

Some Aspects of Energy Efficient Project Management

Trehub Mykola^{1,a*}, Tiukhmenova Kseniia^{1,b}, Kravchenko Kostiantyn^{1,c}

¹National Mining University, Dnipro, Ukraine

^anikolaytregub@gmail.com, ^btyukhmeneva@gmail.com, ^ckravchenkokv84@gmail.com

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Abstract. According to energy-saving trends the use of all types of energy should be minimal and efficient. Since late 90-s such strategy has been already used in well-developed countries. In Ukraine the energy-saving measures became popular since 2014. Now it is possible to receive warm loans supported by Ukrainian government for private households and co-owners of multi-apartment buildings. Also, it is possible to apply for grants of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine – the regional development projects that can be implemented at the expense of the state budget received from the European Union or other grants financed by local authorities at different levels. According to statistics it was found that using thermal sanitation method as a key measure of energy saving, it is possible to provide 85% of insulation efficiency. The research is focused on determination of weaknesses concerning grants for energy efficiency, their application and management. One of the most important factor that influence overall success is the correct calculation of energy losses. Three possible types of errors during calculations and possibilities to reduce their influence were defined. At the end of the article conclusions and suggestions for further research were made.

Introduction

Since 2014, energy-saving measures have been intensified in Ukraine. There are at least two objective explanations for this fact:

1. Rapid increase of energy costs
2. Harmonization of principles concerning the lending of persons and legal entities jointly with the EU.

This situation is conditioned by a number of economic and political factors at the state level. Most private households carry out energy saving measures that are supported at the state level in numerous ways including "warm loans".

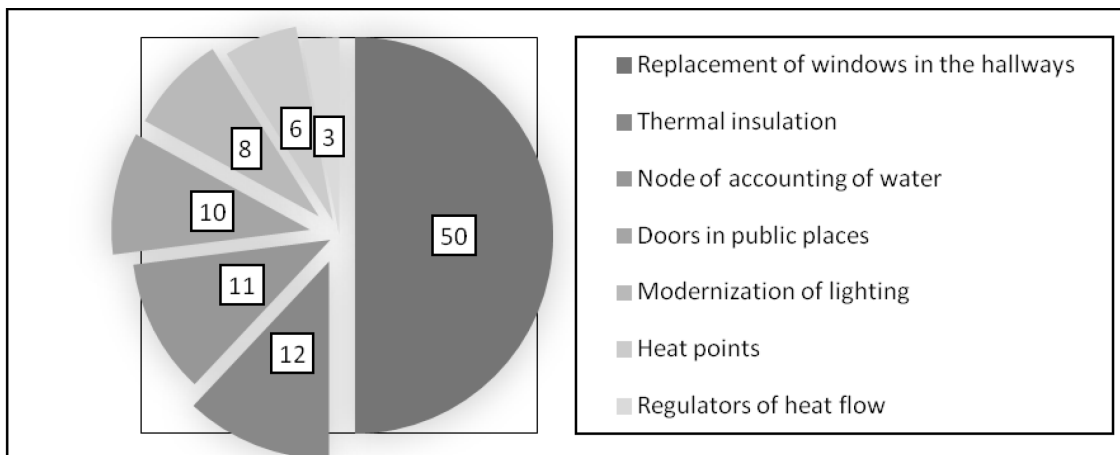


Fig. 1. Distribution of energy saving measures conducted by individuals for private households

The general principle of the program is that a part of costs spent on insulation will be compensated by the state budget (40-60% of all costs) in case the loan would be received at the State Bank. From October 2014 till now 163091 warm loans were received for 2656.2 million UAH for individuals and 660 warm loans for 80.4 million UAH for associations of co-owners of multi-apartment buildings. The distribution of energy saving measures is presented in Fig. 1 and Fig. 2. [1].

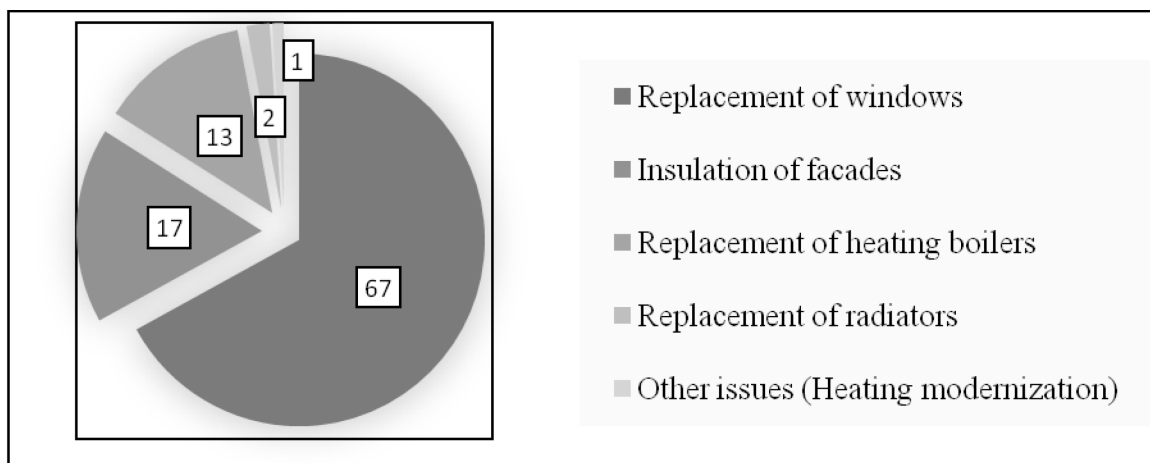


Fig. 2. Distribution of energy saving measures by associations of co-owners of multi-apartment buildings

At the local level, there are programs for introducing energy efficiency of communal property objects that have significant social importance e.g. preschool institutions, institutions of secondary education, hospitals, etc. In most cases, the phased implementation of the developed measures implies infrastructure shifts that allow us to use resources more efficiently and to reduce the pressure on the budget of both the institution and the community as a whole.

Despite the benefits for communal property, the situation with introduction of energy saving technologies in higher educational institutions of state ownership, directly subordinated to the Ministry of Education and Science of Ukraine or other profile ministries, remains unclear. On the one hand, the local authorities are ready to provide grant funding, on the other hand, the regional authorities are ready to support infrastructure transformations, but the current budget law does not allow to allocate funding to state-owned objects. In connection with this, there is a threatening situation regarding the existence of higher education institutions. In terms of reforming the paradigm of government procurement, and reducing its volumes, demographic trends in reducing the number of university entrants, the general impoverishment of the nation, we have a situation where state funding is, at best, sufficient to pay salary to professors and service staff.

For the potential realization of energy saving tasks for objects of state ownership there is a grant program of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine – the regional development projects that can be implemented at the expense of the state budget received from the European Union. Those wishing to participate in the program must fill in the application form and collect relevant documents. However, during the formation of the application, there might be certain problems and complications that significantly affect the positive outcome of all work.

According to the information based on the results of the implementation of warm loans, it was found that the highest savings were obtained from renovation the heating system, windows and insulation of the facades (thermo-sanitation). The share of these components in total savings is 85%. In this regard, the purpose of publication is to identify specific features, problematic and controversial issues, as well as risks during the formation and management of the project on thermal sprawl.

Energy Efficiency Regulation in Ukraine

In December 2010, the Verkhovna Rada of Ukraine ratified the European Energy Community Treaty (ECT): Ukraine became a party to the Treaty and committed itself to implementing the European Economic Community's directives on energy, energy saving and renewable energy. As regards of energy saving in buildings, there is Directive 2010/31 / EEC on energy performance of buildings (EPBD) [2] according to the document, among other requirements, there is a need to develop and adopt a methodology for calculating energy efficiency of buildings at the national

level. According to the Directive, energy efficiency of buildings should be determined on the basis of estimated or actual annual energy to meet the diverse needs associated with its typical use in the building. These needs should include the energy needs for heating and cooling to maintain the desired temperature, as well as the energy needs for hot water supply.

Nowadays, relevant provisions that would support the implementation of the Law on the methodology for calculating the energy efficiency of buildings in Ukraine have been prepared. Existing methods for determining the energy efficiency of buildings, as defined by the regulatory document [3], [4], take into account the annual energy demand for buildings for heating, energy consumption for cooling and the preparation of hot water. This standard is intended to meet the requirements of Directive 2010/31 / EU on energy efficiency of buildings, which provides for the adoption of a national energy certification procedure.

According to State Standard of Ukraine on energy efficiency of buildings calculations are presented at different levels [5].

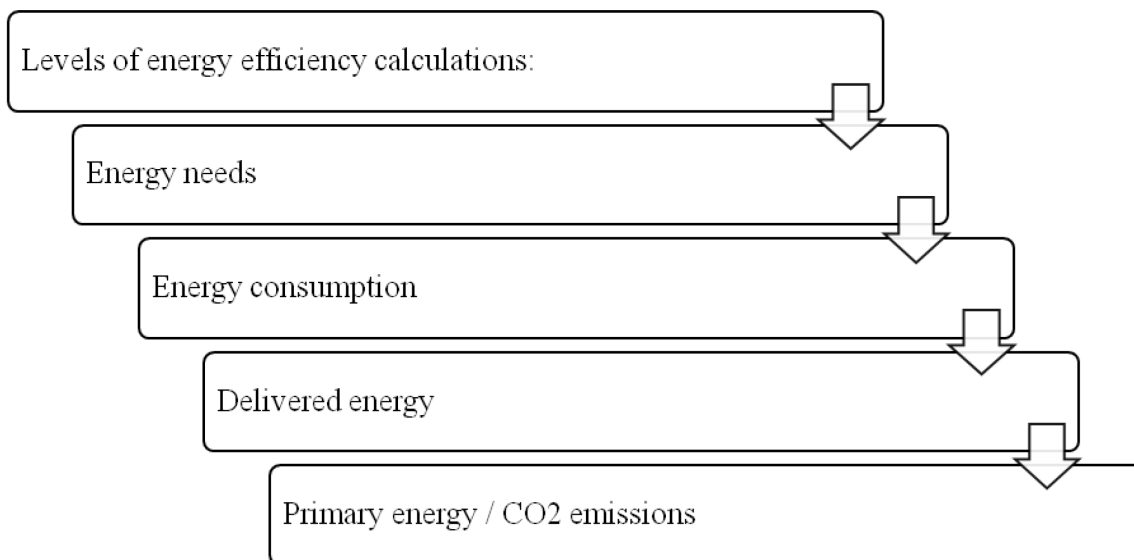


Fig. 3. Levels of energy efficiency calculations

At the moment in Ukraine there are energy efficiency classes of buildings A, B, C, D, E and F. Based on this system, it becomes clear that Class A (the tallest) buildings consume much less energy to support all the necessary functions to provide a normal environment on the site. The amount of payment for utilities is also lower than in houses with low energy efficiency. The classification takes into account the resources spent on common houses that are needed. It should be noted that other countries have been successfully using this model for decades, and its principles is taken as a basis for dividing into energy efficiency classes of buildings.

Calculating the energy efficiency of an object is a difficult task, for the solution of which you need to know certain subtleties and be able to perform complex calculations. This is one of the main stages of energy monitoring, consisting of energy surveys, development and implementation of programs to save energy and increase the productivity of resource consumption. When calculating energy efficiency, we determine the amount of money and means spent annually on the energy needs of the facility - heating, lighting needs. At the same time, certain criteria are taken into account, for example, the size and complexity of the design. The list can include a large number of parameters.

Development of Energy Efficient Projects

Energy efficient projects have the typical phases in accordance to the project management classification: initiating, planning, implementing, controlling, closing [6]. A specific characteristic of planning fazes is primary energy audit. Complex characteristic of the meaning of “energy audit” is composed in Fig 4.

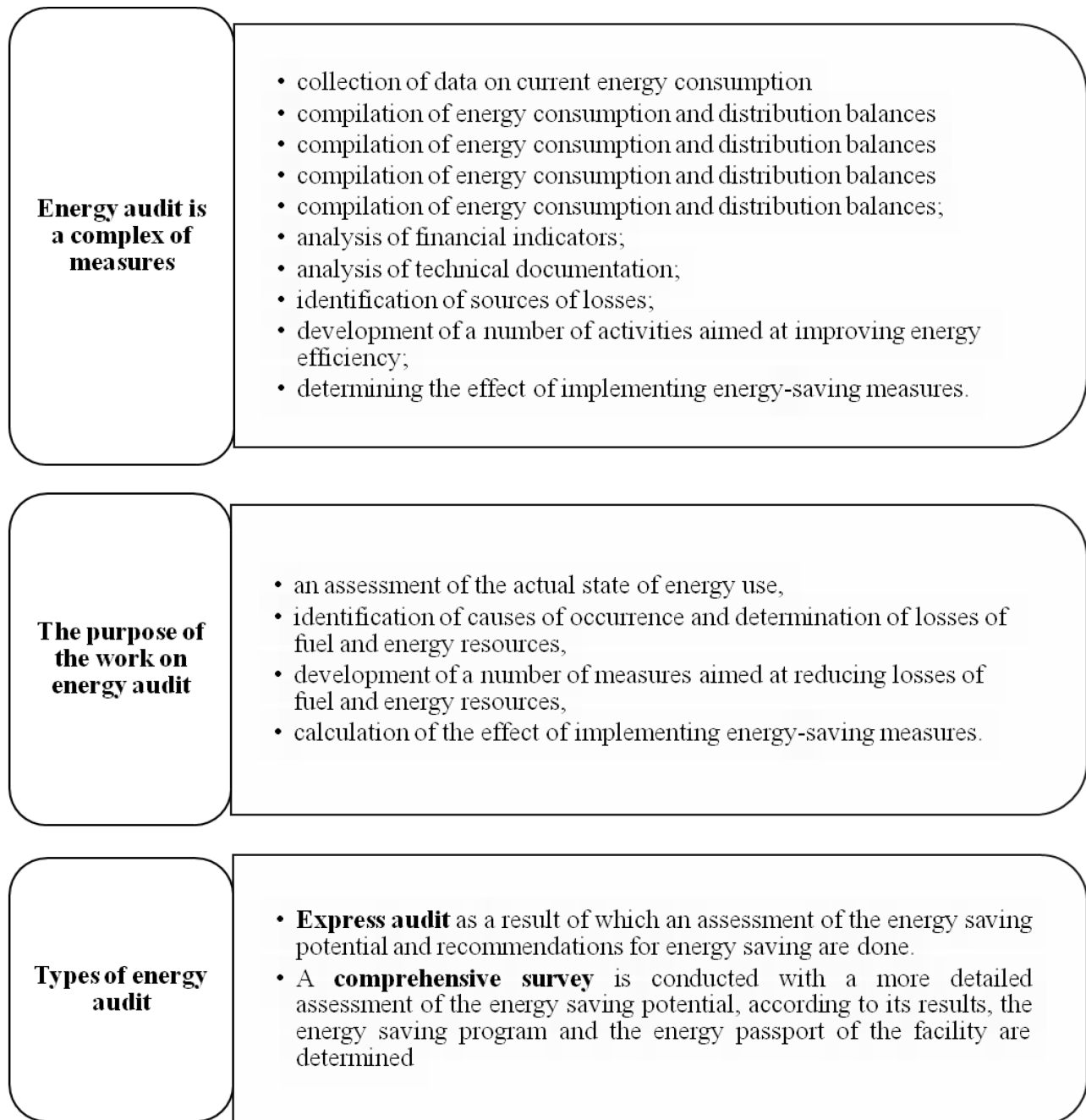


Fig. 4. Characteristics of energy audit

In accordance with the Law of Ukraine "On Energy Conservation," institutions, including residential buildings, and public buildings that consume more than 6,000 tons of standard fuel per year is subject to compulsory energy inspection, in addition to enterprises. An official document confirming the fact of inspection is the energy passport.

The Energy Passport is a regulated normative document reflecting the consumption balance and containing indicators of the efficiency of the use of fuel and energy resources in the process of the facility operation, as well as the implementation program to implement savings in fuel and energy resources.

Conducting the primary energy audit as a necessary element of the planning phase in energy efficient project it is important to follow the main objectives of projects implementation and focus of potential results (Fig.5) [7-8].

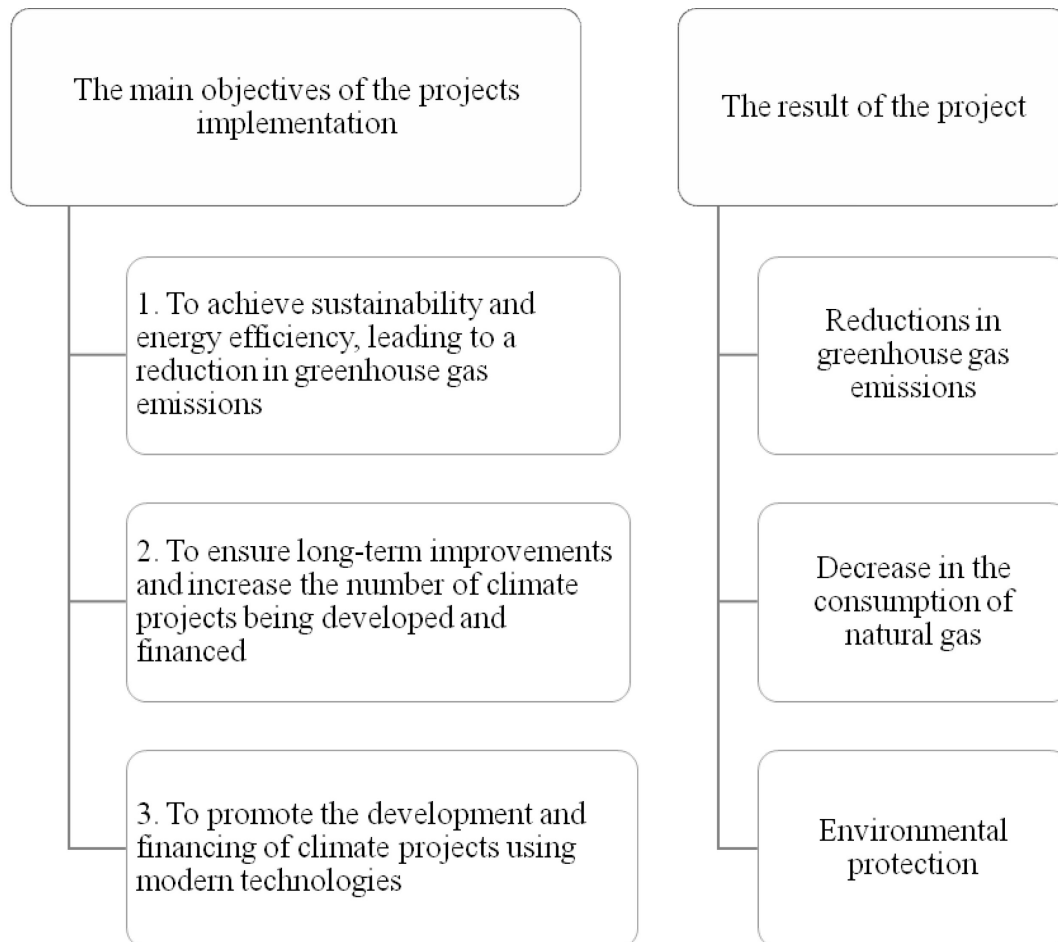


Fig. 5. Objectives and result of the energy efficient projects

An integrated approach to the development and implementation of such projects is that qualified (certified) specialists carry out control at all stages of the project development - from conducting a primary energy audit to developing project financing schemes, and monitoring the savings after implementing energy-saving measures.

Implementation of the Project on Energy Efficiency

Residential and public buildings that were built many years ago in Ukraine do not meet the modern requirements of efficient use of energy resources. In particular, heat energy consumption for heating buildings in Ukraine far exceeds the standards of developed countries. Main reasons are the use of outdated materials and technologies for the construction of buildings. The large number of buildings constructed according to old standards and a significant excess of heat energy consumption for their heating necessitates the significant potential for energy conservation and reduction of greenhouse gas emissions, which can be realized through the rehabilitation of buildings, first of all, by insulation of buildings and installation of means for automatic regulation of heat consumption. Ukraine is one of few European countries where the process of rehabilitation of old houses has not begun yet, and this fact based on the lack of a fuel, poses a real danger to the energy independence of the state. The process of spontaneous heating by the residents of individual apartments of multistory buildings, which has just begun, creates additional obstacles to civilized and planned rehabilitation. Distorted by random patches of thermal insulation of facades of city houses, they do not decorate them, and the lack of any automatics in the heating systems of such buildings eliminates the possibility of saving thermal energy, the surplus of which usually occurs in such cases to the atmosphere through open windows. Only in case of planned rehabilitation of buildings it is possible to preserve energy resources and to reduce corresponding greenhouse gas emissions. [9], [10].

Sufficiently large amount of money is needed to implement rehabilitation measures. Part of the investment necessary for the rehabilitation can be obtained through the use of flexible mechanisms of the Kyoto Protocol. However, the use of these mechanisms needs to ensure the credibility of achieving a reduction in greenhouse gas emissions. To this end, international practice has found application of unified methods for calculating GHG emission reductions for various measures to reduce them. In the absence of methods for determining the emission reductions of greenhouse gases approved by the international authority, national methods may be used. Unfortunately, at the rehabilitation of buildings it is impossible to determine the reduction of greenhouse gas emissions using existing unified methods. Therefore, the development of an appropriate national methodology is relevant for its application will allow attracting investments in rehabilitation of buildings in Ukraine. This methodology for estimating greenhouse gas emission reductions during the rehabilitation of the building was developed and based on data on the physical processes of heat exchange and transformation of heat flows in the enclosure structures of houses and in heat consumption systems, taking into account regulatory requirements for structures and engineering systems, as well as the methods of their calculations. The methodology was developed by M.V. Bereznitskaya, PhD, O.V. Budrym, PhD, V.F. Gershkovich, PhD, G.G. Panchenko, Yu.V. Pirozhenko and S.Ya. Skibik.

The obligatory list of measures for thermal sanitation of buildings includes measures the execution of which is required by the applicable design rules, namely [11]:

- insulation of exterior walls and roofs of the house in order to increase their thermal resistance to the level that is regulated by regulatory requirements;
- replacement of windows in order to increase their resistance to air penetration, as well as to increase their thermal resistance in accordance with regulatory requirements;
- installation of devices for house accounting of heat energy consumption in accordance with the requirements of the current norms;
- installation of home appliances for regulating the heating capacity of the heating system, as required by the design standards for heating;
- installation of automatic thermostats for each heating appliance in accordance with regulatory requirements. These works are carried out in case of replacement of the existing heating system.

Implementing these activities, the following should be considered:

1. The heat-engineering quality of external fences in buildings influences:
 - favorable microclimate of buildings, that is, ensuring the temperature and humidity in the room is not lower than the regulatory requirements;
 - the amount of heat losses in the building in winter;
 - the temperature of the inner surface of the fences, which guarantees the formation of condensate on it;
 - the humidity regime of the fencing, which affects the heat-shielding qualities of the fence and its durability [5].
2. Creating microclimate inside the building is provided by:
 - the appropriate thickness of the enclosing structure;
 - capacity of heating, ventilation or air conditioning systems.
3. The method of heat engineering calculation is based on the fact that the optimal thickness of the enclosing structure is based on:
 - climatic parameters of the construction area;
 - sanitary-hygienic and comfortable operating conditions for buildings and premises;
 - energy conservation conditions.
4. The method of heat engineering calculation is to determine the economically feasible resistance to heat transfer of the external enclosing structure. At the same time, the resistance to heat transfer of the enclosing structure should be no less than the required resistance to heat transfer.

Main Errors in Energy Efficient Projects Calculations

In accordance with project management approach an obligate stage of project planning is prediction of possible risk, probability and its value. Successful implementation of the planned projects activities in planned time and resources depend on minimization of any possible risk of the project. For energy efficient projects one of the most important and vague possible risk is mistakes in calculations at the planning phase:

1. Mistakes in filling an energy passport.

The main and often encountered error is the incorrect determination of the heated volume and the heat envelope that bounds it. To eliminate this error, it is necessary to clearly understand which rooms are included in the heated volume. These are all rooms in which there are heating devices and the internal air temperature maintained by them above 12 ° C. Premises with a lower temperature should be excluded from the heated volume, and the heated enclosure is limited to internal structures (walls or ceilings depending on the location of cold rooms).

2. The second error can be called incorrect definition of indicators of useful area (the area of apartments in a residential house) and the estimated area (the area of living rooms in a residential building).

This indicator is fundamental, because specific heat consumption for residential buildings in particular refers to the area of apartments. It should not include areas of summer premises, car parks, technical rooms and cold entrance tambours. Incorrect definition of this indicator leads to an error in the value of the specific consumption of thermal energy to 50-70%.

3. The third mistake is the incorrect calculation of the given resistances to the heat transfer of the outer enclosing structures.

Often, designers make mistakes in the calculation of external walls: the coefficients of the coefficient of thermal conductivity for the operating conditions of the region are incorrectly adopted (indicators for the dry state are adopted), the coefficient of thermal engineering uniformity is not taken into account. Calculation of reduced resistance to heat transfer, the scope of the used heater types does not correspond to the designed structures, etc.

It should be borne in mind that in accordance with the current regulatory documents, the responsibility for reliable information in the energy passport is borne by the organization that filled it. And the specific heat consumption rates calculated in the design documentation are the basis for determining the energy efficiency class that is assigned to the building when it is put into operation or after the heat modernization is completed.

Conclusions

The application of energy efficiency projects and implementation of measures for thermal sanitation of buildings is an important way to reduce the energy consumption. The applicants should be aware of key steps and risks for successful application of the project. One of the most important aspects that influence the project application is the appropriate calculations of energy consumption and loss. Such calculations are based on the energy passport of the building.

Based on the research there was determined the following:

1. The key steps of energy efficiency projects development are systematized.
2. The demands for implementation of the project on energy efficiency are justified.
3. The conditions of thermal sanitation were systematized. It was defined the factors that influence the heat-engineering quality of external fences; the methods of creating microclimate inside the building; the methods of calculating the energy efficiency.
4. Summarized and justified three possible types of errors that influence the correct data of energy efficiency. Made some suggestions on reducing the influence of each type of error.

Further research should be focused on the evaluation of risks during application and project management issues and development of project management strategy that would lead to minimal losses.

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