Introducing Innovative Technologies To Increase Energy Efficient Buildings

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ABSTRACT:

Energy efficiency and energy conservation are priority areas of energy policy in most countries of the world. First of all, this is due to the exhaustion of non-renewable fuel and energy resources, the absence of real alternatives to their replacement, the presence of risks and significant costs in their production and transportation.

Keywords: energy security, renewable energy, developed country, share of energy, solar energy, energy efficiency.

1. INTRODUCTION

At the present time of advanced technologies, the use of "environmentally friendly" renewable energy sources is very important. It is necessary to stimulate further growth in the consumption of such types of energy as solar, wind, biogas and hydropower.
For many countries with limited resources of combustible minerals, such as Denmark, the Netherlands, Germany, the use of renewable energy sources is an integral part of the economic strategy.Uzbekistan has achieved energy independence relatively recently. The main sources of energy in the republic are oil and natural gas, although in recent years the consumption of coal has also increased after the procedure of gasification. In general, of the entire mass of diverse mineral resources of the Republic of Uzbekistan, only oil shale and uranium are not used in the country's energy sector. However, fossil energy sources cannot fully ensure the country's energy security, especially taking into account modern realities and the need to save non-renewable resources. In addition, traditional energy sources do not always allow providing electric, heat, and water supply to the population living in remote and inaccessible areas, as well as seasonal workers and scientific expeditions. In this regard, the Republic of Uzbekistan attaches great importance to the development of renewable energy sources Table 1 presents the results of expert assessments of the potential of renewable energy sources of the Republic of Uzbekistan (Table 1).
From table 1 it can be seen that the total energy potential of renewable energy sources is approximately 51 million tonne of oil equivalent , technically available potential is 182.32 million tonne of oil equivalent, which is more than three times the current annual the volume of extraction of fossil energy resources. The data presented show that 96.9% of the potential falls on the energy of the sun. The share of all other renewable energy sources is slightly more than 3% of the technically available potential. Of these, the potential of small hydropower is most developed (31.3% of the technically available and 13.3% of the gross). This is due to the relatively high economic efficiency of this type of energy. Of all types of

renewable energy presented in table. The least environmental hazard when consumed is represented by the energy of the Sun, wind, geothermal waters and petrothermal energy.

Varieties of Renewable Energy Sources	Potential, mill tonne of oil equivalent		
	Gross	Technical	Mastered
Hydropower, totalincluding	9,2	2,32	0,72
largerivers	8,0	1,81	0,56
smallrivers, reservoirs, canals	1,2	0,51	0,16
Solarpower	50973	176,8	
Windpower	2,2	0,4	
Biomass	-	0,5	
Geothermalresources:			
geothermalwaters	0,2	0	0
petrothermalresources **	6700000	0	0
Total	50993,8***		

Potential of renewable energy in Uzbekistan.

Today, the world is trying to solve the energy problem on the basis of new approaches, which are based on: firstly, the improvement of the technological process in terms of energy intensity of production; secondly, the development of energy conservation; thirdly, the expansion of energy production from renewable sources.

One of the priority areas for the development of domestic and world energy is the use of non-traditional renewable energy sources, which are coalbed methane, wind energy and solar energy. Intensified development of these energy sources will not only raise the country's energy sector to a high level, significantly reduce the price of electricity consumption, but also put the economy on a par with more developed countries. Therefore, the strategic objective of the energy sector is the introduction of energy-saving technologies, in particular the development of alternative energy sources. Alternative energy sources include peat, oil shale, natural bitumen, coal-bearing gases, water-soluble gases, oil and gas in low-permeability rocks, hydrocarbon gas hydrates, geothermal energy, solar, wind, ocean, bioenergy, small river energy, hydrogen energy , energy of silicates, fuel cells and secondary energy resources. In the world more and more often cars, buses, trains, planes and even submarines replace traditional fuel with hydrogen [1].
In connection with the depletion of natural resources, and, as a consequence, their appreciation, renewable energy sources (RES) are beginning to play an increasingly important role in construction and the economy. The attention of the Government of the Russian Federation to this direction is indicated by the Government Order “The main

directions of state policy in the field of increasing the energy efficiency of the electric power industry based on the use of renewable energy sources for the period until 2020”. dated January 8, 2009 It was in this document that the goal was set to increase the share of alternative energy sources in the country's total fuel and energy balance by 2020 to 4.5%. The concept of "energy efficiency", first of all, implies the achievement of economically justified rational use of energy resources, based on the latest achievements of engineering and technology. Getting maximum energy efficiency at home is achieved primarily by reducing heat loss, a more rational use of thermal energy in all energy processes without compromising the final result.

The heat and energy effect of the external climate on the heat balance of a building can be optimized by choosing the shape of the building (for rectangular buildings, such parameters as its size and orientation are taken into account), the location and areas of filling of light openings, and regulation of filtration fluxes. For example, a good choice of orientation and dimensions of a rectangular-shaped building makes it possible in the warm season to reduce the effect of solar radiation on the building envelope and, therefore, to reduce the cost of cooling it, and in the cold period, to increase the effect of solar radiation on the building envelope and reduce heating costs . Similar results will be obtained with a good choice of orientation and dimensions of the building with respect to the effect of wind on its heat balance.

The methodology for designing heating, ventilation, and conditioning systems is based on calculations of the building's heat and air balances for typical periods of the year. For example, for Russia, these periods of the year are: the coldest five-day period, the heating period, the hottest month, the cooling period, the estimated year. In this case, the optimization of the heat and power effect of the external climate on the heat balance of the building by choosing its shape and orientation will give the following results:

- for the coldest five-day period - a decrease in the installation capacity of the heating system;
- for the heating period - reducing the cost of heat for heating;
- for the hottest month - reduced installation capacity of the air conditioning system;
- for the cooling period - reduction of energy costs for cooling the building;
- for the settlement year - reduction of energy costs for heating and cooling the building.

This article discusses the results of introducing technologies to improve the energy efficiency of buildings and assesses the benefits of using renewable energy sources. Advanced energy efficiency technologies are known from foreign practice. The first projects of energy-efficient homes took up in the United States. Currently, the most successful work is underway on the construction of energy-efficient buildings in Europe. The experience of European countries suggests that even in residential buildings built according to old standards, energy losses can be reduced. In Europe, there is a classification of buildings by energy consumption: the “Old Building” (until the 1970s) consumes 300 kWh / m2 per year. The “new building” (from the 1970s to 2000) consumes no more than 150 kWh / m2 per year. "House of low energy consumption" consumes no more than 60 kW · h / m2 per year. "Passive house" consumes no more than 15 kW · h / m2 per year. The “zero energy house” consumes 0 kW · h / m2 per year. “House plus energy” or “active house” produces more energy than it consumes as a result of using renewable energy sources [4].

2. MAIN PART

In Uzbekistan, at the government level, there is a fundamental decision (Order of the Government of the Republic of Uzbekistan of January 2009) to increase the share of renewable energy sources in the overall energy balance to 2.5% and 4.5% by 2015 and 2020 (excluding hydropower, which is renewable energy and generating 16% of energy today), which is about 80 billion kW / h of electricity generation using renewable energy sources in 2020 at 8.5 billion kW / h at present [5]. The design practice of energy-efficient construction allows us to distinguish the global and local levels of design of the object. Global level - an assessment of natural conditions, ecological conditions in a country or the world as a whole. At this level, it is possible to single out territories where the implementation of energy-efficient projects can become an alternative to traditional construction methods, or justify the economic effect in the use of natural resources. At the global level, urban planning issues of designing energy-efficient buildings are considered and resolved: identification and selection of a construction site in terms of favorable and unfavorable climatic and anthropogenic factors, as well as rational use of the landscape. Local level - implies the development of an object at all stages of design, in a specific territory. This is the development of a master plan, space-planning, constructive solutions; engineering support. Practice shows that the following communities are identified in the characterization of energy-efficient buildings:

1.Volume-planning characteristics: a compact grouping of volumetric forms, their optimization, orientation and insolation (Fig. 1).

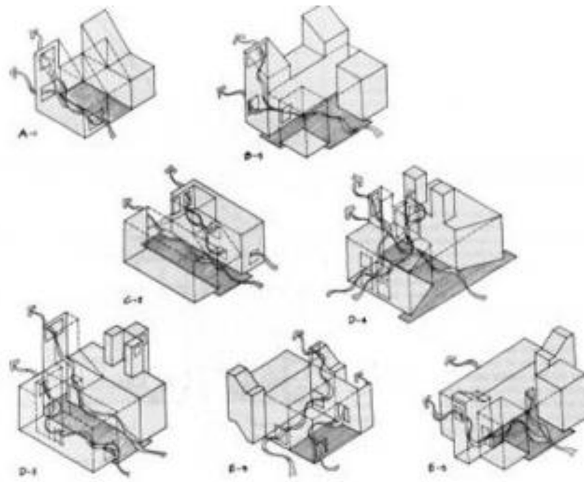

Figure 1.Space-planning solution.
Figure 2.Constructive decision.

Figure 2 Constructive: to effectively regulate external and internal air flows, ensure the transformability of structural solutions (Fig. 2).

Engineering: optimization of the technical and operational parameters of engineering systems by recycling secondary waste, or by introducing automatic control and regulation of energy distribution (Fig. 3).
In energy-efficient buildings, energy consumption is reduced due to the improvement of engineering support systems and structural elements. This plays a significant role in the search for architectural and planning solutions for buildings: layout, facades, aesthetics [2,3]. Often, energy-efficient buildings are expressed in concise architectural forms, at best made in high-quality selected finishing materials. Architectural solutions of energy-efficient buildings are inferior to the search and development of renewable energy sources (RES) devices:solar panels, collectors, heat pumps. This puts forward one of the priorities in the search for architectural images of these objects and identifies their problems.

Currently, there are also a number of problems in the practical implementation of energy saving projects through the use of alternative energy sources. Investors solve the training of qualified personnel for innovative enterprises under construction themselves, compensate for the lack of domestic raw materials and components with imports, while simultaneously exploring the possibilities of localizing the entire production process. However, despite all the temporary inconveniences, the implementation of projects for the construction of energy-efficient houses not only favorably affects the environmental situation in the country, but also demonstrates economic efficiency and, therefore, attractiveness for private investments.

3. ANALYSES

An energy-efficient building is the result of the skill of an architect and engineer. When designing an energy-efficient building, the architect solves the problem of making the best use of the positive energy impact (impact) of the outdoor climate and neutralizing the negative impact of the outdoor climate on the heat balance of the building as much as possible. At the same time, the engineer solves the problem of organizing such a building air conditioning system that, with the least energy, provides the required microclimate in the rooms. It is extremely important - maybe this is the main idea for the construction of the 21st century - nature is not a passive background of our activity: as a result of our activity, a new natural environment can be created that has higher comfortable indicators for urban development and is at the same time an energy source for air conditioning of buildings.

A wonderful example of harmonizing the construction of the facility and the natural environment is the sports complex in Sapporo (magazine "ABOK", No. 6, 2000, p. 50). In the project of the satellite city of Sapporo, located on the island of Hokkaido, the problem of the effective use of natural, geographical and climatic factors in urban planning decisions was solved. Given that the peculiarity of the island of Hokkaido is the stable strong winds of the northern direction, the urban development decision of the satellite city is made as a natural breakwater.
The shell shape of the stadium simulates an airplane flying in the direction of the prevailing wind (Fig. 4).

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Figure 3. Engineeringsolution

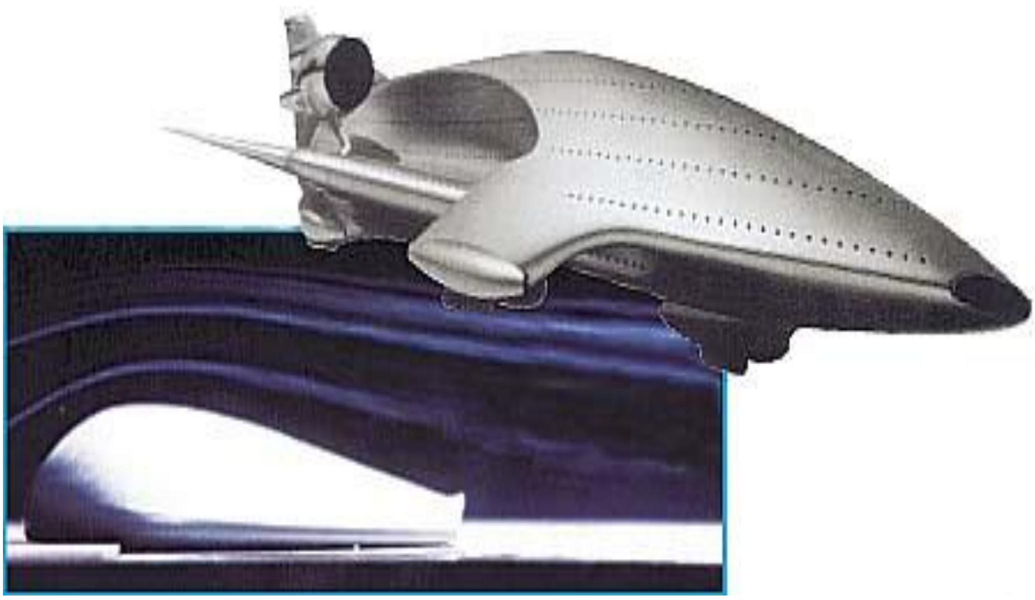

Figure 4.Modeling the dynamics of blowing the dome in winter.

The sports complex with indoor and outdoor fields is designed as a single aerodynamic system, providing for effective natural ventilation with outside air from the side of a low located open stadium. Air removal is organized in the upper part of the enclosed field. The use of effective natural ventilation has reduced the cost of air conditioning.

The logic of the development of modern architecture is largely the result of the desire for harmony in the natural environment surrounding the building and the indoor microclimate. A wonderful example of this harmony is the House over the Waterfall (architect Frank Lloyd Wright). Here, the artistic image of the house lives in complete harmony with the natural environment (Fig. 5).

Figure 5.Frank Lloyd m Wright.The House over the Waterfall.

The skill of the architect, who best takes into account the energy impact of the outdoor climate, was manifested in the design of the fifty-story energy-efficient building of the bank's main office in Frankfurt, which represents a triangle with rounded corners. Four-story conservatories spirally surround the building in height. In total there are 9 conservatories with a view of the city (Fig.6).
The conservatories are orientated and provide office space with natural ventilation and lighting. On the glazed walls there are special opening devices for intake of fresh air. For internal areas, mechanical ventilation is used with a minimum air exchange rate for hygiene requirements, while the heating system along the perimeter of the building and cooling ceilings regulate the temperature of the indoor air. The main criteria that determine the aerodynamics of a building are: the frequency of the wind speed in different orientations, the average wind speed and wind rose, as well as the calm frequency.

4. CONCLUSION

In conclusion, it is necessary to dwell on two circumstances affecting the final choice of the building design. First, the project of an optimal energy-efficient building may be worse than the proposed project at the reduced cost. In this case, the final choice of the design of the designed building is determined by the minimum of costs.
The second circumstance - in real design, the choice of the best option for an energy-efficient building can be constrained by a number of restrictions, the so-called "disciplining conditions", which are fixed from the very beginning and cannot be violated (for example, the number of storeys or the length of the building). In this case, the optimization problem is posed with given constraints, and the goal is achieved when obtaining the optimal solution taking into account the given constraints. And we also note that the adoption of the final decision falls within the competence of the responsible person (usually a group of persons) who is granted the right to make a final choice and who is responsible for this choice. Making

a choice, he can take into account, along with the recommendations arising from the mathematical calculation, a number of considerations of a quantitative and qualitative nature that were not taken into account in these calculations.

Thus, the need for a stable energy supply to the population and economy of the country, reduction of the technogenic burden on the environment, reduction of social tension in the energy sector, general increase in the level of energy security of the Republic of Uzbekistan will require solving problems associated with a number of energy efficiency of the country's economy, and significant public costs for its power supply. Various factors influencing the level of energy efficiency on energy security, although to varying degrees, clearly indicate the positive role of increasing the level of energy efficiency in ensuring the country's energy security.

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