Social, Financial and Ecological-Energy Criteria for Making Management Decisions in Construction

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Abstract The construction industry functioning on an up-to-date stage of economic development requires the implementation of energy efficiency and environmental friendliness principles, which is in line with global trends in sustainable development. Transformation processes have been encouraged construction companies to adapt their management decisions to meet the needs of construction products consumers. It has been really important under condition of the urbanization level growing.

Main trends and features of the construction industry of Ukraine and European countries have been analyzed; problems of the industry functioning during the pandemic have been identified. On the empirical research basis, financial and ecological-energy criteria of the housing choice by buyers in Ukraine have been substantiated, and also priorities changes in dynamics have been investigated. The mathematical function for making managerial decisions in construction has been formed.

Also the ways for financial problems decision in building sphere taking into account possibilities of the financial market have been developed. The energy-efficient decisions in the field of real estate exploitation have been proved.

Keywords Construction · Energy efficiency · Ecology · Social-financial indicators · Management

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1 Introduction

The construction industry is an integral part of the economic complex, an indicator of the growth or the decline of the economy. It is closely connected with other industries, their development through the production facilities creations, storage and offices, logistics and engineering networks. Construction companies' further development dynamics prospects are an important research area under transformation processes conditionals occurring around the world during the pandemic.

These processes significantly affect the economy of each country. Thus, not only external factors of influence, such as political, macroeconomic, globalization, but also internal guidelines for the functioning of enterprises are changing. An enterprise's activities vectors have been directed to the energy-saving, which saves the internal financial resources of the business entity and energy efficiency i.e. the most efficient use of all available resources provides.

A reduction of economic activity and incomes of economic entities influences a reduction of employment and incomes of citizens. At the same time, the trend of rising energy prices continues. Under such conditions, the dwelling's energy efficiency increase and the level of financial costs for its maintenance reduction are the key advantages of the proposals in the residential real estate market. This poses to make new challenges to the construction industry, which has suffered the most during the pandemic. Competitive advantages will be given only to those construction companies that offer to customers housing that meets modern environmental, energy efficiency criteria, will be economical and at the same time meets the social needs of people. That is, management decisions of construction companies must be adapted to modern pandemic conditions.

2 An overview of the Latest Sources of Research and Publications

The problems of energy efficiency and energy saving in the housing sector have been engaged by such economists: H. Elsharkawy and P. Rutherford, M. Villca-Pozo, B. Serrano-Lanzarote, I.G. Hamilton, B.Coyne, R.Lawrence and C.Keime, B.Lin, V.Brigilevich, V.Volkov, S. Sivitska, Komelina O. [1–11]. In particular, the studies of Spanish scientists regarding the quantitative determination of the energy saving potential in the Spanish housing fund, the formation of a strategy for its energy renewal and the introduction of tax benefits for the modernization of energy efficiency in housing in Spain are interest [6, 7]. Elsharkawy H. and Rutherford P. presented the results from an extensive pre- and post-retrofit home energy use and performance survey of 150 properties located in Nottingham's Aspley. Their research seeks to inform and improve the uptake and delivery of future housing retrofit initiatives [5]. The reasons for the high level of energy consumption in Ukrainian housing have been covered in the work by Sivitska S., Vartsaba V. and Filonych O. [8].

The issue of construction efficiency in rural areas has been partially explored in our previous work [9]. Many Ukrainian scientists study foreign experience of improving the energy efficiency in housing and technologies of rehabilitation and construction of energy efficient buildings. Mykytenko V. [10] study tools and spheres of energy efficiency state regulation. Komelina O.V., Samoilyk I.V., Boldyrieva L.M., Krapkina V.V. [11] comprehensively investigated energy efficiency in the use process of machines and equipment in construction. Problems of financing the construction business were studied by Onyshchenko V., Krekoten I., Svistun L. [12, 13]. Varnaliy Z. and Onyshchenko S. [14, 18, 19] studied construction complex development influence on region social and economic indicators.

Consequently questions of a constructions efficiency increasing are very important. But this problems needs further investigation taking into account current trends in the energy and construction spheres. Especially, the criteria for making decisions about construction, as well as the acquisition of real estate need to be studied in detail.

3 The Purpose of Scientific Research

The purpose of scientific research is to summarize scientific approaches to basic criteria for making managerial decisions in construction, identifying the main trends in the construction industry in the world with a focus on European countries, analyze empirical research results to rank socio-financial and ecological-energy criteria for making managerial decisions in construction, creating an appropriate model and the recommendations for improving criterions compliance to customers' expectations.

4 Main Body

The construction is one of the most dynamic industries for many countries. The construction development level shows the country's investment attractiveness, the technology development, innovation activity. The construction industry on the one hand is an economic development indicator, and on the other hand is an of social security indicator. Housing class, the new buildings number growth dynamics, the difference between construction infrastructure in rural areas, medium-sized cities and metropolises, the housing availability for different segments of the population affects other socio-economic spheres, namely industry, labor market, other areas of construction, financial and investment sphere, technologies, etc. In general, the world is growing rapidly. Before the coronavirus pandemic construction industry costs grew approximately to 12 trillion U.S. dollars, during next period this indicator will grow by three percent per annum. These constructions costs include building projects in residential and commercial real estate and also it is costs in infrastructure

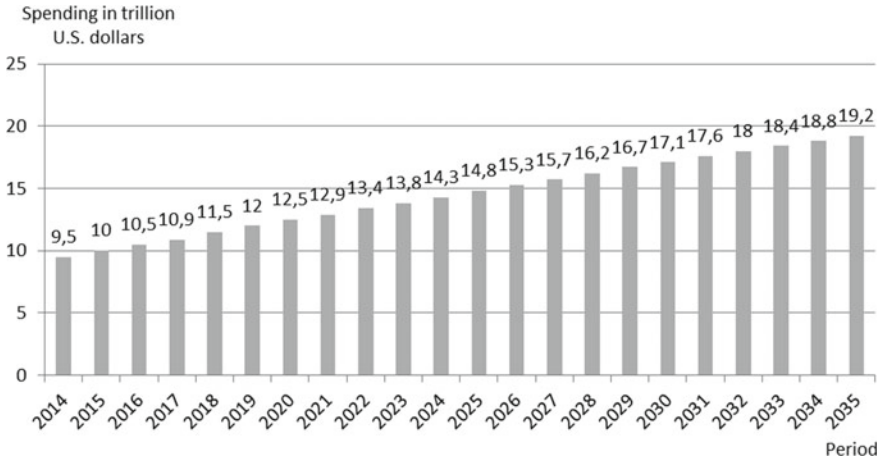

Fig. 1 A Construction industry spending worldwide from 2014 to 2019, with forecasts from 2020 to 2035 [15]

and industrial structures. Construction costs include labor and materials, architectural and engineering work, and taxes data spending (see Fig. 1).

Since 2014, there has been an increase in total construction costs from $ 9.5 trillion U.S. dollars to 12 trillion U.S. dollars. By analytics forecasts to 2035, construction will grow to 19.2 trillion U.S. dollars. Every year the differences between the level of construction development in terms of rural and urban areas become more noticeable. The level of urbanization in all regions of the world is growing significantly. At the same time, the American continents are the most urbanized (see Fig. 2).

The construction industries in the United States are one of the largest around the world. During 2019 and 2020, Buenos Aires shows one of the largest growths in the city's constructions industry. In 2021, Asia Pacific will have the highest construction industry production in the world.

Rises in the European construction industry carry out in recent years also. The EU construction market has been showing positive dynamics since 2014 after a prolonged decline in 2008–2013. Albania is showing significant indicators of the development of the construction industry. Also, the leaders by the EU construction market growth in 2019 were Malta (3.2 times), Ireland (3.1 times), Cyprus (3 times), and Hungary (2.9 times) (Table 1).

The construction pace has hardly changed in the countries of old Europe, in particular in the United Kingdom, the Netherlands, Norway, and Sweden. Slightly lower construction growths are in Eastern Europe: Lithuania, Slovakia, Poland, Bulgaria, Slovenia, Latvia and Hungary. Despite the increase in the tax press and the mass withdrawal of production abroad, the Greek market has been shown a positive pace in recent years. Three major European economies, namely Germany, France and Italy, have been shown a general trend of improving the situation in the construction industry. The German construction market has remained either more or less stable.

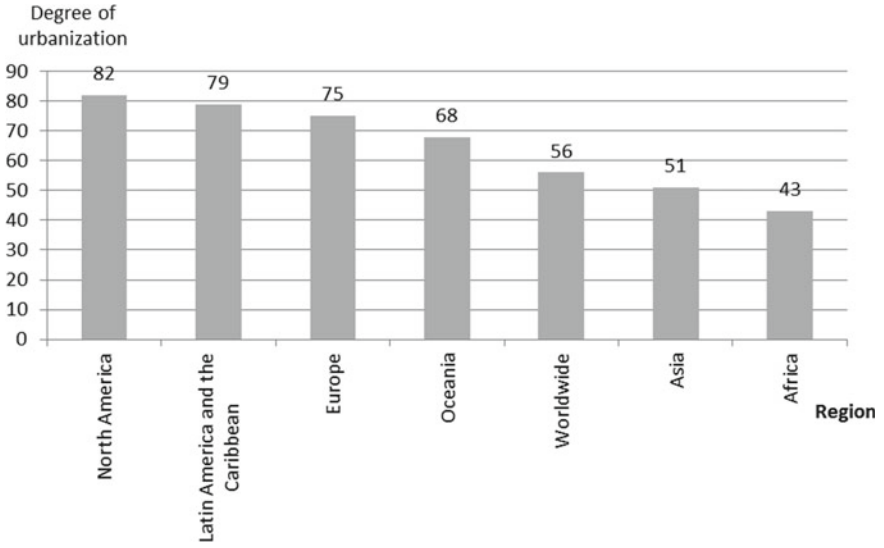

Fig. 2 Degree of urbanization (percentage of urban population in total population) by continent in 2020 [15]

France, after a long decline for a decade, showed growth, which was the beginning of the recovery process.

Favorable conditions are created for Ukrainian companies focused on the export of construction materials to enter foreign markets. In addition to such large and stable markets as Germany, Austria, Sweden, for Ukraine it is interesting and not so large, but fast-growing markets of Eastern Europe with a lower level of competition during periods of growth.

The construction industry affects the efficiency of the country's governance system. It belongs to the material production sphere and ensures the creation and restoration of fixed assets of economic entities and the population. The development of the construction industry contributes to the growth of building materials production, equipment, mechanical engineering, metallurgy, petrochemistry, woodworking, transport, energy, which leads to economic growth and solving many social problems.

The construction industry in Ukraine has been received a very big boost in recent years. According to the results of 2019, Ukrainian enterprises performed construction works in the amount of UAH 181,697.9 million UAH (Table 2).

The index of construction products in relation to 2018 was 123.6% (see Fig. 3). New construction, re-construction and technical re-equipment accounted for 74.2% of the total volume of construction work performed capital and current repairs (25.8%). According to the sub-bags of the year, the construction of engineering structures increased by 31.8%, buildings - by 25.1%.

The construction industry leaders are Kharkiv, Dnipropetrovsk, Poltava, Kyiv, Lviv, Odessa regions. However, despite the positive changes, there are still problems

Table 1 Building permits in European countries – annual data [16]

Countries	2013	2014	2016	2017	2018	2019
Albania	…	…	614,6	1083,3	1583,3	1500
Malta	68,5	74,4	190,2	248,8	326,5	316,3
Ireland	55,2	56,8	122,3	159,3	223,1	308,6
Cyprus	129,5	89,3	114,1	154,5	194	301,1
Hungary	59,2	77,4	257,1	312,3	302,4	291,1
Portugal	90,4	84,9	139,2	172,5	245,8	287,7
Serbia	76,2	77,4	126	168,9	184,8	238,6
Greece	128,8	104,6	103,5	123,9	175,9	234,4
Croatia	110,2	112,1	133,1	179,6	168,9	221
Spain	86,6	92,4	123,7	154,4	191,8	216,3
Bulgaria	71,1	91,8	105,2	144,6	205,8	189,9
Latvia	197,5	112,1	122	143,1	167,6	167,7
Czechia	84	90,9	104,2	123	127,2	152,4
Poland	72,4	82,5	112,2	133,8	138,2	144,5
Estonia	54,6	70,5	107,7	141	125,1	143,6
Luxembourg	90,8	145,7	120,6	123,6	137,3	134,8
Denmark	51,1	71,6	129,6	129,4	158,7	134,3
Italy	124,4	109	103,9	120,8	127,4	128,4
Slovenia	117,6	99,3	109,2	116,8	136,2	122,2
Austria	90,6	95,9	115,6	130	108,2	121,8
Belgium	107,1	119,1	111,4	110	136,1	121,5
Finland	84,2	94,5	126,2	150,3	135,9	121,3
Germany	90,1	93,2	115,6	113,1	115,4	119,4
Slovakia	74,7	81,1	114,6	104,7	116,6	115,5
Lithuania	88,3	83	122	119,4	122,5	113,8
France	106,3	93,1	114,7	122,1	114,1	110

Table 2 The volume of construction work performed by type of construction products in Ukraine, 2014–2019 [17]

Years	Construction total		Building		including				engineering structures	
					residential		non-residential			
	million UAH	%	million UAH	%	million UAH	%	million UAH	%	million UAH	%
2014	51108.7	100	24856.5	48.63	11292.4	22.09	1356.1	26.54	26252.2	51.37
2015	57515	100	28907.5	50.26	13908.8	24.18	14998.7	26.08	28607.5	49.74
2016	73726.9	100	38106.4	51.69	18012.8	24.43	20093,6	27.25	35620.5	48.31
2017	105682.8	100	52809.6	49.97	23730	22.45	29079.6	27.52	52873.2	50.03
2018	141213.1	100	66791.6	47.30	29344.8	20.78	37446.8	26.52	74421.5	52.70
2019	181697.9	100	83589.3	46.00	33208.8	18.28	50380.5	27.73	98108.6	54.00

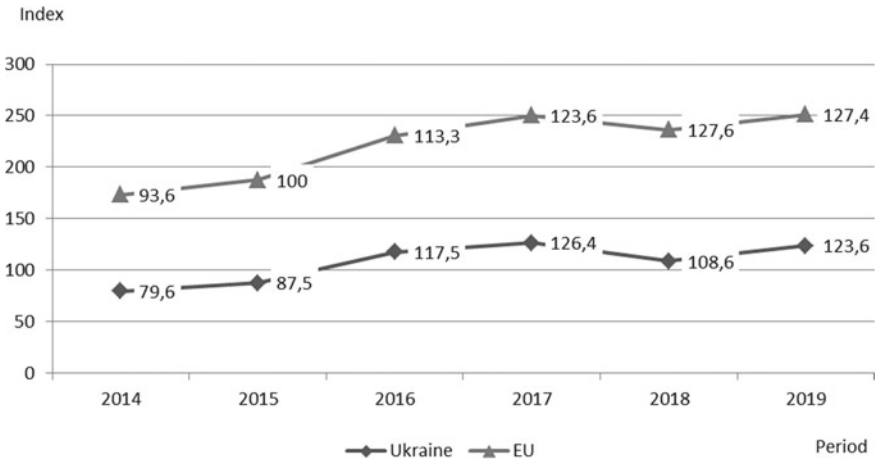

Fig. 3 The construction growth index in the European Union and Ukraine, 2014–2019, % [16, 17]

with registration, lending, investment, quality control in the construction industry. The construction industry in Ukraine includes housing construction, construction of industrial facilities, repair and construction of roads. In today's conditions, the construction industry of Ukraine operates mainly through the construction of residential buildings, as this component of the construction industry is in demand. Industrial, social and communal construction is practically not carried out due to lack of investment.

In order to develop proposals for effective management decisions in the construction sector and level the threatening trends of reduced construction during the pandemic by developing an appropriate anti-crisis management strategy, a survey has been conducted to identify current priorities in housing selection.

The conducted empirical research included a survey of different age groups respondents (of working age) and social groups from the metropolis (Kyiv), medium-sized city (Poltava) and rural areas of Poltava region. The majority of respondents belong to the age groups of 36–46 years (21.4%) and 46–60 years (26.5%) in an almost equal ratio of men and women. Among the respondents, 37.7% belong to families of 3 people and 76% are working with a stable income. As for the level of income, in Kyiv the majority of respondents have an average monthly income of 20–25 thousand UAH per person, in Poltava, it is 10–15 thousand UAH, and in rural areas, it is up to 10 thousand UAH.

Respondents over the age of 45 mostly have their own housing (over 82%), and young people, especially in Kyiv, mostly live in rented housing. Respondents from cities live in apartments (94%), but only 77% would prefer an apartment if there was a choice. Others would move to their own homes. In rural areas, on the contrary, the population lives and wants to continue living in private homes.

Respondents from Poltava and the region in 96% of cases would prefer their own housing as opposed to rent, and in Kyiv there were only 83%. In general, the mentality

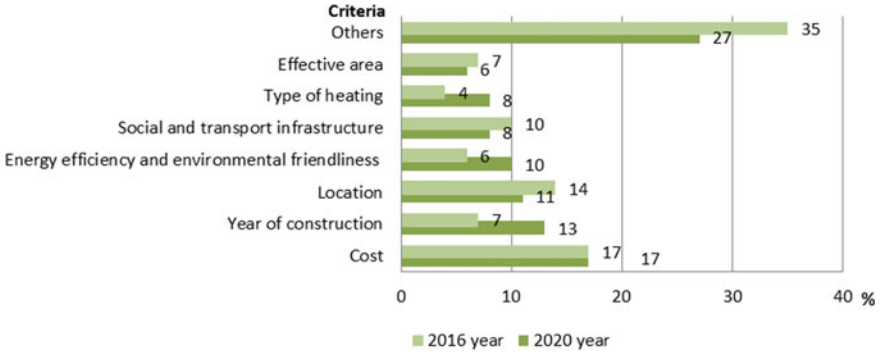

Fig. 4 Criteria for choosing a home when buying it in Poltava according to the 2016 and 2020 survey

and the idea of a successful life dictate to Ukrainians the need for their own housing. Given the need to choose housing, the vast majority would prefer a new building rather than a secondary market (this percentage is slightly lower in rural areas).

The study was conducted during 2016–2020. During this time, respondents' preferences regarding the key priorities of housing choice for the last 5 years have been changed. The following criteria were proposed for respondents: cost, area, planning, year of construction, location, environmental friendliness of the neighborhood and area, social and transport infrastructure, distance to work, energy efficiency and environmental friendliness of materials and structures, type of heating, maintenance costs (utility bills), the availability and size of the adjacent territory, the security of the neighborhood, etc. Thus, for a typical Ukrainian medium-sized city in 2016, the main criteria for purchasing housing were cost and location (see Fig. 4).

Also the availability of developed infrastructure and the area and layout of the apartment were important for respondents. Instead, in 2020, along with cost and location, the key criteria for a potential buyer were the energy efficiency and environmental friendliness of the materials and structures of a residential building and the type of heating. Cost, location, planning, infrastructure and distance to work are priority for a big city in 2016 (see Fig. 5).

And in 2020, along with cost and location, the emphasis has shifted to the energy efficiency and environmental friendliness of the materials and structures of a residential building, the type of heating and the reliability of the developer. In both cases, the year of construction is also important; everyone would prefer to buy housing in a new building. In 2016 also the leaders of the rating were the area of apartments, year of the construction, type of heating (see Fig. 6).

In 2020 from the sixth to the second place came the criterion of energy efficiency and environmental friendliness of the houses materials and structures, and the third place from the fifth moved the type of heating. Also, villagers are concerned about the cost of maintaining the house and the level of heating costs.

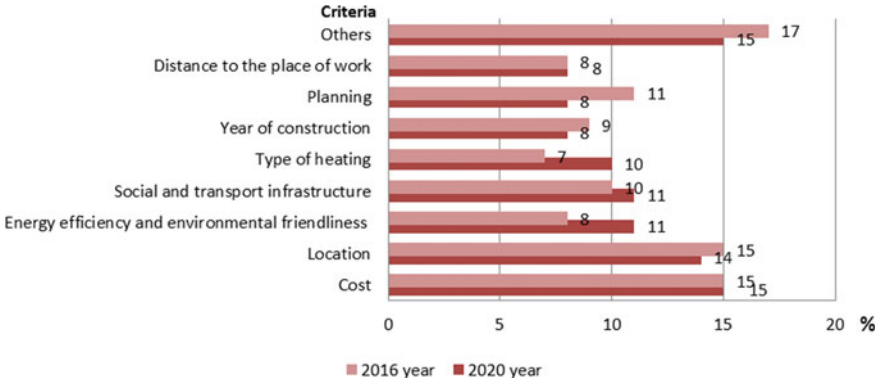

Fig. 5 Criteria for choosing a home when buying it in Kyiv according to the 2016 and 2020 survey

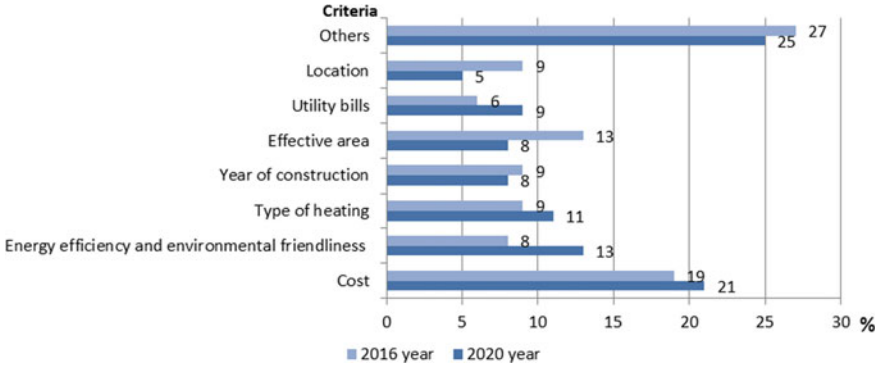

Fig. 6 Criteria for choosing housing when buying it in rural areas according to the 2016 and 2020 survey

In general, it is advisable to conclude that the energy efficiency and environmental friendliness of real estate along with its location for residents of large cities compared to small ones are very important.

In all regions, due to the trend of rising energy prices in recent years, the area and type of heating, which depends on the level of operating costs and utility bills, is becoming more important. In the background are planning of the house, security, the adjacent territory.

At the same time, there are differences in preferences for the type of heating in urban and rural areas. In cities, district heating still predominates with a decreasing trend (about 64% is it district heating, 22% is it individual and 14% is it autonomous), and in rural areas individual and autonomous dominate (63 and 30%, respectively). The preference for electricity and alternative sources is growing as a desirable type of

energy source for heating homes, especially in individual homes. Electricity and alternative sources are the most desirable types of energy for heating homes, especially in individual homes.

Thus, on the survey basis, a mathematical function (Eq. 1) for making management decisions in construction (for the medium-sized city) can offer:

$$F\left(X_{1,\ldots}X_2\right) = 0.17\,X_1 + 0.13\,X_2 + 0.11\,X_3 + 0.1\,X_4 + 0.08\,X_5 + 0.08\,X_6 + 0.07\,X_7 \quad (1)$$

X_1 – Cost,
X_2 – Year of construction,
X_3 – Location,
X_4 – Energy efficiency and environmental friendliness,
X_5 – Social and transport infrastructure,
X_6 – Type of heating,
X_7 – Effective area

Each of the factor features is an integrated indicator that takes into account the characteristics of the region. For example, the criterion of "location" is a formed rating of districts. The criterion of "energy efficiency" is formed on the basis of building materials rating and so on. The criterion of the construction year is represented by the number of the actual operation years of the building after commissioning.

Thus, financial indicators occupy the first place when making management decisions to purchase real estate.

An important criterion when choosing real estate is the ability to purchase it in the mortgage. The vast majority of respondents (68%) would prefer to buy a home on credit under favorable mortgage terms. However, modern conditions of mortgage lending in Ukraine do not allow making this tool available to Ukrainian consumers in contrast to European countries [13].

At the same time, the state construction financing reduction (reduction of investments, deterioration of the investment climate) is one of the main problems hindering the development of the construction industry. The following measures are needed to solve the problems of construction financing in Ukraine:

- expansion of the project financing and the self-financing opportunities for construction companies and introduction of an integrated scheme of the housing financing, which consists in using project financing of developers at the first stage and attracting funds from individuals in the second stage of construction;
- attracting funds from citizens for the construction of industrial and social projects through the issuance of securities;
- de-shadowing of the capital of construction companies;
- creating favorable conditions for lending to construction companies;
- development of a long-term programs to expand the possibilities of financing construction by state and regional authorities.

The implementation of these measures will contribute to the development of the construction industry, which, in turn, will increase the investment attractiveness of construction companies in Ukraine.

Issues of energy efficiency and environmental friendliness, when choosing housing, are very important and is becoming more significant every year. For Ukraine, the benefits of energy saving are especially important due to its high energy dependence and energy consumption. The domestic economy is energy-deficient, satisfying its energy needs through its own production only in part. For the most part, the available housing stock of Ukraine belongs to the most energy-intensive class.

Modern new buildings largely meet the requirements of energy efficiency and environmental friendliness, but the share of new buildings in Ukraine remains insignificant. In Ukraine, the issue of energy saving is especially acute in the global financial crisis that arose during the pandemic. Regarding energy saving in the housing and communal sector, the strategic task is to use energy efficient materials, modern engineering networks and systems, equipment, energy metering and control devices at the stage of construction of new facilities, and modernization and insulation of existing housing. An important role in improving the energy efficiency of construction is played by the comprehensive use of alternative energy sources, which also meets the needs of society in the environmental friendliness of building structures and the environment. All this should be taken into account when developing a strategy for managing a construction company and making decisions at the level of state regulation in the construction sphere of the country.

5 Conclusion

Thus, under conditions of transformation processes taking place all over the world during the pandemic period, the priorities of the construction industry enterprises change significantly. There has been a direction of real estate owners' needs to increase energy efficiency and reduce maintenance costs, which saves financial resources. Under such conditions, the key advantages in the construction market will have developers who provide appropriate proposals, that is, they offer to customers housing that is economical, environmentally friendly, energy efficient and meets the social and aesthetic needs of people. That is, management decisions in construction companies must be adapted to the needs of consumers. And such needs differ significantly in large-scale settlements.

Improving the energy efficiency of the construction complex will solve a number of pressing problems: reducing the cost of housing through more rational and efficient use of energy resources; reducing the country's energy dependence by reducing imports of scarce fuel and energy resources; improving the environment.

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