About the introduction of the educational module "The best European experience in the field of energy saving" in DSTU

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Abstract: The article assesses the implementation of the educational module and its potential in promoting the European principles of social development and culture at the institutional and national levels in Russia. The characteristics of the project aimed at the inclusion of a master's degree discipline in the university curricula that reveals advanced European practices in the field of energy and resource conservation are given. Analytical data and characteristics of architectural, structural and engineering solutions of modern technologies of energy-efficient, environmentally friendly types of buildings implemented in European countries are presented. Conclusions are made about the implementation of the Jean Monnet Module project at the Don State Technical University.
Keywords: education, energy saving, construction, European experience.

The development of universities and higher education in general, both in Russia and in Europe, is primarily a national task. The European Union (hereinafter referred to as the EU), having adopted the Bologna Declaration in 1999, declared an increase in the international competitiveness and attractiveness of European universities, an increase in research standards, which in the future should serve as a model for national research systems and professional training of future generations of scientists around the world.

The promotion of education and research on European integration among academic specialists is carried out, among other things, through the activities of the Jean Monnet framework programs (since 2013 it has been included in the ERASMUS+program). The Jean Monnet Module refers to the areas in the section "teaching and research" and implies support for the educational and scientific work of leading university teachers.

In 2019, within the framework of the Erasmus+ Jean Monnet Action program, the application of the Don State Technical University (hereinafter DSTU) passed the competitive selection of the Executive Agency for Education of the European Commission, and in October 2019, the Chair of Urban Development and

Municipal Economy started creating a new training module" The Best European Experience in Energy Saving "(Jean Monnet Modules" The Best European Experience in Energy Saving " (E3SAVE)).

The proposed project is aimed at including a new educational module in the university curricula of the master's programs of DSTU ("Spatial planning and territory management" and "Civil Engineering") to study advanced European practices in the field of energy and resource conservation, increase interest in the European experience in solving energy efficiency problems and improve the quality of research papers and publications of students and teachers in the field of implementing energy - saving technologies in the field of construction and public utilities.

The problem of rational use of energy resources is one of the many most pressing issues that needs to be studied taking into account the best European experience. The Russian Federation began to pay sufficient attention to energy saving issues much later than the EU countries. That is why, to date, the European Union has accumulated significant and useful experience that can be used in other countries, including Russia. The first regulatory documents aimed at reducing the volume of energy consumption by buildings were adopted in Europe in the late 80s. The following countries were the first to introduce new energy-saving standards at the state level: Denmark (Danish BR77 standard) in 1977, in 1980 – Sweden (SBN-80, Svensk Bygg Norm). Due to this, by 1988 Sweden reduced the annual heat consumption in residential buildings by 28 % (compared to the level of consumption in 1978), in Denmark by 1985 the consumption of thermal energy in residential buildings was reduced by 28% compared to 1972 [1].

The European Union actively strives and does everything necessary and possible to reduce the level of total energy consumption in buildings, increase energy and resource efficiency in construction and increase the use of the share of renewable energy in building engineering systems. Certification of buildings in the

"green" construction system has been used in European countries for more than 20 years.

The working program of the course demonstrates the following tasks:

- to study and adopt the extensive European experience of implementing energy saving policies in the field of energy-efficient construction and housing reconstruction;

- to get acquainted with the best European practices in the development of methods and tools for reducing energy consumption of buildings and their engineering systems;

- to study the basics of innovation management in energy-saving construction and reconstruction projects in Europe;

- to introduce a European culture of environmental awareness and way of thinking, economical use of resources, in which the issues of environmental conservation and energy efficiency are the most important priorities of modern European urban policy;

- to train future specialists who are well versed in European advanced methods and technologies in the field of energy conservation and rational use of energy resources.

After the first year of work, educational and methodological materials were published, which provide analytical information on the study of the best practices in the field of energy saving in Europe. The characteristics of architectural, structural and engineering solutions of modern technologies of energy-efficient, environmentally friendly types of buildings implemented in European countries are given (table No. 1).

Table No. 1

Comparative analysis of the concepts of eco-friendly types of buildings

Passive house	**Multicomfort house**	**Active House**	**Eco-house**
1) The location, orientation and shape of the building in the cardinal directions reduce the heat loss of the object, by ensuring maximum energy intake from the sun.			
2) Reduction of heat losses of the building due to high-quality thermal insulation of enclosing structures, the use of energy-efficient multi-chamber double-glazed windows, sealing the joints of building elements, the use of heat recovery in the ventilation system.			
3) The tightness of the building shell is confirmed by the Blow Door test. 4) The use of alternative energy sources in the building. 5) The max-required power of the heating system should be less than 10 W / m^2. 6) The specific consumption of thermal energy for heating is less than 15 kWh*h/m^2 per year. 7) The indicator of primary energy consumption (hot water, heating, electric energy,) ≤ 120 kWh*h/m^2 per year.	3) The use of renewable energy in the energy supply and heat supply of the building. 4) Increased requirements for sound insulation, indoor air quality. 5) The use of building materials that have an environmental declaration (EPD) and EcoMaterial Absolute eco-marking, ISOVER insulation. 6) The maximum required power of the heating system is less than 10 W / m^2. 7) The specific consumption of thermal energy for heating is less than 15 kW•h / m2 per year. 8) Carbon dioxide emissions into the atmosphere do not exceed 2 kg/m^2 per year. [5]	3) The independence of the building from external energy sources due to the use of renewable energy. 4) Installation of the Smart-house system "Smart house" for automation of processes and management methods of all building systems.	3) The building's autonomy from external energy sources due to the use of renewable and alternative energy sources. 5) The use of environmentally friendly building materials that are low-cost in terms of production method. With their possible future disposal naturally on the spot. 6) The use of methods and technologies for the processing and disposal of organic waste, increasing soil fertility on the site of the eco-house. 7) Affordability for the majority of the population.

The project's working group studied the specifics of implementing the energy saving policy and improving the energy efficiency of buildings in Russia and the EU [2-4] and performed a comparative analysis of the regulatory framework for energy saving (Table No. 2).

Table No. 2

Comparative analysis of gradation of energy efficiency classes of buildings in Russia and Europe

Germany (EnEV 2014 standard)		Russia (Order of the Ministry of Construction of the Russian Federation No. 399 / pr)	
energy efficiency class	final energy consumption, kWh*h/m^2 year	energy efficiency class	final energy consumption, kWh*h/m^2 year
A+	< 30		
A	30-50		
B	51-75	A++	<82
C	75-100	A+	82-103
D	100-130	A	103-124
E	130-160	B	124-144
F	160-200	C	144-175
G	200-250	D	175-207
H	> 250	E	207-258
		F	258-310
		G	>310

Special attention in the module implementation program is paid to the research of energy consumption in buildings at various stages of the life cycle and the calculation of the cost of the full life cycle [6,7] using the information and analytical complex of the IAS of housing and communal services (Fig. 1,2).

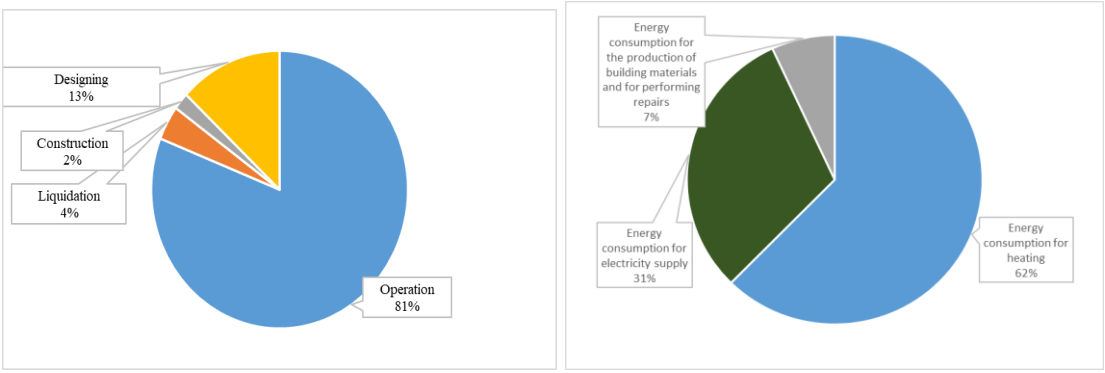

Fig. 1. - The structure of energy consumption in residential buildings at the stages of the life cycle

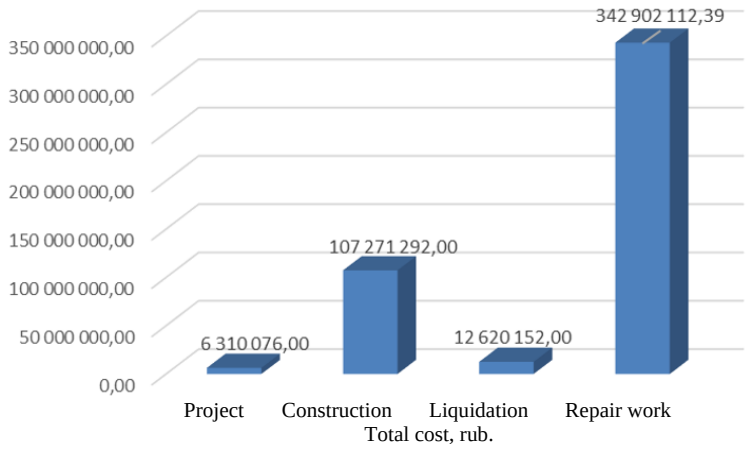

Fig. 2. - Cost sharing scheme at the stages of the life cycle of a 5-storey business center

In the studies, it was noted that the level of energy efficiency of buildings affects not only the operating costs of the building, but also the level of comfort of living, the level of negative impact of the building on the environment [8, 9]. Newly constructed buildings should be economical in construction and operation, have a minimal negative impact on the environment and human health, only in this case it will be possible to achieve the sustainable development goals proclaimed by the United Nations [10].

The working program of the discipline has been developed taking into account a wide range of similar courses at leading European universities, primarily at the Vienna University of Technology. The results of students ' training and the evaluation of surveys, which included quality criteria (the degree and level of complexity of tasks, the presence of active and group training, interaction with teachers, the use of developing practices) showed the success of implementing such projects in Russian universities and increasing interest in the European Union. It is expected that this will create a methodological basis for further modernization of educational programs at DSTU, prepare a theoretical and empirical basis for future research in the field of environmental education and sustainable development.

There is no doubt that international cooperation in the field of higher education will contribute to improving the quality of educational services provided. The introduction of such a module is crucial for the training of modern highly qualified specialists for the Russian, Eurasian and international construction industry, which in turn expands the employment opportunities of students and contributes to the introduction of European energy-saving technologies into the practice of modern design and construction in Russia.

It is expected that this module will have an impact on a wide range of audiences: researchers, undergraduates and students of the Don State Technical University, representatives of other educational institutions interested in studying and implementing advanced energy-saving methods and technologies, as well as other professionals in the field of construction.

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