straw and other vegetable waste.

Residents of Polish houses were organized into certain associations, such as analogues of Ukrainian condominiums. As prices remained quite high, these organizational structures that managed the house began to take bank loans to renovate the house in order to save energy. In Poland, this process started in 1998. Thanks to loans, residents insulated roofs and basements, installed meters and regulators of heat consumption, and replaced windows. Thus, they increased the energy efficiency of their homes. Today, all Polish houses have already gone through this process.

In Poland, the creation of associations similar to Ukrainian condominiums was forced. Participation in such an association is mandatory for all co-owners, and this structure does not require legal registration for its existence. Every year, Polish co-owners must approve the level of contributions for the maintenance of the house, from this money and works condominiums. From the bank's point of view, condominiums are a good borrower. For example, in Western Europe, the amount of loans issued to all condominiums over the past 15 years is estimated at about 2 billion euros. All loans were repaid.

Poland has a positive experience of mixed financing of energy projects (EU funds, international donor funds, environmental foundations, budget), where the system of tax benefits is effectively used.

The government is trying to use leverage to expand the circle of creditors to carry out such energy saving measures, which require significant funds and which are designed for the long term. In Poland, there is a special utility fund,

the funds of which are accumulated through fees from the population and are used to implement low-cost energy saving projects, improve the quality of heating, maintenance.

Energy consumption in the country is carried out on a contractual basis. This avoids the bureaucratic red tape associated with the licensing system, prevents monopolization of the sphere, improves the quality of services through competition, reduces prices, and simplifies auditing.

The creation of powerful state-owned companies has intensified the investment process in the Polish energy sector. However, the problem of upgrading generating capacity and power grids remains relevant. Measures are being taken to systematically decommission obsolete and uneconomical facilities. In particular, Polska Grupa Energetyczna (PGE) has commissioned a new 858 MW power unit at Belchatow TPP. However, the introduction of new modern facilities is not sufficient and needs to be significantly expanded with the involvement of appropriate investments.

All leading Polish energy companies have significant investment budgets. Thus, PGE by 2025 plans to invest in the creation of new and modernization of existing capacity in generation and network economy EUR30 billion, Tauron - EUR12 billion by 2020 and Energa - EUR5 billion. In total, the total investment in the industry is estimated at about 100 billion PLN (about EUR24 billion) by 2020. During this period, the total generating capacity is expected to increase to 41.5 GW, ie increase it by 27%. By 2020, at least 4-5 GW of obsolete economically inefficient generating capacity must be decommissioned.

One of the sources of financing is the European financial structures, the European Investment Bank and the EBRD. In particular, a ten-year loan of $ 300 million was provided for the implementation of the project of modernization and expansion of distribution networks (the total amount of the project exceeds $ 770 million).

Today, more than 90% of generating capacity in the country is accounted for by coal-fired power units. With large coal reserves, the country intends to continue to use this resource, which contradicts European energy policy aimed at reducing carbon emissions.

Last year, the European Commission extended the permit for the issuance of free CO2 emission quotas to existing Polish coal-fired power units at least until 2020. However, the issue of extending this provision to the projected facilities has not been resolved. As a result, PGE today stopped developing about 30 projects for the construction of new coal-fired power units.

Earlier it was planned to compensate for the decommissioning of coal-fired units by building new nuclear power plants, which by 2025 were to cover up to 25% of the country's electricity needs, but after the accident at Japan's Fukushima nuclear power plant last year, these plans were postponed. However, PGE together with Tauron, KGHM announced the possible creation of a consortium for the construction of the first Polish NPP with a capacity of 3 GW, while the complexity and high cost of this project (EUR12.1 billion) may delay the implementation process.

Poland is developing projects to build powerful wind farms on the Baltic coast, but according to experts, the share of this source in the country's energy balance in the next 20 years will not exceed 10%.

Thus, all the above makes it possible to identify steps that will increase the energy efficiency of housing of Ukrainian citizens and significantly increase their energy awareness.

1. Mandatory metering - installation of meters for gas (savings up to 70%), water (savings up to 70%), electricity. "It is impossible to control what cannot be measured." So you will pay for household consumption not "according to regulations", but for the actual resource consumed. Most families consume less resources than they pay on receipts. Monitor your intake. If you notice that consumption has increased sharply compared to the previous period -

look for possible malfunctions in the system, the causes of overspending. To achieve greater savings, it is also recommended to install a heat regulator or automatic weather regulator in an apartment or private home. Such devices allow you to adjust the amount of heat supplied depending on weather conditions and pay less. It is also possible to install a multi-zone electricity meter, when appropriate (the consumer pays 30% less for electricity consumed at night, with dual-zone metering and 60% less - with three-zone.).

2. Replacement of old and low-efficiency equipment with modern and economical: replacement of incandescent lamps with LED lighting (continuous LED life of at least 50,000 hours, equivalent to 11 years of operation with 12 hours of work per day - this is two orders of magnitude longer than normal incandescent lamps), the use of motion sensors for street lamps or lamps in the entrances, the use of ventilation systems with recuperation, the installation of appliances with low energy consumption (marked "A" or "A +"). Devices of this class have an efficiency of more than 90% and consume 30-50% less electricity than devices of class "B". The payback period of more expensive energy-saving equipment is on average 2-3 years.

3. Complex thermal modernization - replacement of windows and doors with energy-saving ones (with double-chamber energy-saving double-glazed windows and heat transfer resistance higher than the standard 0.6; this will reduce excessive heat loss by up to 40% and increase the temperature in apartments by more than 2 ° C, payback period 3- 7 years), thermal insulation of the roof (payback about 7 years, cost reduction up to 30%, exterior walls and plinth (savings up to 40%, payback period up to 10 years), basement (if the basement is not heated, insulation will maintain a positive temperature of 5-10 Important: Facade insulation only needs to be carried out completely!

4. Modernization of heating systems - installation of an individual heating point (ITP, payback period 1-3 years), thermal insulation of pipelines (payback period about 1 year), if necessary, flushing of the heating system (scale up to 1

mm thick reduces the level of heat transfer by about 15%) , installation of a highly efficient boiler (efficiency more than 85%), use of thermostats.

5. Use of renewable energy sources - installation of solar panels and power plants, heat pumps, solar collectors (vacuum and flat), installation of wind turbines (more for private buildings). Such systems require large investments at first, but make it possible to use natural and environmentally friendly sources for energy. They are in great demand in areas far from public networks and communications. An additional bonus from the state is the ability to connect to the "green tariff" provided that consumption is less than generation. Green tariff is a special tariff at which the state buys electricity from private individuals generated by solar and wind power plants. The maximum power of a private power plant should not exceed 30 kW.

6. Energy-saving behavior - the most affordable method of saving: timely switching off lights, appliances, faucets, do not close the heaters with curtains and foreign objects, ventilate the room, use light and warm colors in the interior, take a shower instead of a bathroom, install a reflective screen behind the radiator (increase the temperature in the room by 2-3 degrees) use aerator nozzles on the taps.

Tasks for independent work

Develop energy saving projects on the following topics:

1. 10 tips for saving energy.

2. How you can save money and reduce your impact on the climate.

3. How to get useful from useless?

Questions to control knowledge

1. What is the structure of household energy consumption of residents of a multi-storey building?

2. Describe the energy structure of the house?

3. What is the difference between energy saving and energy efficiency?

4. Take existing steps towards energy efficiency?

5. What is energy efficient consciousness?

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