



# ENERGY SERVICE COMPANIES ARE AN EFFECTIVE TOOL FOR FINANCING ENERGY-EFFICIENT PROJECTS

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## ABSTRACT

*The current state of the housing and communal complex, and especially multi-storey buildings, is extremely critical. According to statistics, their wear is from 70 %. More than 100 thousand high-rise buildings require immediate modernization. Energy losses in such homes are from 53 %. Taking into account the constant growth of tariffs for housing and communal services and such a level of energy losses, all this has led to such a critical situation that has developed today. In this context, residents of multi-storey buildings should independently solve this situation. Attention is paid to the analysis of changes in the legal framework in the field of energy saving and energy efficiency. Problem areas and certain shifts were identified. It is established that the activity of the created energy efficiency Fund is based on Bank schemes for financing energy-efficient projects. And it does not yet use the generally accepted European practice. This is why the article analyzes the mechanisms for financing energy-efficient projects both in Ukraine and in European countries. Attention is focused on the use of a financing mechanism such as ESCO, as the most acceptable for Ukrainian realities. Drastic changes regarding the use of this mechanism in practice were noted. The analysis of financing of already existing energy-efficient projects with the help of ESCO companies was carried out. The advantages and prospects of using ESCO-financing mechanism for multi-apartment Fund for Association of multi-apartment buildings co-owners are revealed.*

**Key words:** energy consumption, energy efficiency projects, energy service companies (ESCO), financing mechanism

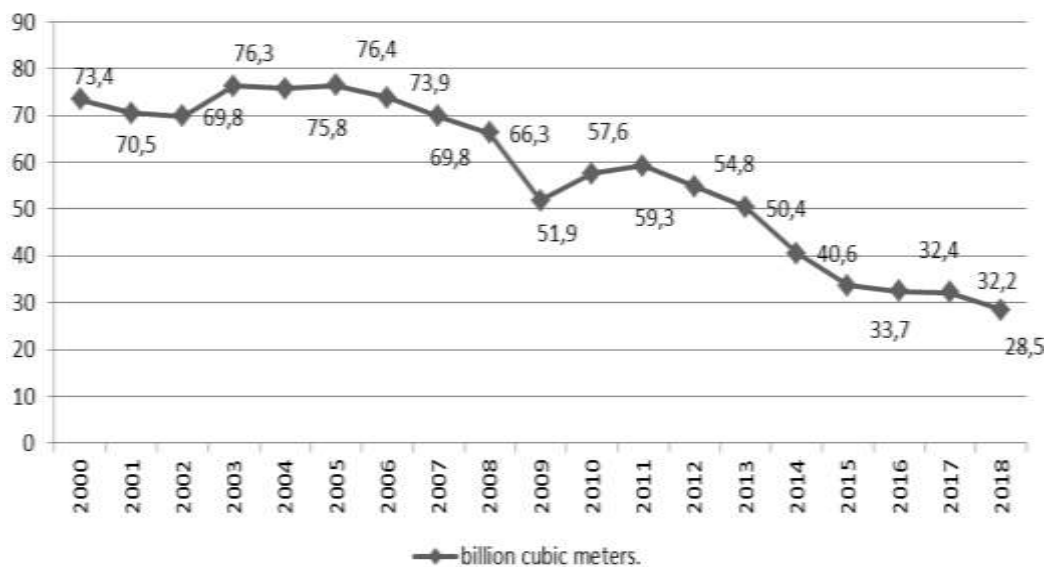
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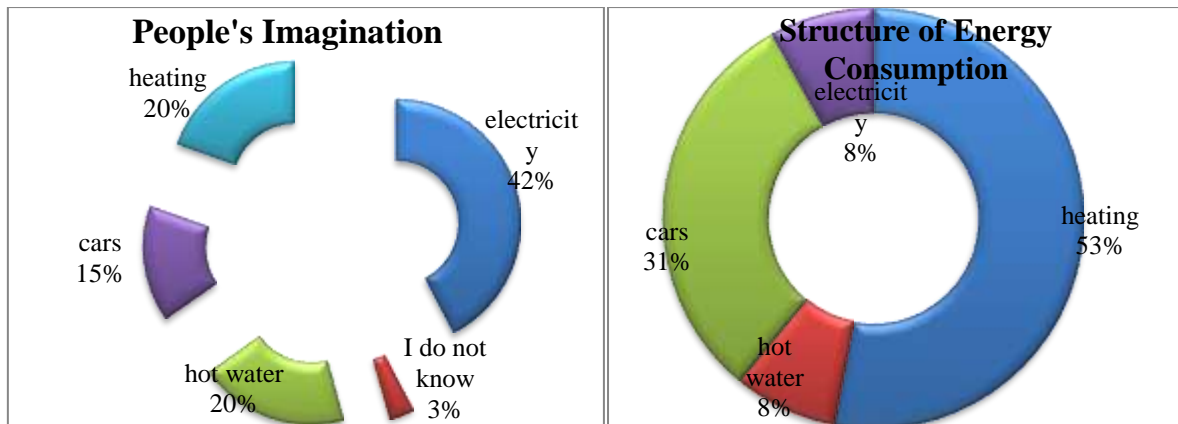
## 1. INTRODUCTION

The energy richness of the earth allowed people to create comfortable living conditions for themselves. However, the possession of significant natural resources led to the fact that their efficient and rational use was not organized in time. At the current level of consumption, coal reserves will last for 250 years, gas for 60 years, and oil for 20 to 40 years. Energy losses in Ukraine due to low energy efficiency amount to 100 million UAH per day or almost 1.5 billion us dollars per year. Over the past decade, the problem of saving energy resources, i.e. water, heat and electricity, has become particularly acute, since their cost increases in an arithmetic progression, due to the natural depletion of natural energy. That is why reducing the amount of energy consumed from external sources is a priority today. As for Ukraine, during the period from 2000 to 2018, the industry reduced the use of gas by more than 3 times, and the population by only 1/3 (Fig. 1.).

It is the reduction of energy use by the population that has significant potential. Ukrainians have a false imagination about the structure of energy consumption. Thus, consumers believe that only 20% of energy is spent on heating, but in fact this figure is 53 % (Fig. 2). Therefore, the use of energy for heating should be significantly reduced. Ukraine has already developed quite a lot of technical solutions to solve this problem, but the issue of financing these measures remains unresolved, because they are quite expensive and are beyond the power of many segments of the population.



**Figure 1** Dynamics of gas consumption by industry and population of Ukraine in 2000-2018



**Figure 2** Structure of household energy consumption

## 2. LITERATURE REVIEW

Financing energy-efficient measures has a long history and is found in many studies. General characteristics and economic substantiation of the use of energy service companies for energy-efficient measures are reflected in works in the works of many scientists.

In particular [13], the authors consider energy service companies (ESCOs) in China. ESCOs have been adopting various energy conservation measures, thus playing a significant role in mitigating carbon dioxide emissions. This study aims to develop an efficiency evaluation framework using data envelopment analysis (DEA) to guide the selection of the most efficient ESCO measures in different parts of China. Data from 1304 ESCO projects in six parts of Mainland China were examined using DEA to determine the efficiency of 15 energy-saving measures in the manufacturing and building sectors. The results indicate that reconstruction of industrial boiler furnaces is the most energy-efficient measure in the manufacturing sector, while energy management systems are the most efficient measure in the building sector.

In work [6] identified that energy inefficiency in the building stock is a substantial contributor to climate change. Integrated energy service companies (IESCs) have a potentially important role in improving energy efficiency. Authors presents a qualitative analysis of the energy efficiency barriers in the Finnish building sector based on data from interviews with twelve IESCs.

Also [10] in mind the residential housing sector is a major consumer of energy accounting for approximately one third of carbon emissions in the United Kingdom. Achieving a sustainable, low-carbon infrastructure necessitates a reduced and more efficient use of domestic energy supplies. Energy service companies offer an alternative to traditional providers, which supply a single utility product to satisfy the unconstrained demand of end users, and have been identified as a potentially important actor in sustainable future economies.

The work of power services companies is highlighted in the work [11], where the authors believe that many energy efficiency professionals have proposed using Energy Performance Contracts (EPCs) as a mechanism to improve public sector energy efficiency in countries with restrictive government budgets. However, in practice, most middle-income countries have used this mechanism only in a limited way. Russia offers an interesting case study because of its huge energy savings opportunities, increasing energy prices, robust political backing for public sector energy efficiency, and evolving legislation that supports EPCs. In 2009, the Russian Federation initiated reductions in the country's energy intensity, including of the large public sector, which accounts for 9 percent of Russia's total energy consumption. To achieve

energy efficiency goals in the public sector, Russia experimented with its public procurement rules, adjusting them to encourage EPCs.

The concept of energy services is considered in the work [5], whose authors believe that they are used in different contexts and scientific fields mainly to emphasize that it is the services provided by energy rather than energy carriers that people demand and that generate well-being. While the value of the concept is widely acknowledged, there are remarkable differences in how energy services are conceptualized. The authors offer the 'Energy Service Cascade' (ESC) as a conceptual framework aimed at clarifying and bridging different approaches. The ESC is inspired by Haines-Young's and Potschin's (2011) 'Ecosystem Service Cascade', which distinguishes: a) structures, b) functions, c) services, d) benefits and e) values.

The business model of energy service companies is considered in the work [6] and [9]. In the work it was investigated that Energy Service Companies have faced strong expectations to capitalise on large but untapped energy-efficiency opportunities, but have fallen short in terms of diffusion. This paper focuses on the viability of a business model based on Energy Performance Contracting. Following a two-round Delphi study conducted in Finland, we analyse the insights provided by the experts through the Hamel business model framework. The main aim is to increase understanding of the model that Energy Service Companies use, and to identify the main factors that hinder their business development.

The methods to estimate the market investment potential for ESPC (energy-saving performance contracts) and annual blended energy savings remaining in buildings typically addressed by U.S. ESCOs are presented in the next paper [12]. Authors define ESCOs as companies for whom performance-based contracting is a core business activity.

The interaction of local authorities with energy service companies in the UK is considered in the work [3]. This paper explores how some UK Local Authorities (LAs) have opted to engage with the Energy Service Company (ESCO) in their bid to increase their influence over local energy system changes and help them deliver on their political "public good" goals. Three common approaches to LA ESCO model engagement are outlined including the: (1) LA's own arm's-length model; (2) private sector owned concession agreement model; and (3) community owned and run model.

The process of making an optimal investment solution for energy service companies should be based on certain methods. In the work [1] an approach is developed for the ESCO (Energy Service Company) to evaluate the potential energy savings profit, and thus make the optimal investment decisions. The energy savings revenue under uncertainties, which are derived from energy efficiency performance variation and energy price fluctuation, are first modeled as stochastic processes. Then, the derived energy savings profit is shared by the owner and the ESCO according to the contract specification.

The theoretical analysis of energy services was carried out by the authors [4]. He found that in total, 27 definitions of 'energy services' were recorded, and 173 separate examples (such as 'space heating' or 'lighting'). As a result, the authors were granted the following recognition Energy services are those functions performed using energy which are means to obtain or facilitate desired end services or states.

The authors of [7] also believe that energy services play a key role in increasing energy efficiency in the industry. The key actors in these services are the local and regional energy companies that are increasingly implementing energy services as part of their market offering and developing service portfolios.

New ways of managing energy services are analysed in the work [8]. This work proposes an energy services framework which introduces a new way of energy services management

and which aims at reducing the environmental footprint of production sites through the control and monitoring of electrical energy usage. Following the shift to Servitization, energy suppliers want to offer more than traditional energy contracts to their industrial customers. Considering that tendency, an Energy Services Framework with three interdependent services namely Environmental Impact Calculator, Energy Demand Management and Power Interruption Planner is proposed. The proposed framework is validated using real data from an energy supplier and its potential customers.

However, the study of these authors regarding the financing of energy efficiency measures by energy service companies does not take into account some aspects, especially those inherent in Ukraine. Therefore, these issues are relevant and need further study. This aspect will be the main purpose of our article.

### 3. MATERIALS AND METHODS OF STUDY

The main provisions of the ESCO-mechanism for financing energy-efficient projects form the theoretical and methodological basis of the article. To achieve this goal, methods of analysis and synthesis were used to reveal the concept of "ESCO", "ESCO-mechanism", "ESCO-contract"; comparative analysis – to study the opportunities and advantages of financing mechanisms; systematic approach – for a comprehensive assessment of European financing practices; economic and mathematical modeling – to calculate the economic efficiency of the implementation of the ESCO mechanism; specification and analogy – to formulate conclusions and proposals on the prospects and possibilities of using the ESCO mechanism. At the time of writing, the regulatory framework, legislative acts, Directives of the European Parliament and the Council of the EU [2,19,20], norms and standards of energy consumption, statistics of the Ministry of development of communities and territories of Ukraine [21] and the all-Ukrainian center for energy conservation and energy efficiency [22], the energy efficiency Fund [18].

### 4. RESULTS OF STUDY

Therefore, considering the above issues, as well as in conditions of limited working capital, inability to attract serious investments in energy efficiency to implement energy saving techniques and technologies there is a need to address this issue. For financing energy efficiency measures in the European practice, there are certain types of investment vehicles, namely, loan financing schemes and partial guarantees (happens commercial Bank institutions or specialized agencies, funds revolving funding); the use of energy service companies (ESCOs, these are companies that have contracts guaranteeing results energy company for investment on communal or private ownership); other types of financing (in the form of Public-Private Partnerships, grants or global Development Alliances, or financing in the format of the Kyoto Protocol). In Ukrainian reality, the successful experience of Western countries, namely the use of ESCO companies, has already been used to solve the problem of implementing energy-saving measures.

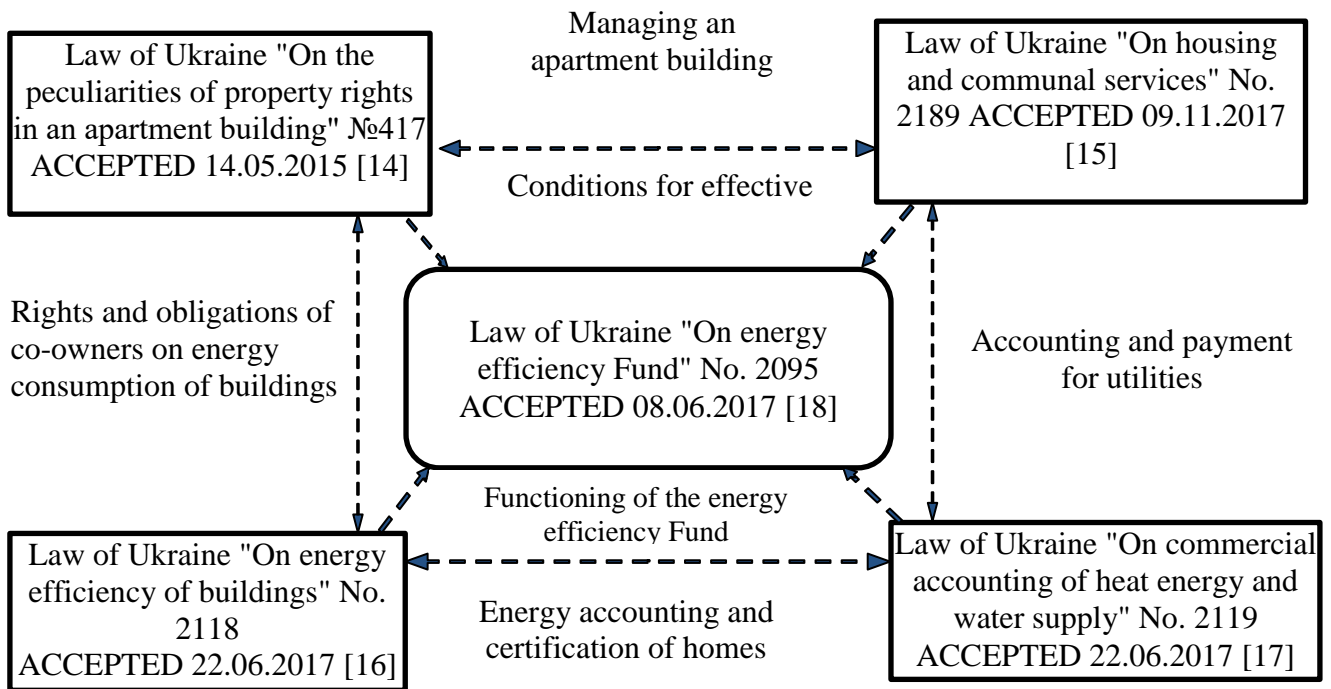
ESCO (energy service company or energy savings company) is an energy service company, a specialized company whose main activity is to provide services to reduce energy consumption and/or increase energy efficiency at the Client's facilities. An ESCO can be an individual or legal entity that provides energy services and / or other measures to improve energy efficiency at the user's facilities or premises and at the same time assumes a certain share of financial risk. Payment for services provided is based (in whole or in part) on achieving improved energy efficiency indicators and meeting other agreed performance criteria [19].

The essence of ESCO is that a private investor performs thermal modernization, financing it from their own funds, and can make a profit due to the savings achieved on utility bills. Principles of service from ESCOs are the energy consumer (client) does not incur any upfront costs for implementation of energy saving projects; all costs for the project “turnkey” assumes energy service company ; all costs for the project are returned through the achieved result in energy efficiency savings .

In the European countries of the world, the success of energy service companies lies in the fact that there is political support, especially at the local level; active support at the state level to stimulate investment; the interest of financial institutions (banks, MFIs, investment funds) to invest in energy services; quality standards; the presence of experienced and competent energy agencies; well-developed measurement systems: energy bills, measuring instruments, agreed basic consumption; favorable conditions for ESCO activities: reliable contracts, easy access to Finance, attractive insurance, the possibility of obtaining subsidies, and so on. All this makes it possible to identify the following advantages of using the ESCO mechanism: guaranteed return on investment due to the implementation of energy-efficient measures for their further reinvestment; preparation of effective technologies for attracting financing; qualified project management at all stages of its implementation; guaranteed provision of standard indicators of microclimate in the premises of the institution; modern management of the operation and maintenance of the object after the completion of the project.

So, usually, energy service companies work on the basis of concluding energy service contracts. Energy service contract – a contract between the customer of services and the company, the subject of which is the provision of energy services. Payment for completed works is made by saving energy resources. The main provisions of energy service contracts are: the procedure for calculating and paying for energy services; the procedure for accounting and paying for energy consumed in accordance with payment documents and operational monitoring data; appendices to the contract, including reporting forms, acts of performance, reconciliation and fixing indicators; the responsibility of the parties.

Today, Ukrainian legislation has also undergone certain changes in the sphere of financing energy-efficient projects, as well as in the regulation of major energy efficiency issues. A number of laws and regulations have been adopted. Thus, one of the key issues was the adoption of the law "On the energy efficiency Fund" No. 2095 dated 08.06.2017 [18] and a number of other important bills (Fig. 3), which significantly regulated some issues of energy efficiency. It is also worth noting that only on 09.05.2015 the laws of Ukraine "On introducing new investment opportunities, guaranteeing the rights and legitimate interests of business entities for large-scale thermal modernization" (No. 327-VIII) and "On amendments to the Budget code of Ukraine (concerning the introduction of new investment opportunities, guaranteeing the rights and legitimate interests of business entities for large-scale energy modernization)" (No. 328-VIII); introduced a new legal institution energy service agreement and its basic terms, regulated the relationship between the customer and the provider of energy, determined pricing mechanism energy service agreement provided the opportunity for budget institutions to conclude energy service contracts for a term exceeding 1 year, with warranty to investors regarding the payment of remuneration for the achieved savings within energy service agreement introduced a transparent mechanism for the procurement of energy service ; resolution of the Cabinet of Ministers of Ukraine from 21.10.2015 No. 845 approved sample energy service agreement (100%).



**Figure 3** Legislative framework for energy efficiency regulation

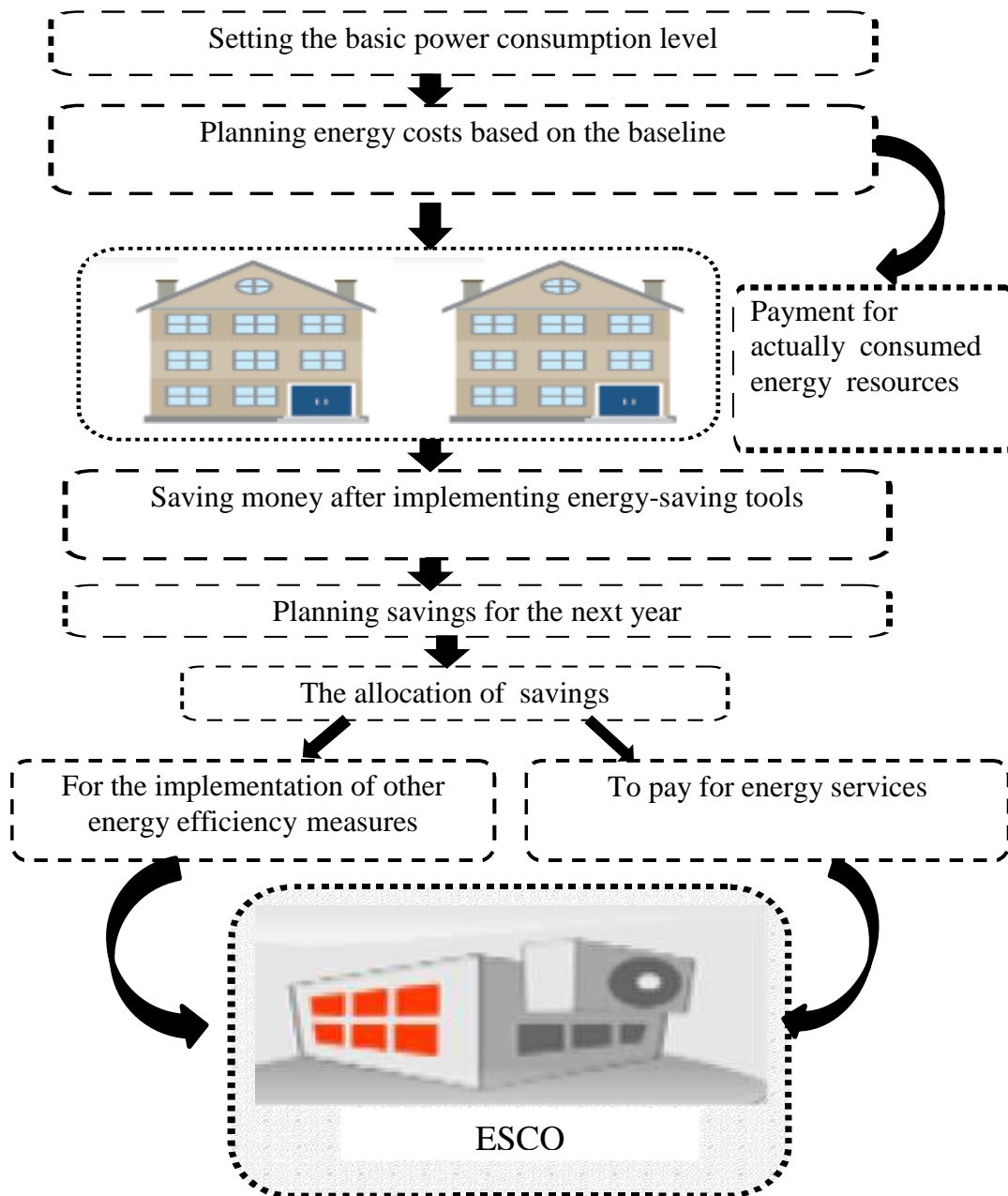
The adoption of these bills allowed ESCO companies to work with budget institutions as well. The term of the ESCO agreement has been extended to 15 years, up to 100% savings are allowed, ESCO has received 5 years of qualification holidays, and the risk of non-return on investment has been leveled in case of climate change.

So, all this gives us grounds to say that ESCO, as a rule, operates in three main directions. These areas are energy services (energy audit, calculation of energy saving opportunities, monitoring and verification of savings, etc.); services and work on project implementation (development of project documentation, construction and installation work, etc.); ensuring project financing (search for financing schemes, lending, leasing, etc.).

That is why ESCO should identify and evaluate the potential for energy conservation and energy efficiency; develop technical and other solutions; manage the project from design to completion, which is basically understood as full payback and profit; provide ongoing maintenance and training services; and provide a guarantee that the savings will cover the project costs.

In other words, Association of multi-apartment buildings co-owners or a kindergarten practically does not spend money on carrying out works on thermal modernization. However, after all the work is done, they continue to pay the "saved" part of utility payments, but not the housing Department, but the ESCO company. This continues until the end of the ESCO agreement with the company. After the end of the contract, the co-owners of the house, if it is an Association of multi-apartment buildings co-owners, receive it in good condition and already independently use the money saved. It is important that the logic of ESCO-financing encourages the investor to perform the modernization works as efficiently as possible in order to achieve greater savings, and therefore profit.

The General scheme of operation of energy service companies is quite simple (Fig. 4).



**Figure 4** Scheme of operation of energy service companies

After reaching agreements with the owner of a building or complex of buildings, they develop a plan of measures necessary to reduce energy consumption. This may relate to a strategy for purchasing and using energy, or changing the type of energy, or certain adjustments to heating systems or technological innovations, such as automatically turning off lights in an empty room. As a rule, a set of measures in various fields is formed and proposed.

The ESCO mechanism is a relatively new tool for financing thermal modernization projects in apartment buildings from energy service companies. The ESCO contract assumes that the investor implements energy-saving measures in an apartment building at their own expense, which they return from the resulting cost savings to pay for the resources consumed, and then, due to the same savings, they make a profit during the time period stipulated in the contract.



As a rule, one of the conditions of the ESCO contract is mandatory energy audit of the house. Since the investor assumes the risks of obtaining savings due to the implemented project, he is directly interested in preliminary calculations of potential savings. Based on the data obtained during the energy audit, the return on investment project is estimated and the term of the ESCO contract is calculated.

Both Ukrainian and foreign ESCOs can be involved in project financing. Today, the following can be used as a source of financing for energy-saving projects: 1-own funds; 2-budget funds (targeted allocation of funds from the state budget using the mechanism for returning these funds); 3-private investment and third-party financing (with a full or partial refund of the savings received) from international financial institutions.

A distinctive feature of the organization of energy saving project financing is the creation of an intermediary between the customer and investors, an economically independent legal entity in the form of an energy service company, which carries out all the necessary measures and assumes the risks arising during the project implementation period.

ESCOs in the residential sector of Ukraine have more opportunities to work (due to the lack of restrictions related to the use of budget funds). On the other hand, there are additional requirements for apartment buildings – in particular, the presence of an Association of multi-apartment buildings co-owners. In Ukraine, 180 thousand 456 apartment buildings, of which almost 100 thousand are in need of large-scale modernization. As of January 1, 2019, in 30 thousand 188 there are 26 thousand 603 Associations of multi-apartment buildings co-owners. That made up 16.7% of the total number of homes. In 2019, almost 1,500 more associations were built. On 01.01.2020, the Association of multi-apartment buildings co-owners operates in 31583 apartment buildings. This is a great dynamic. Today, the average number of houses managed by the Association of multi-apartment buildings co-owners is 17.6%. Now among the regions in terms of the number of associations of co-owners of apartment buildings, the Kherson region is the leader where associations are created in 40%. In second place is Ternopil region, where 35% of apartment buildings have associations. The regions that lag behind and have a significantly lower indicator of home management through the Association of multi-apartment buildings co-owners are Luhansk, Kharkiv and Chernihiv regions.

It is also worth noting that since September 2019, the energy efficiency Fund has finally started working. This is how we started accepting applications from the Association of multi-apartment buildings co-owners to participate in the Energy house program for partial cost recovery in the amount of 40% of the cost of energy efficiency measures in apartment buildings for the "Easy" package and 50% for the "Complex" package. The first 300 applications received an additional grant of 20%. In the future, the energy efficiency Fund plans to implement from 3.5 to 5 thousand such projects per year. However, the energy efficiency Fund cooperates with Ukgazbank, which was the first to sign a cooperation agreement with the energy efficiency Fund and provides loans for energy-efficient projects. Not all associations are satisfied with these conditions and have such financial opportunities. As already noted, the ESCO mechanism has other conditions for obtaining funding. This means that ESCO companies have a unique opportunity to Finance these energy-efficient projects [21]. The practice of implementing projects in Ukraine for the implementation of energy-efficient measures in apartment buildings shows that ESCO should not only carry out work on the house, but also become a performer/supplier of utility services for district heating in it. ESCO conducts energy-saving measures, which reduces energy consumption. And due to the savings received (the service rate is not reviewed), it is possible to repay the loan.

This means that ESCO companies have a unique opportunity to Finance these energy-efficient projects [21]. The practice of implementing projects in Ukraine for the implementation of energy-efficient measures in apartment buildings shows that ESCO should

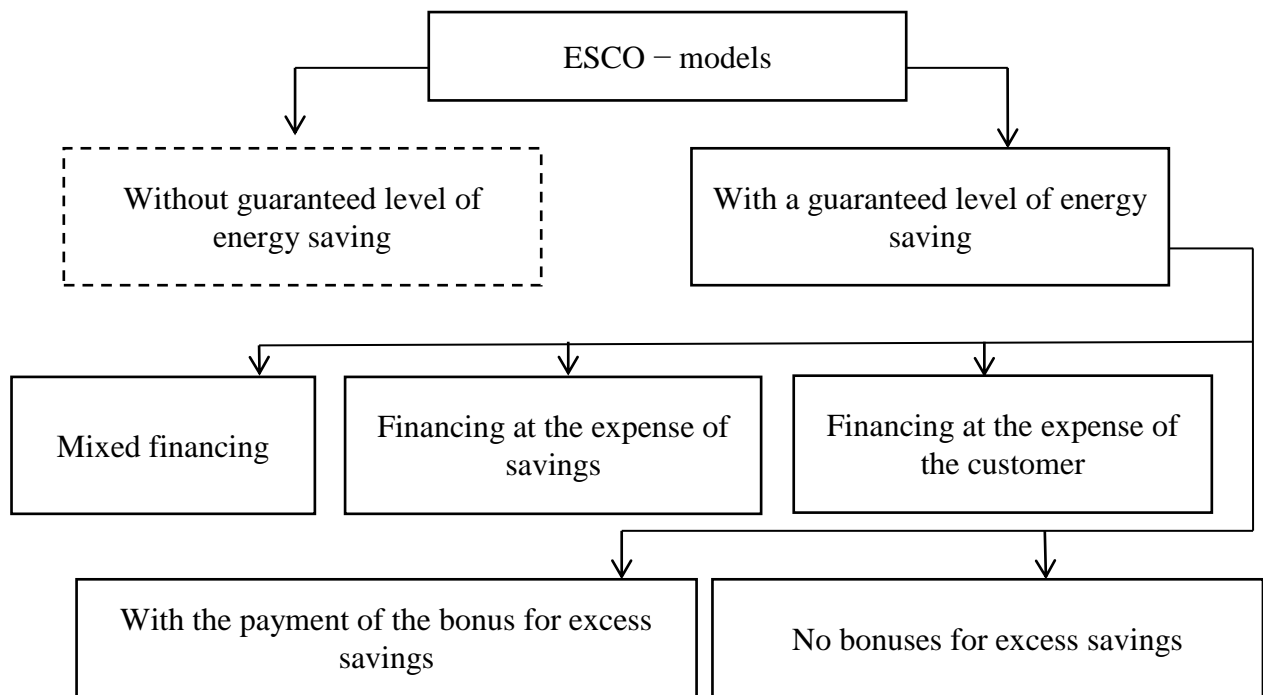
not only carry out work on the house, but also become a performer/supplier of utility services for district heating in it. ESCO conducts energy-saving measures, which reduces energy consumption. And due to the savings received (the service rate is not reviewed), it is possible to repay the loan.

- there is no culture of careful accounting and statistics of resource consumption, and many objects do not have metering devices installed;
- engineering networks and systems, premises and facilities often operate in violation of regulations and standards (lack of lighting, lack of ventilation and air conditioning, etc.);
- the potential for energy saving is obvious when the standard operation of the object in the base period, otherwise, after bringing the object into proper operation, will not cause savings, but an increase in energy consumption;
- as a rule, small and medium-sized businesses act as energy service companies, whose own working capital is limited for such long-term financing, and the borrowed resources of banks and financial structures are valuable and difficult to access;
- the issue of transferring ownership of the equipment that is being installed has not been resolved. It seems that many companies working with the public sector have faced a fairly strict attitude "either you play by my rules, or you don't play at all", as they say now, there is a certain corruption component in the complex organizational and legal scheme of energy saving;
- in General, the domestic experience of energy saving in its global, and not natural monopolies, understanding, is now reduced to 0.

Given that the energy service contract includes elements of various contracts (contract, services, financial lease or leasing, guarantee, loan agreement, agreement for design and search work, etc.), that is, by its nature is a complex and multi-component contract, it is necessary to consider the mechanism for financing an energy saving project, which is based on an energy service contract.

If a trilateral 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 financing mechanism for energy-saving measures will have the following form (Fig.5).

In Ukraine today, only models that have a guaranteed level of energy saving are used. It is also considered appropriate to use both options when implementing energy saving projects in Ukraine, depending on the functions that the financial and credit institution assumes and the terms of the energy service contract. The use of another financing scheme that is common in the world practice is based on the interaction of the customer and the energy service company at the present stage in Ukraine is almost impossible, since the energy service company, as a rule, does not have funds for the entire complex of energy-saving measures.



- models used in Ukraine;

--- models that are not used in practice in Ukraine

**Figure 5** Main ESCO models

When the energy service company finances a number of energy-efficient measures, overspending can be reduced by 50 %, and the boiler efficiency can be increased to 92 %, or up to 85 %. All this will make it possible to reduce energy costs from 20 to 22 %. The overall effect of ESCO financing of energy saving measures is shown in figure 6.

Figure 7 also shows a graphical representation of the ESCO mechanism. Therefore the data this graph suggests that the return of funds to companies is due to savings in energy, and thus the funds as a result of implemented measures (insulation, replacement boiler, pump, etc.). After the expiration of the contract, the payment of funds is terminated and the measures in place work for the consumer.

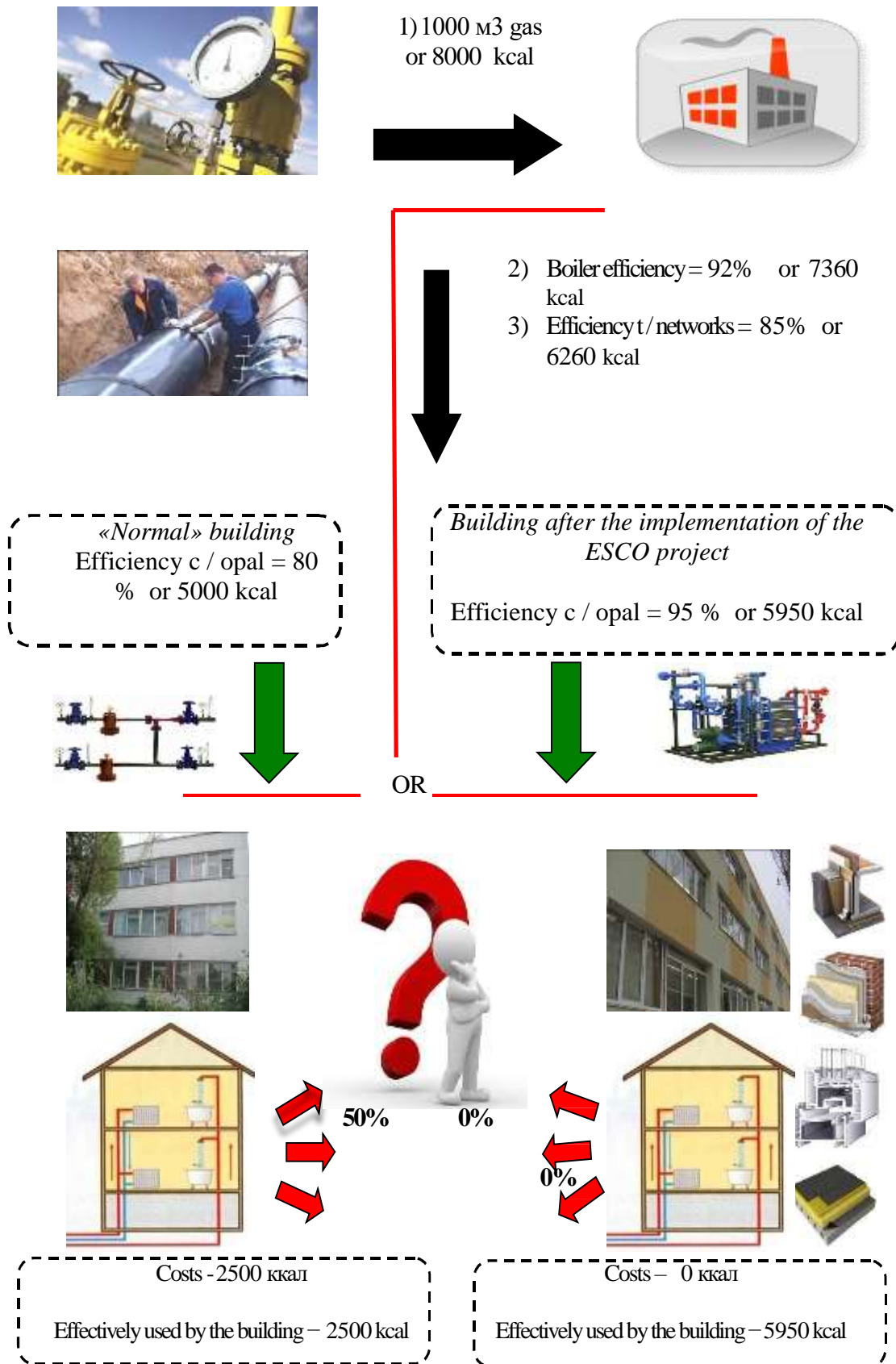
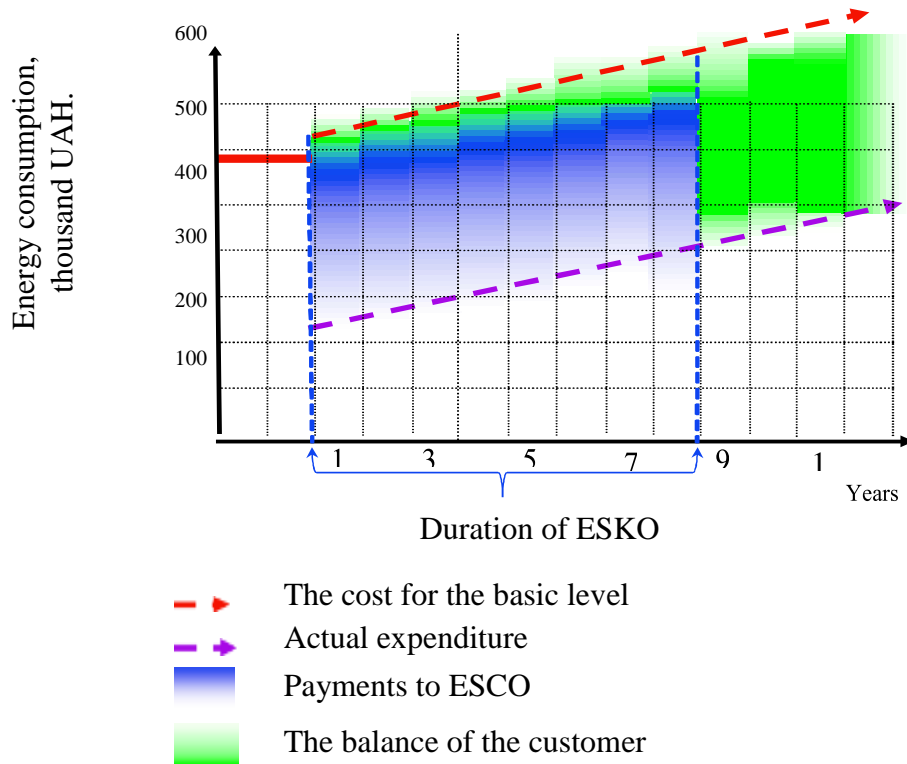


Figure 6 Effect of the ESCO mechanism



**Figure 7** Graphic representation of the ESCO mechanism

According to the all-Ukrainian center for energy conservation and energy efficiency in Ukraine, only 100 associations of multi-apartment buildings co-owners in 12 regions of Ukraine are involved in the implementation of the ESCO mechanism and the best picture in the budget sphere. This is how 204 ESCO agreements have been concluded and are working in 14 regions of Ukraine [22].

## 5. CONCLUSION

So, to sum up, we can say that today in Ukraine a lot has been done to implement energy-efficient projects. It is already clear to everyone that the housing and utilities sector is the largest consumer of energy. It needs immediate modernization and reorganization. As for technical measures, they are also known. But the financial aspect of this problem remains unresolved and most vulnerable. So the government has taken certain steps. An energy efficiency Fund has been created, which has finally started working. But, unfortunately, the same banking institutions that Ukrainians usually do not trust, and sometimes they are afraid of, remain the source of financing for the Association of multi-apartment buildings co-owners. Therefore, it is impossible to convince the residents of apartment buildings. Usually, the company is not fully informed about other sources of financing for energy-efficient projects. European practices of financial mechanisms are unacceptable for Ukrainian realities. However, the changes show that there are other sources of funding. In this way, ESCO mechanisms can become an alternative to existing preferences. As statistics have shown, only Bank loans will not be able to cope with the scale of financing.

This gives us the right to talk about significant opportunities for ESCO financing. Moreover, they have certain advantages. So the main ones include: savings on utilities, insulation turnkey (from the time of preparation of the project until commissioning); ESCO (Manager) is interested in maximum effective results; the financial and technical risks borne

by ESCOs (Manager); increase comfortable; significantly increases the commercial value of housing.

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