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ЕУРАЗИЯ ҰЛТТЫҚ УНИВЕРСИТЕТІ

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«ҒЫЛЫМ ЖӘНЕ БІЛІМ - 2018»
XIII Халықаралық ғылыми конференциясы

СБОРНИК МАТЕРИАЛОВ

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студентов и молодых ученых
«НАУКА И ОБРАЗОВАНИЕ - 2018»

The XIII International Scientific Conference
for Students and Young Scientists
«SCIENCE AND EDUCATION - 2018»

12th April 2018, Astana

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RESIDENTIAL GREEN BUILDING IN ASTANA IN RESPONSE TO RISING RAPID GROWTH AND DEVELOPMENT

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Environmental challenges motivate people to re-evaluate the processes of planning, designing and construction of buildings. The consequences of increasing concentrations of greenhouse gases produced by human activities are changes in the climate. According to the United Nations Environment Program report, «The building sector contributes up to 40% of greenhouse gas emissions, mostly from energy use during the life time of buildings. Identifying opportunities to reduce these emissions has become a priority in the global effort to reduce climate change» [1]. Moreover, a significant number of human illnesses are the result of toxic chemicals. There is a critical need to reduce energy consumption and to re-examine the use of building materials, construction procedures and operational processes, such as heating, cooling and lighting for buildings [3].

A building that has a significantly reduced impact on the natural environment and provides indoor conditions, which promote good human health, is called a green building [4]. Governments and a considerable number of architects, ecologists, engineers, and constructors are currently working together to develop methods to create residential green buildings and to improve the surrounding environment.

Increased interest in sustainability and the construction industry creates a good opportunity for the growth of green building in Kazakhstan. The United Nations Development Programme states «Kazakhstan's energy sector accounts for about 80 percent of total emissions, 90 percent of which comes from power and heat generation. Residential buildings are responsible for 13.5 percent of power and 24 percent of heat demand» [2]. In Kazakhstan, the UNDP reports that the residential sector is the third-leading energy consumer after energy and manufacturing sectors.

The critical need to reduce the impact on the natural environment is improving the environmental performance of buildings. The use of green building standards in residential areas creates excellent opportunities to create a more healthy and sustainable environment for citizens and to significantly reduce greenhouse gas emissions and the environmental impact of energy consumption. However, green houses are not as easily standardized as conventional houses. Different countries and organizations have their own green building standards, which regulate, evaluate and promote the construction of green buildings.

For example, various rating systems are used for the certification of green buildings:

- Leadership in Energy and Environmental Design (LEED);
- The United States Green Building Council (USGBC) system;
- In the UK, EU, EFTA member states, Building Research Establishment Environmental Assessment Method" (BREEAM);

- Green Star in Australia;
- Kazakhstan Green Building Council (KazGBC) in Kazakhstan.

Green building requires a combination of sustainability, ecology, and performance. The extent of its "greenness" is based on the level of interaction of these categories (Figure 1). Linked to each category are essential components and values that further define and isolate them [3].

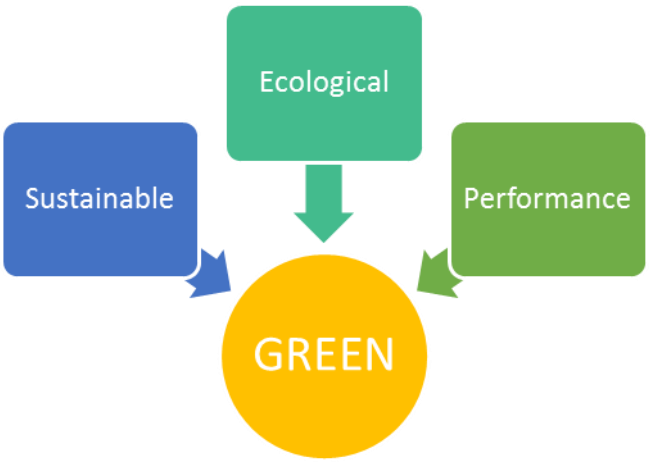


Figure 1: Relationship between green categories

Kazakhstan's existing residential sector comprises of about 160 million m², the large majority of which are aging, inefficient buildings constructed during the Soviet era [6]. The existing residential sector consists of municipal buildings, which are connected to district heating produced by boiler houses or cogeneration stations. Coal is used for more than 80% of district heating in Kazakhstan; gas is the next most important primary fuel at 13% and is especially used in the central and southern regions of the country [2]. Moreover, more than half of GHG emissions from residential energy use in Astana arise from heating. Domestic hot water and electricity each account for approximately one-fifth of residential-sector emissions, with cooking and other uses making up the remaining share. Coal also accounts for about 85% of Kazakhstan's electricity generation [2]. Furthermore, according to the UNDP report, with its population of 18 million Kazakhstan consumes about twice as much electricity per capita than any other country in Central Asia, and about 3.5 times more than the average of other developing countries worldwide.

At the same time, a booming economy and an aggressive government housing-development policy led to the rapid acceleration of new housing construction in Astana (Figure 2). As a result, on average, new housing increased by 15-20% per year between 2000 and 2007 [2]. Despite the rapid pace of construction, population growth and increasing affluence, the rapid expansion of Kazakhstan's capital, Astana, resulted in demand significantly outstripping supply.

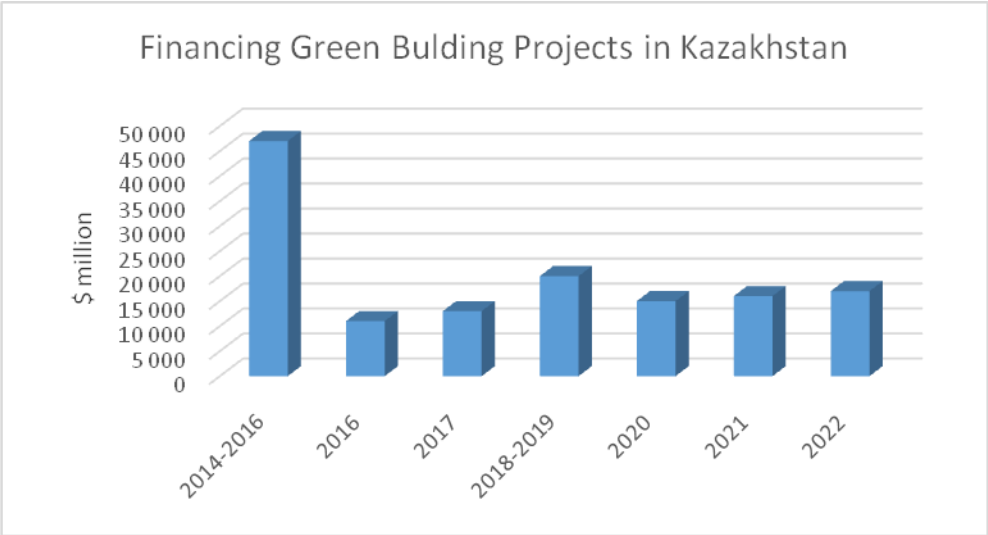


Figure 2. Green Building in Kazakhstan

The use of green technologies in the construction of residential areas in Astana only began in 2014. Energy-efficient designs and the construction of residential buildings is part of the UNDP projects implemented with the assistance of the Global Environmental Fund and the RK Government. The goal of the project is to reduce the greenhouse gas emissions from new residential buildings by introducing new practices and making changes to the housing sector markets in order to ensure more energy-efficient design and construction.

Energy efficiency is gaining importance as a national strategic priority in Kazakhstan. The successful implementation of the green strategy will support Kazakhstan's reputation and increase national prestige (Figure 3). Official projections and policy priorities call for rapid growth in the residential sector, which accounts for ninety-seven percent of buildings [1].

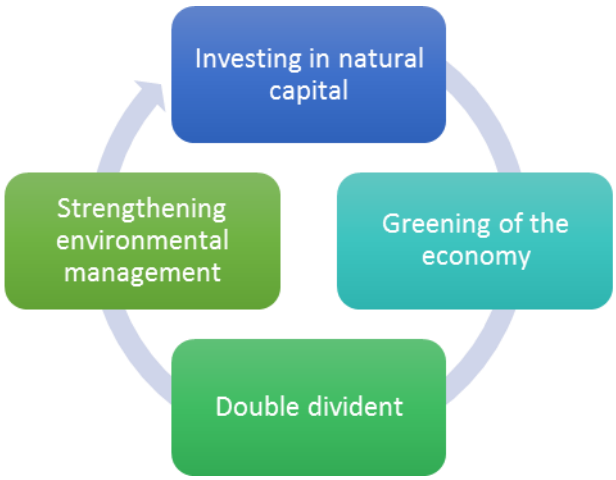


Figure 3. Green growth capacity development support

Various government agencies are involved in energy efficiency in some way. The Government and Ministry of Natural Resources and Environment of the Republic of Kazakhstan implemented Green Standards, which developers are motivated to apply, whilst minimizing losses and reducing energy consumption. For the residential building sector, the two institutions with the greatest responsibilities are the Agency for Construction and Residential-Communal Affairs and the Committee for the State Energy Oversight. The country will require strong growth in skills capacity across the whole construction industry staff, including developers, architects, engineers, contractors and technology providers. Moreover, the widespread certification of venues to national and international standards (BREEAM) has the potential to create a new, innovative construction industry in

Kazakhstan.

The assessment of the KazGBC Standard differs from international practice. Energy efficiency plays a key role in Government policy and therefore, in the construction standards for Kazakhstan's construction industry. All buildings have to comply with the Green Standard, which recommends how to implement energy efficiency measures and how to use renewable energy sources:

- Buildings being certified to BREEAM standards gain additional points if they use computerized energy modelling techniques which confirm energy saving plans.
- Allows accurate calculations of costs/paybacks.
- Venues are at various stages of construction – ranging from concept to active construction. Project documentation shows impressive energy saving concepts - enabling it to be carried out all year round in a continental climate.

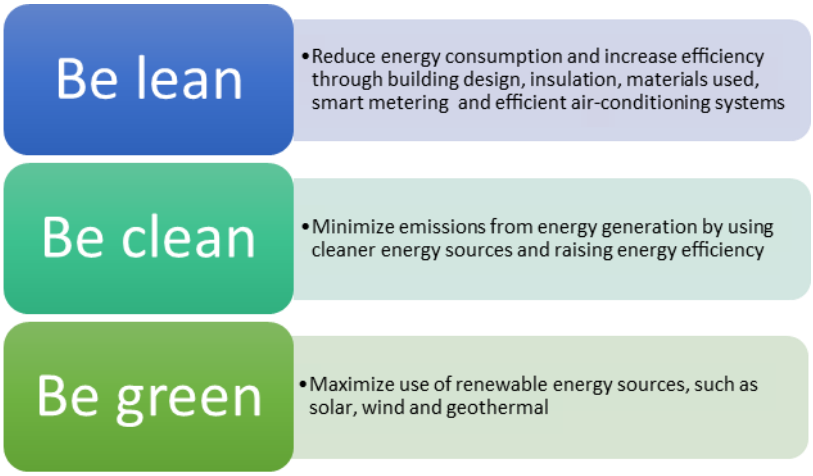


Figure 4. Key principles of reducing energy consumption, using renewable and «clean» energy

The existing national programs and legislation on energy efficiency, construction industry and housing policy implemented to achieve cost-effective energy savings include:

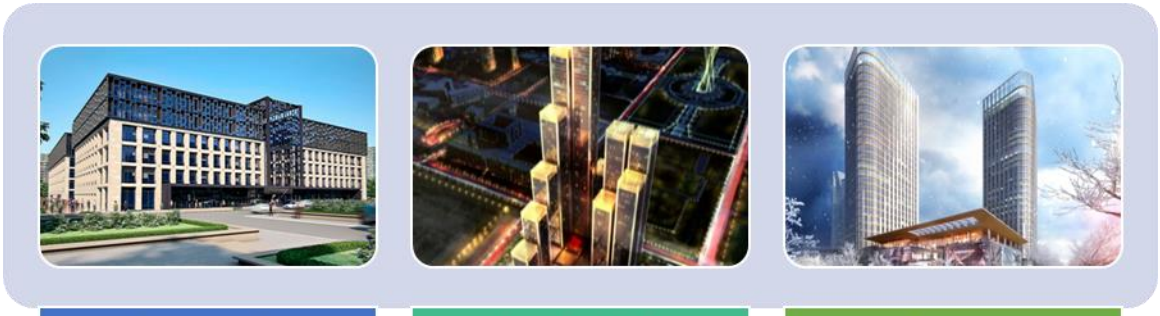
- Improving compliance with existing building energy codes;
- Providing energy performance beyond existing code requirements;
- Providing enhanced information to manufactures, building designers, and the general public;
- Transforming practices and markets for building design and construction (Figure 4).
- Three buildings located in Astana were selected as existing buildings that meet the criteria of green building (Table 1). These buildings are as follows:

1) Hilton Garden Inn/Q Astana business centre – Astana's first BREEAM certified existing-rated green building in Kazakhstan, located next to Round Square. The building, which is a mixed-use type, accommodates a hotel, business centre and apartments and was occupied in February 2013.

2) Abu Dhabi Plaza, the tallest building in Astana, known as the most expensive structure in Central Asia. It is located at the left bank of Astana and was designed by Norman Foster. The construction process was carried out by the Irish architecture practice, HKR Architects.

3) Talan Towers – this is the first LEED certified green building in Kazakhstan. It is located in Astana. The case study is a mixed-use commercial building, which accommodates more apartments, a hotel and offices.

The purpose of the three was primarily to reduce energy consumption, improve performance, lower carbon emissions and make these buildings energy-efficient and sustainable.



1. Hilton Garden Inn	2. Abu Dhabi Plaza	3. Talan Towers
Year of completion: 2014	Year of completion: under construction	Year of completion: 2016
Type: includes apartments	Type: includes apartments	Type: includes apartments
Number of floors: 7	Number of floors: 80	Number of floors: 26
Cost: $100 million	Cost: $1 billion	Cost: $350 million

Table 1. Green Building Projects in Astana

On overage, buildings in Kazakhstan consume two to three times more energy per unit of floor area than buildings in northern countries in Europe.

Topic	KazGBC Energy Saving program	BREEAM New Construction (residential)	LEED For New Constructions v4
Energy Efficiency	GEF Strategic Objective CC-1 - promotion of energy-efficient technologies and practices in appliances and buildings	Either by BREEAM's own calculation standards, ASHREA or approved local building standard	Requires a minimum of 5% energy efficiency improvement compared to the baseline performance rating (can be based on local standard) or ASHRAE standard
Renewable Energy	Maximize use of renewable energy sources, such as solar, wind and geothermal	Encourages feasibility study for using local low or zero carbon energy source, the study has be carried out by an energy specialist	Encourage use of renewable energy and grants points starting from 1% of total energy consumption
Energy Usage	Minimize emissions from energy generation by using cleaner energy sources and raising energy efficiency	Encourages monitoring of energy consumption through use of energy display devices in order to create awareness	Requires energy monitoring in order to identify opportunities for additional energy saving. Also required to share energy consumption data with USGBC

Table 2. Comparison between selections of requirements for energy saving

Residential green building programs have a variety of differing missions and goals (Table 2), however they all tend to measure similar categories of concern namely, energy efficiency, water efficiency, wise use of materials and resources, site selection and planning, and homeowner's education.

Good progress is being made. However, some opportunities need to be taken in order to provide the teamwork to implement the Green Standards; need to raise awareness of the benefits of «green» construction and provide reliable data monitoring techniques.

The Republic Kazakhstan is incorporating changes into the current building design and construction practices that promote green building as a means to create healthy indoor living environments, reduce the depletion of precious natural resources, control the rising cost of energy and reduce the emissions of GHG into the environment.

As a result, a decision model was developed, to be used as a guide to access this market. There are systems in Kazakhstan that can contribute to, controlling or reducing the potential environmental problems in the country, which are caused by building construction, and, the effects that are inherent to non-sustainable buildings. These potential environmental problems can be controlled or reduced with green building practices.

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XXI ҒАСЫРДЫҢ ҒИМАРАТТАРЫНЫҢ ЖЫЛУ ЖӘНЕ КЛИМАТИЗАЦИЯ САЛАСЫНДАҒЫ ДИЗАЙН ЖӘНЕ ҚҰРЫЛЫС КОНЦЕПЦИЯСЫ

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1974 жылғы әлемдік энергетикалық кризистен соң, сәулет және құрылыс тәжірибесінде, ғимараттарды жылытуға жұмсалатын энергия ресурстарын үнемдеу мәселесіне үлкен көңіл бөлінеді.

Бұрын айқындауыш көрсеткіш болмаған, ғимараттың энергия тұтынуы, жобаның сапасының үстем бөлшегіне айналды. Уақыт өте келе зерттеу нысаны өзгерді және кеңейді: ғимараттағы энергияны тиімді қолдану.

Энергетикалық тиімді ғимараттар құрылысын басында, 1990 жылдардың басында дейін, негізгі пайыздық энергияны үнемдеу үшін іс-шаралар зерттеу болса, онда 1990-жылдардың ортасында, басым бір мезгілде микроклимат сапасын жақсартуға көмектесу энерготиімді шешімдер беріледі қазірдің өзінде [1].