

## The influence of the *green economy* on the development of eco-architecture

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**ABSTRACT:** One of the criteria that influenced the choice of Astana as the new capital of Kazakhstan was the environmental factor. Although the climate of the Saryarka steppes is not mild, scientists consider it to be one of the most ecologically clean areas of Kazakhstan, with its frosty dry winters, hot summers, drought, and the availability of free land for the growth of the city and planting of greenery. It is also important that there are no large industrial facilities here. The master plan for the construction and development of the capital of Kazakhstan was carefully studied in consideration with its ecological component. Currently, the authorities are planting a ring of greenery and woodland around Astana. At present, buildings should not be constructed guided by the old principles. Advanced technologies are being used in construction (in architecture, in energy, in the economy), based on the safety and health of the planet. The approach to architectural design has changed. The aesthetic beauty of the buildings has turned out to be dependent on green technologies. Ecology dictates its rights. The old standards and rules of house building are being rebuilt in a new way.

### INTRODUCTION

Nowadays, an intensive growth of urban development can be observed in northern Kazakhstan. The population is growing, cities are expanding beyond their borders, and increasing their impact on the environment. Recently, the green economy has become widespread as a new direction in economics. Economics is recognised as a dependent part of the natural environment, it exists in its borders and is an integral part of it. Kazakhstan needs to move to a new economy and a new formation that will increase the welfare and quality of life of the population of the country with the least stress on the environment and natural resources.

The modern economic system has its positive and negative sides. It gave positive results in improving the living standards of people in general, as well as individual groups. The negative consequences of this system are great: desertification, depletion of natural resources, climate change, poverty of some of the population, a lack of fresh water and food, a lack of energy, and inequality of people and countries. This is a certain threat to the current and future generations of the inhabitants of the earth.

The transition to a *green economy* is needed for the survival and further development of mankind. It is necessary to pay more attention to the system of those types of economic activity that are associated with the consumption of goods and services, production and distribution, which lead to an unchanged increase in human well-being in the foreseeable future. However, this should not expose future generations to environmental risks. Today, well-being is under threat and it is necessary to respond to this with certain actions. To counteract climate change, there must be an energy revolution and cardinal changes in the generation and consumption of energy in society.

Nowadays, the most relevant industry is the generation of renewable energy, in which a significant part of technological innovation is carried out. A new era of economic change will open. In an intensive flow of changes, it is necessary to act reasonably, to take into account of the possible damage and benefits that can be done to the ecosystem. Buildings as the basic components of a cell of cities cannot exist without green technologies that create conditions for safe living. To create favourable conditions for life, the habitual order of things in nature should not be destroyed. The destructive forces of natural energy (wind, for example) can be directed to create an oasis of wildlife in the severe steppes of Kazakhstan.

### STRATEGIES OF THE *GREEN ECONOMY* IN KAZAKHSTAN

The green economy is a direction in economic science, formed in the last two decades, in which it is considered that the economy is a dependent component of the natural environment within which it exists and is part of [1]. The *green economy* is an economy aimed at preserving the well-being of society through the effective use of natural resources,

as well as ensuring the return of end-use products to the production cycle. First of all, the green economy is aimed at the economic consumption of those resources that are currently subject to depletion (minerals - oil, gas) and the rational use of inexhaustible resources. The green economy is based on pure or *green* technologies. According to experts, the development of a green economy will allow the country to avoid environmental crisis, which is already affected by its scale in many post-industrial countries.

On 30 May 2013, the President of the Republic of Kazakhstan, N.A. Nazarbayev developed and signed *The Plan of Measures on Implementation of the Concept on Transition of the Republic of Kazakhstan to Green Economy for 2013-2020* (the Concept) [2]. First of all, the Concept contains a list of priority tasks, the main ones of which are aimed at reforming certain sectors of the economy. The Concept lays the foundation for deep system transformations with the purpose of transition to the economy of a new formation by means of increasing the well-being and quality of life of the population of Kazakhstan and the country's entry into the list of 30 most developed countries in the world that preserve the environment and prevent the degradation of natural resources.

The Concept is being implemented in three stages:

- The first stage - 2013-2020 - optimising the use of resources and improving the efficiency of environmental activities, as well as the creation of a *green* infrastructure;
- The second stage - 2020-2030 - is the rational use of natural resources, introduction of renewable energy based on high technology;
- The third stage - 2030-2050 - the transition of the national economy to the principles of the *third industrial revolution*, based on the use of natural resources in the case of their renewability.

According to the Concept, measures for the transition to a *green economy* will be implemented by area: sustainable use of water resources; development of sustainable high-performance agriculture; energy conservation and energy efficiency development of electric power industry, waste management systems, reduction of air pollution; and conservation and effective ecosystem management. According to calculations, by 2050, the transformations within the framework of the green economy will allow GDP to increase by 3%, create more than 500,000 new jobs, form new industries and services, and ensure universally high standards and quality of life for the population.

The first direction is the introduction of renewable energy sources (RES). The issue of further conservation of minerals has achieved a huge scale. The country is recognised as being rich in natural resources. All over the world, oil and gas are classified as one of the largest energy resources, but even they will be exhausted in due time and, therefore, it is necessary to find new resources for life. At the same time, the fact that Kazakhstan has a good ecosystem, soil, water and forest, significantly increases its position in front of other countries.

The second direction is energy efficiency in housing and communal services. Because a significant part of the urban housing stock was built in the post-Soviet period, the majority of residential complexes are equipped with inefficient thermal insulation structures and systems heat supply, which has led to significant heat losses. Currently, in Kazakhstan, energy service companies are called upon to implement measures to overcome the malfunctions of heat supply devices.

The third direction is organic farming in agriculture. First of all, this special direction considers the rejection of synthetic fertiliser products (pesticides) and various fodder additives. This refers to the use of organic fertilisers to ensure yields and the growth of cultivated plants. The *greening* of agriculture will provide food for the population without harming natural resources. Kazakhstan plans to act in the following directions: management of soil fertility; effective use of water; health management plants and animals; and mechanisation of farms.

The fourth direction is the improvement of the waste management system. Particularly popular has been the acquired problem of waste management. Increasingly one is confronted by dirty streets, dumps and lack of any control over what is happening. In connection with the current circumstances, it is the waste use as a secondary product of the production cycle. So, for example, technologically complex processing of solid domestic waste and obtaining alternative fuel is already being implemented in Almaty.

The fifth direction is the improvement of the water management system. Water remains the key natural component of ensuring the existence of mankind and the integrity of ecosystems. The rational use of water resources remains a problem.

The sixth direction is the development of *clean* transport. Most of the traffic in Kazakhstan relies on diesel/gasoline. At present, most of the traffic uses diesel/gasoline. First of all, this contributes to high greenhouse gas emissions.

The seventh direction is the conservation and effective management of ecosystems. Activities in this direction are mainly aimed at preserving the unique natural wealth of the country.

As part of the green economy development programme, Kazakhstan plans to invest in 10 key sectors of the economy: agriculture; housing and utilities; power engineering; fishing; forestry; industry; tourism; transport; waste management and recycling; and water resources management.

Today, 40% of world's innovation falls on the green economy, and 50% of it for energy saving and energy efficiency, which is a key factor in the green economy. Energy is responsible not only for the competitiveness and security of the economy, heat and light in our homes, but also for 50% of pollutant emissions and 70% of greenhouse gas emissions. That is, the level of energy intensity determines the ecological and climatic components of national economies. According to this indicator, Kazakhstan occupies eighth place in the world energy intensity rating, and Russia is 15th [3].

## INFLUENCE OF THE GREEN ECONOMY ON ARCHITECTURE

Urban design, like architecture, is an exercise in analysis and synthesis enhanced by intuition. Uniting a building with its immediate hinterland, creating a community of buildings or recreating a part of a city provides greater opportunities for beneficial environmental design and allows one to address the wider aspects of sustainability. Whereas a master plan often ends up as a conceptual model of physical infrastructure, buildings and landscape, it is the design of the life support systems that link them that lies at the heart of holistic environmental design. Flows of heat, light and energy, air and water, material and waste, and most importantly, the movement of people are all issues that need to be considered, mapped and modelled.

Design at any level requires consideration of the local and the global, addressing the specific and the present, as well as the general and the future. Recognising the boundaries of the systems that the architect is designing for often presents the greatest challenge. With university master plans, it is easy to constrain one's thoughts to the physical boundaries of the site, but the economic and social consequences of the influx of thousands of young people into a community need to be considered, as do the movement patterns that they generate.

Other systems come under stress. The capacity of water supply, energy, infrastructure and drainage systems need to be able to cope with increased loads. There is a continual import and export into servicing systems beyond the constraints of the site. However, the plans for a new community, like the plans for a building, should follow the same systemic principles of environmental design. That is, they should be as self-sufficient as possible in terms of energy, water, material and waste, using the site and its microclimate, sun, wind and rain, in preference to bought in alternatives. Emphasis should be on closing loops around energy and water flows rather than creating a dependency on outside systems [4].

Currently in the Republic of Kazakhstan, there are several programmes, such as *Transition to Green Economy and Development of Alternative and Renewable Energy Production*, which by 2050 should account for not less than half of total energy consumption. The *Green Bridge* partnership programme was initiated by the Republic of Kazakhstan at the 66th Session of the General Assembly and endorsed by all states at the United Nations Conference on Sustainable Development as an interregional initiative for sustainable development, which is voluntary and open to the participation of all partners. The programme assumes close interaction between countries in Central Asia in ensuring sustainable development with the support of key international institutions and the private sector. The mission of the programme is formulated as follows: *the management of green economic growth in Central Asia* through international cooperation and assistance in the transfer of technology, the exchange of knowledge and financial support.

The development of the green economy is not only financially costly, but science is a capacious process. The effectiveness of its implementation is increased many times when using not only domestic, but also international experience. For example, the development of high technology in Spain began over 15 years ago. Among the priorities are wind power, solar panels and recycling. Now this country is one of the leaders in the production and introduction of alternative energy sources. The sphere of alternative energy in Kazakhstan is developing rapidly. The government is developing a project on RES, which will undoubtedly affect the sphere of construction.

According to the *Energy Balance and Energy Saving Programme 2020*, new standards are being introduced in the construction of buildings, taking into account the world experience of heat and energy saving. This will give a great impetus to the development of architecture in this country. Smart houses equipped with modern technologies is a new turn in the history of Russian architecture. Such a development means that Kazakhstan will need architects with innovative skills, with knowledge of new rules and regulations for the location of the building, their roofs, window openings, etc. The international experts who are developing the strategy of Kazakhstan on the transition to the green economy, conducted the analysis and came to the conclusion that the transition of the country should be carried out in four priority areas:

1. Reduction of emissions (CO<sub>2</sub>). Reduction of emissions at combined heat and power (CHP) plants, which are the main sources of release of harmful substances into the atmosphere (the share of CO<sub>2</sub> emissions from CHP is 36%) through measures to improve energy efficiency and resource saving. That is, it is necessary to burn less coal and at the same time produce more electrical and thermal energy. Construction of renewable energy sources and development of energy storage technology. Transfer of coal-fired CHP plants to gas.
2. Improve the water supply system. Providing access to drinking water and improving the quality of drinking water. The system of water resources management at the level of river basins. Addressing issues of transboundary waters.
3. Waste management. Reducing waste by collecting glassware, waste paper, plastic. Cleaning of garbage landfills. Creation of infrastructure for waste recycling and processing.

4. Sustainable agriculture. Increase the productivity of crops in agriculture by increasing the fertility of soils and using energy-saving crops. Production of low-cost agricultural products, taking into account the limited natural resources.

These priority areas should develop in two stages: 2013-2020 - improvement of the existing situation; 2020-2030 - transition period. There are other problems, but to date, these issues are considered basic and important. For example, in Kazakhstan, 90% of the total waste is disposed of as garbage, and only 10% of all waste is recycled. Each inhabitant of the country accounts for up to 2,000 tons of waste, while the world figure is four times less.

Analysis of the options for introducing alternative energy sources in North Kazakhstan allows for conclusions to be drawn about the need for their implementation. The message of President Nazarbayev to the people of Kazakhstan dated 4 December 2012 says: *Remaining a major player in the hydrocarbon market raw materials, we must develop the production of alternative types of energy, actively introduce technologies that use the energy of the sun and wind. All the possibilities for this we have. By 2050, the country must have at least half of the total energy consumption for alternative and renewable energy* [5].

In 2009, under the Kyoto Protocol, Kazakhstan voluntarily accepted the obligation to reduce greenhouse gas emissions by 15% by 2020, and by 25% by 2050. However, over the past three years, rather than the level of greenhouse gas emissions decreasing, it has increased by almost 6%. Today, alternative energy sources provide Kazakhstan with 110 MW of electricity. In seven years, according to the government's plan, this indicator should increase 10 times (up to 1040 MW). The key directions for the country are sun, wind and water.

The potential of the country's wind energy is estimated at 920 billion kWh. It is interesting that this figure is 10 times higher than the needs of the entire country. Kazakhstan has a huge potential also in solar energy - 2.5 billion kWh per year. According to the plan, by 2020 more than 12% of energy should be produced by RES, 2.5% of which will come from solar panels. If each house is equipped with solar roofs, they can use this energy, while preserving the resources through which Kazakhstan currently produces energy. For the development of this industry, it is necessary to implement and develop the *solar roofs* project and the construction of plants that will produce the necessary equipment of different capacities. Hydroelectric power stations in Kazakhstan have been producing electricity for a long time. 14.3 MW is produced by small hydropower plants on the Karatal and Aksu rivers. By 2020, 74% of alternative energy is planned to be produced in this industry. More than 50 wind turbines operate in the regions of the *Bolotov country*. The construction of two plants for their serial production has been started. In the wind park in the North Kazakhstan region is already producing 1.5 MW of electricity.

More than 25 projects are already in place for energy plants. In 2012, they produced 450 million kWh of electricity. According to the plan, the number of green spots on the electrification map will increase annually. In 2013, another 13 facilities were introduced. By 2020, the share of green energy will be 13%. The main disadvantage is the cost. According to specialists, alternative electricity is more expensive than traditional electricity. Wind turbines produce 1 kW of electricity at a cost of 20-25 Kazakh Tenge (₸ - KZT), solar energy is even more expensive, and hydropower - from 5 to 12 KZTs. But, world experience asserts that in the future everything will be the other way around. For traditional sources of energy, the tariff is growing, while the development of RES is reducing.

Today, the world energy industry is mainly based on sources of energy, such as oil, gas and coal, but their reserves are limited. Of all the alternative sources, wind power is developing most rapidly. Its potential is at least five times higher than world energy consumption. The world leader in installing wind generators is Germany. There are more than 23,000 of them. This is one-third of the world's number of wind generators. If today the share of renewable sources in Germany is about 34%, then by 2050 this country plans to reach 80% [6].

In 2016, another record was recorded for the volume of electricity exports - the export balance grew by 4% compared to the previous year, also a record year. The main buyer of German electricity was the Netherlands, partially transferring the purchased electricity further - to Belgium and Britain. Electricity was also supplied to Switzerland, Austria and Poland. The German analytical centre, Agora Energiewende, spoke about the national record in the field of renewable energy: on 30 April, about 85% of all electricity consumed in Germany came from renewable sources. According to Energiewende's concept of *energy turnaround*, in Germany by 2025, the share of electricity received from renewable sources should be about 40-45%, and by 2035 - at least 55-60% [7].

Kazakhstan has the same high potential, and many experts note that wind energy could be the main energy source for the country. For example, in places like the Dzungar Gate and the Almaty Gate, the wind speed is very high - 9-10 metres per second. This is a very good indicator. The wind potential of Kazakhstan is estimated at one trillion kWh of electricity per year, which is 25 times higher than the entire country's energy consumption. The problem is not the availability of energy, but the technology by which it can be transformed. All facilities at EXPO - 2017 in Astana were electrified by renewable energy sources.

EXPO - 2017, which was held in Astana, was a great achievement for the country, and a powerful impetus for the development of the entire region in all spheres of the national economy, including in architecture and construction.

The capital attracted the newest innovative technologies of the present, as well as the technologies of the future. During the International Specialised Exhibition Astana EXPO-2017, the Coalition for Green Economy and Development G-Global jointly with partners held a number of significant events aimed at promoting the green economy and Expo-2017 subjects, involving all categories of citizens of the country [8].

In Astana, they will produce energy-efficient glass. Unlike conventional glass, the new glass reduces heat loss. In winter, it retains heat, and in summer, on the contrary, it restricts its intake. According to specialists, when using energy-efficient glass, air conditioning costs are reduced and heating costs are reduced by 2.5 times. Innovators of the state technological park Alatau have developed a new energy-efficient solution: lamps operating on the photoelectric principle. Their main feature is the consumption of a minimum amount of energy. Currently, such lamps are installed everywhere on city streets. In Kazakhstan, renewable energy technologies are developing. There is a plant for assembling photovoltaic modules. The production is handled by the subsidiary company KazAtomProm - Astana Solar.

The plant is capable of producing 30 modules per hour and more than 200,000 a year, with a service life of up to 25 years. The energy saving potential of Kazakhstan is 75%, and the Global Environment Facility has allocated \$3 million as a grant for a project to promote energy-efficient lighting. World statistics say that 1.3 billion people in the world live without electricity, while 60% of all electricity is not used effectively. Today, about 19% of all consumed electricity world-wide is used for lighting. For illumination alone, humanity annually spends energy, which is 15% more than all nuclear power plants in the world, and according to the forecasts of specialists, by 2030 the consumption will double.

Residents of the country began to install hybrid heating systems in their homes. Solar panels and water heaters have become a symbol of clean energy. This system allows savings of up to 60% of heat. Advanced technologies, such as the solution of some domestic problems at a distance via SMS messages allows owners to contribute to the environment. Thanks to these alternative sources, the emission of harmful substances into the atmosphere is reduced. In the Akmola region, 20 such heating systems have already been installed. In the future, it is planned to cover the whole of Kazakhstan with hybrid plants. The effectiveness of hybrid plants in the combination of natural energy is that solar panels can produce energy only during the day when there are rays of the sun. Windmills can work at night, but the wind does not always blow. Therefore, due to their joint work, the energy is produced regularly. The future of such hybrid installations is assured, as they are environmentally friendly and at the same time significantly save money.

Global warming has become one of the most important problems of mankind. For the entire history of human existence, its climate has continuously changed, but this has never happened at such a rapid pace. Rapid climate change is also taking place in Kazakhstan. Over the past 70 years, the temperature has risen by 1.9 degrees. At the moment, the world community is trying to prevent global warming by 2 degrees Celsius. After which, according to Nobel laureates, the point of no return will be passed, and the climate will become dangerous and unpredictable.

## WASTE RECYCLING IN THE CITIES

About 44 million tons of garbage is stored across Kazakhstan now. Solid waste landfills are replenished daily. The long years it takes for garbage to decompose does harm to ecology. The gases emitted by grounds have a negative effect both on nature and on health of the people. In Kazakhstan, waste recycling plants have not gained mass development yet. About 20 million cubic metres of household waste are forming annually. This waste is being collected not only in special platforms, but also in spontaneous dumps in the cities and villages. So, many years are required for full disintegration of garbage.

For example, chewing gum can be in the earth for years and a plastic bottle can be in the earth for 50 years. Sorting of garbage reduces the level of environmental pollution, especially in the large cities. This practice exists in Astana, and in other cities of Kazakhstan and relies on the international experience. On the streets of many developed countries, it is possible to see the multi-coloured containers for garbage divided by types of waste. Paper, plastic and household waste are collected separately. It provides an opportunity for their secondary processing that significantly reduces environmental pollution. Germany uses the unique system of sorting of waste and is the leader in Europe in waste recycling. The average resident of Germany produces 618 kilograms of garbage within a year, Deutsche Well reports [9].

However, 64% of all garbage waste in Germany is processed or utilised. Sorting of waste begins in private houses. Each German dwelling is supplied with 3 - 5 different bins. Citizens of Germany are obliged to sort garbage: waste paper, glass, organic waste (biomass), metals and plastic. Glass for utilisation is sorted by inhabitants according to colour. Producers are responsible for the recycling of plastic and glass packaging. Funds for it are built into the cost of products. Raw materials worth half a trillion euros are processed annually in Germany. The burning garbage emits energy, and this energy is applied to the heating of rooms and to hot water supply.

Statistically, German industry receives 14% of raw materials from waste. The German municipal services collect large-size garbage: furniture or household appliances every three months. Inhabitants can be fined for non-compliance with rules of sorting of garbage or the service to them is stopped. Total turnover of all companies collecting garbage in only one year is about 50 billion Euro. Therefore, some experts are convinced that in about ten years' time, the so-called green economy will already play a more important role in the German market than the automotive industry today.

Sweden is also a leader in the field of ecological initiatives. Sweden plans to become 100% non-dependent on fossil fuel by 2050. Sweden processes 99% of garbage waste, and only 1% arrives in dumps. The process *waste-to-energy* (WTE) allows receiving steady electricity practically from any garbage [9]. The garbage arriving at the WTE plants is burnt to produce steam, which is then used for rotation of turbines and power production. Sweden has so succeeded in the fight against waste that actually it imports 800,000 tons of garbage from nearby countries for use in 32 waste recycling plants.

## CONCLUSIONS

The President of Kazakhstan stressed that for the transition to green energy, the introduction of green technologies is a growing vector of the global economy. Despite having access to huge natural resources, including hydrocarbons, Kazakhstan intends to develop renewable energy sources.

Such tasks are set in the *Strategy-2050*, and it is planned to invest 2% of the national gross product annually in the *green modernisation* of funds. Savings and a diligent attitude to energy resources should become a principle of life for every resident of Kazakhstan, because ...*Nature is not what we inherited from our ancestors, but what we borrowed from our descendants* [10].

A few decades ago, the concept of eco-efficient architecture occupied a very small niche in the international market. Today, thanks to eco-architecture, innovative technologies are emerging in the world. Eco architecture is becoming a stable trend; this connection will develop in the future.

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