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An analysis of green technologies' development in Kazakhstan: problems and perspectives

Green technologies are essential tools to ensure sustainable development of the economy. In this regard, the article deals with the problems and prospects of development of green technologies in the Republic of Kazakhstan. In the first part of the study, authors investigated more than 50 official sources of information, including laws, concepts, programs, events and reviews of major international organizations. The chronology of development of green technologies in Kazakhstan has been drawn up based on the analysis of secondary sources, which was divided into several stages, taking into account the key moments. Urgent problems and trends of development have also been identified in this area. In order to check the correctness of the analysis, expert interviewings were conducted with six experienced specialists, 2 of which are foreign. The article describes the methodology and the main results of the study in detail. Conclusions are classified on such aspects as the demand, technology, human resources, mentality and perspective of development, which are also supported by direct quotations from interviews of experts.

Key words: green economy, green technologies, development stages of green technologies, expert interview.

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Қазақстандағы жасыл технологиялардың дамуын талдау: мәселелері мен келешегі

Жасыл технологиялар ел экономикасының тұрақты дамуының бірден-бір маңызды құралдарының бірі болып табылады. Осыған орай, мақалада Қазақстандағы жасыл технологиялардың даму мәселесі мен келешегі қарастырылған. Зерттеудің бірінші бөлігінде авторлар заңдар, тұжырымдамалар, бағдарламалар, елеулі оқиғалар мен халықаралық ұйымдардың шолуларынан тұратын 50-ден аса ресми ақпарат көздерін саралап, талдады. Екінші ретті ақпарат көздерін талдау негізінде Қазақстандағы жасыл технологиялардың даму шежіресі жасалынып, түйінді ерекшеліктеріне қарай бірнеше кезеңге бөлінді. Сонымен қатар, осы саладағы өзекті мәселелер мен саланың даму үрдісі анықталды. Зерттеу нәтижелерінің дұрыс не бұрыстығын анықтау мақсатында 6 тәжірибелі маманнан сұхбат алынды, оның екеуі шетелдік сарапшылар. Мақалада зерттеу әдіснамасы мен зерттеудің негізгі нәтижелері толық сипатталған. Зерттеу қорытындысы сұраныс, технологиялар, адам ресурстары, менталитет және даму келешегі сияқты 5 аспект бойынша топтастырылып, сарапшылардың пікірлерімен дәлелденген.

Түйін сөздер: жасыл экономика, жасыл технологиялар, жасыл технологиялардың даму кезеңдері, эксперттік сұхбат.

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Анализ развития зеленых технологий в Казахстане: проблемы и перспективы

Зеленые технологии являются важнейшими инструментами обеспечения устойчивого развития экономики страны. В этой связи в статье рассмотрены проблемы и перспективы развития зеленых технологий в Республике Казахстан. В первой части исследования авторами было изучено свыше 50 официальных источников информации, содержащих законы, концепции, программы, крупные события и обзоры международных организаций. На основе анализа второстепенных источников была составлена хронология развития зеленых технологий в Казахстане, которая была разделена на несколько основных этапов с учетом ключевых моментов. Также были определены актуальные проблемы и тенденции развития в данной области. С целью проверки правильности составленного анализа было проведено экспертное интервьюирование с 6 опытными специалистами, 2 из которых являются зарубежными. В статье подробно описаны методология и основные результаты исследования. Выводы классифицированы по таким аспектам, как спрос, технологии, человеческие ресурсы, менталитет и перспектива развития, и подкрепляются прямыми цитатами из интервью экспертов.

Ключевые слова: зеленая экономика, зеленые технологии, этапы развития зеленых технологий, экспертное интервью.

**AN ANALYSIS OF
GREEN TECHNOLOGIES'
DEVELOPMENT IN
KAZAKHSTAN:
PROBLEMS AND
PERSPECTIVES**

Today the task of ensuring the sustainable development of human civilization is being viewed as the guiding principle of the life of the economy and of the society in general. UNEP defines a green economy as “one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities” [1]. The OECD has defined green growth as follows: “Green growth is about fostering economic growth and development while ensuring that the natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, it must catalyze investment and innovation, which will underpin sustainable growth and give rise to new economic opportunities” [2].

Critically, the green economy concept is more than merely “greening” economic sectors; it is a means of achieving the sustainable development imperatives of:

- Improving human well-being: securing better healthcare, education and job security;
- Increasing social equity: ending persistent poverty and ensuring social, economic and financial inclusion;
- Reducing environmental risks: addressing climate change, ocean acidification, the release of hazardous chemicals and pollutants, and excessive or mismanaged waste; and
- Reducing ecological scarcities: securing access to freshwater, natural resources and improving soil fertility.

In most countries, and Kazakhstan is not an exception, the transition to a green economy requires changes to existing governance approaches, institutions, and markets. This transition will take different paths in different countries depending, inter alia, on a country's domestic context, natural capital, and socio-economic priorities.

The Earth Summit Rio 1992 provided the vision and important pieces of the multilateral machinery to achieve a sustainable future. Nevertheless, many authors around the world, such as environmentalists, scientists, politicians, economists have made a huge contribution in attempting to create a more sustainable future.

For example, A. Leopold published his well-known book in 1949, wherein the main message is that the land is not there to serve us, but that we need to live in community with the land [3]. P.L. Eh-

rich states that population growth and environmental deterioration are inextricably linked, and proposes four action items to address the crisis. He also accentuated that gargantuan efforts are necessary to increase food production and feed all human-being [4]. R. Buckminster Fuller argues that shortsightedness and siloed thinking are the main causes of impending ecological crisis. His book is a remarkable for its overall message as for its elaboration of concepts that were ahead of their time. Also, he suggested considering the planet as a closed system, using a metaphor "Spaceship Earth" to indicate it, so there is no "away" [5]. In 1972, group of authors published a commissioned report to the Club of Rome, which is known as a book "The limits to growth". Their book was revolutionary, and reports 13 scenarios for the future based on a computer simulation model developed at MIT. Despite variations, all of them produce a sobering conclusion, namely that "the behavior mode of the system is clearly that of overshoot and collapse. Authors claim that growth trends in world population, industrialization, pollution, food production and resource depletion suggest that biophysical limits will be reached sometime within the next 100 years [6]. One of the turning points in the sustainable development is the publication of the Brundtland report, also known as "Our common future". This report introduces the three fundamental components of sustainability – environment, economy and society – and highlights what is needed in each area to achieve sustainable development. It makes it clear that we cannot achieve success in one of these areas at the expense of areas. Being considered one of the first comprehensive assessments of both the social, environmental and economic problems facing the world, one should admit that the UN Conference in Environment and Development held in Rio de Janeiro in 1992 was a direct outcome of this Brundtland Report [7].

Doubtless, Kazakhstan has a distinct understanding of the state management assuming that promotion of the green economy is the main way and the only one in maintaining a sustainable development. And our paper aims to consider the development and future perspectives of green technologies in Kazakhstan as a main tool of establishing sustainable economy.

Research methodology

The relevance and necessity of development green technologies have been investigated in the first

phase of the study. Then, stages of development of green technologies in Kazakhstan were identified based on secondary sources of information. In addition to the analysis of statistical indicators, it was decided to conduct an expert interviewing with leading experts in various industries. The main and indirect questions were drawn up for interviews in order to reveal five aspects of development of green technologies, such as demand for the product or service, technology (scientific aspect), human resources, mentality and perspective. It is important to distinguish main research question and subsidiary questions according to methodology of qualitative research [8]. 6 experts were interviewed on condition of anonymity. Interviews were conducted by the method of story-telling, where the researcher asked basic questions to guide conversation in the right direction, subsequently the story of an expert based on his personal experience and deep knowledge. A great experience and professionalism of the experts revealed several hidden factors and the specific problems of green technologies. Direct, but anonymous quotes from the interviewees are used to support our analysis, because examining theoretical scheme and active work of both interviewer and interviewee can make the research lively and original [9].

The main guiding questions during an interview with an expert:

1. How do you assess the demand for green technologies in Kazakhstan?
2. Who is the main consumer of your products / services?
3. How do you assess the human resources in your area?
4. What are the factors hindering the development of green technologies in Kazakhstan?
5. What can you say about the scientific research, development and technology transfer in the "green" area?
6. What can you say about the mentality of the people of Kazakhstan in terms of the transition to a green economy?
7. How do you see the future of green technology in the country?

Main characteristics of the selected expert are specified in the following Table 1. One should note that even if the E2 does not have a branch in Kazakhstan, his company intends to open it in the West of our country. Thus, he did market research and other complex investigation before making such decision, so, undoubtedly can be considered as an expert in green technologies regarding conditions of Kazakhstan.

Table 1 – Characteristics and interviewees' roles in 6 organizations

Experts	Fields of activity	Interviewee role	Location	Experience: total / in Kazakhstan (year)
Expert 1 (E1)	solid waste management, municipal infrastructure, renewable energy sectors	Board Advisor	Astana (Headquarter in Poland)	30 / 10
Expert 2 (E2)	cleaning soil from pollution	Member of the Board	No branch in Kazakhstan (Headquarter in Latvia)	18 / 0
Expert 3 (E3)	sewage treatment, pump equipment, environmental protection	Sales Manager	Astana (Headquarter in Finland)	45 / 9
Expert 4 (E4)	sustainable development, waste management, energy efficiency	Executive Director	Almaty	12 / 12
Expert 5 (E5)	reuse and recycling of waste	Manager	Almaty	2 / 2
Expert 6 (E6)	alternative energy sources, biophysics	Scientist	Almaty	21 / 10
Note: compiled by the author on the basis of research.				

The main part of analysis

Green Economy is instrumental to nation's sustainable development. Transition to green economy will enable Kazakhstan achieve the proclaimed goal of entering the top 30 developed countries of the world. According to estimates, the transformations to be implemented as a part of a Green Economy will additionally increase the GDP by 3%, create more than 500,000 new jobs, develop new industries and services and generally provide higher living standards all over the country by 2050. Overall investments required for transition to a Green Economy will be about 1% of GDP per annum, which is equivalent to USD 3 to 4 billion [10].

The top-priority measure to assess the situation and determine action priorities is to introduce a system of indicators of sustainable development. These are primarily indicators of the resource in-

tensity and energy intensity in economic growth and specific indicators of pollution. Moreover, accumulated environmental damage, resource depletion, landscape degradation and the impact of pollution on human health should be taken into account. It is principally important, especially to determine prospects for development and to assess the use of 3 renewable energy sources, to evaluate ecosystem services (including various ecosystems, biological resources, biodiversity and area of protected natural reserves). Therefore, we compare key indicators of green economy for Kazakhstan and other developed countries (See Table 2).

During the study, we analyzed more than 50 sources of information including laws, conventions, concepts, programs, reviews, and reports of international organizations, as well as the sites of government agencies and nongovernmental organizations.

Table 2 – Key indicators of green economy for Kazakhstan in comparison with other countries

Countries	Energy efficiency (GDP per unit of energy)	The share of fossil fuels (% of total)	The share of renewable energy (% of total)	Carbon dioxide emissions per capita (tonnes)	Urban pollution (mg/m3)	Exhaustion of natural resources (% of GNI)	Satisfaction with the actions for the protection of the environment (% satisfied)
Norway	8,1	58,6	45,3	10,5	16	10,6	51,5
Netherlands	7,7	92,5	4,4	10,5	31	0,8	66,1
Germany	8,3	80,1	8,9	9,6	16	0,1	61,8
Sweden	6,6	31,1	32,4	5,3	11	0,2	62,9
Denmark	9,5	80,4	18,9	8,4	16	1,5	64,3
France	7,4	51,0	7,6	6,1	13	0,0	57,5
Czech Republic	5,5	81,5	5,4	11,3	18	0,3	56,6
United Kingdom	10,1	90,2	2,8	8,5	13	1,2	66,8
Poland	6,8	93,8	6,3	8,3	35	1,0	43,6
Belarus	4,1	92,1	5,5	6,5	7	0,9	50,6
Russia	3,0	90,9	3,0	12,1	16	14,5	18,3
Kazakhstan	2,5	98,8	1,1	15,3	15	22	37,4
China	3,7	86,9	12,3	5,2	66	3,1	73
Note: compiled by the author on the basis of [11], [12].							

According to the results of such a comprehensive analysis, we found that the scientific works about stages of development and establishment of a green economy are virtually absent.

This has led us to draw up our own vision of the evolution of green technologies in Kazakh-

stan. As a result, we have identified the key moments in the history of independent Kazakhstan regarding the green technologies based on the following aspects: the adoption of laws, ratification of conventions, the establishment of competent authorities and companies, major events and other factors (Figure 1).

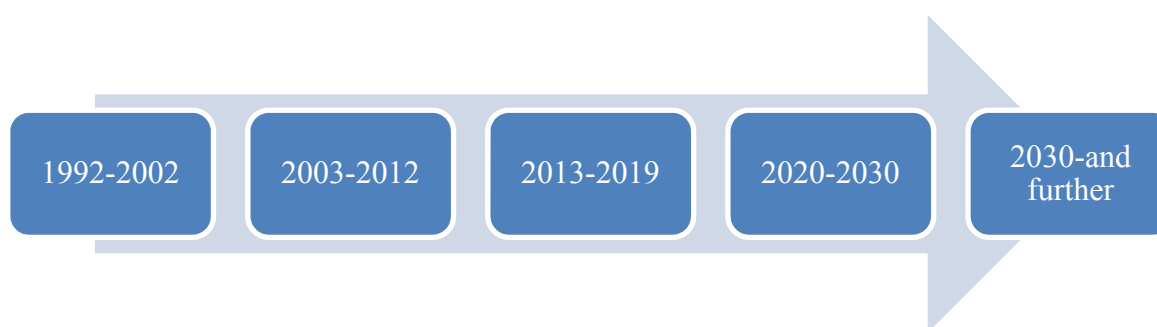


Figure 1 – Stages of green technologies' development in Kazakhstan

Descriptions and key features of each stage are briefly given below:

1. 1992-2002 years – the period of formation of the basic principles, concepts and the emergence of the foundations. This period includes following key events:

- 1992 – Kazakhstan took part in the “Earth Summit” in Rio de Janeiro which brought together more than 100 heads of state and government representatives from 178 countries. Its main result was the adoption of the “Declaration on Environment and Development”, “Agenda XXI century”, the two conventions – “Convention on Climate Change” and “Convention on Biological Diversity”.

- 1993 – the economic crisis in the region caused by the collapse of the Soviet Union in 1991, limited the opportunity to continue the sustainable development program.

- 1997 – Kazakhstan established a National Council for Sustainable Development.

- 1997 – adoption of the law “On Environmental Protection”.

- 1998 – declared as “The year of the protection of the environment” under the auspices of the United Nations.

- 1999 – as a result of tight fiscal and monetary policy the government managed to keep inflation low and relatively balanced budget, which gave further growth prospects.

- 2000 – the Central Asian sub-regional report was prepared for the World Summit on Sustainable Development, which includes an overview of the progress made by the government in implementing the recommendations.

2. 2003-2012 years – the period of serious steps by the government in terms of support and major events remarkably influenced the course of development of green technologies. Key events which occurred in this period are indicated below.

- 2003 – the adoption of Strategy of Industrial and Innovation Development of Kazakhstan for 2003-2015.

- 2003 – Kazakhstan Business Association for Sustainable Development was established.

- 2007 – adoption of “The Environmental Code” of Kazakhstan.

- 2007 – the National Program on Wind Energy Development in the Republic of Kazakhstan till 2015 was developed, with an outlook to 2024.

- 2010 – the initiative of Astana under the name “Green Bridge”: Partnership of countries in Europe, Asia and the Pacific for the implementation of “green growth”.

- 2010 – Decree of the Government of the Re-

public of Kazakhstan for 2010-2014, called “Green Development”.

- 2012 – The Kazakh delegation took part in the next United Nations Conference on Sustainable Development in Rio de Janeiro, Brazil, called Rio + 20.

- 2012 – Kazakhstan’s capital Astana chosen to host the international exhibition EXPO-2017 by secret ballot of the member countries of the International Exhibitions Bureau in Paris. Subject of the exhibition is “Energy of the Future”.

3. 2013-2019 years – the period of active development of green technologies and increased public awareness in our country. Key events both occurred and planned are as follows:

- 2013 – Concept of transition of the Republic of Kazakhstan to the “green economy” approved by the Decree of the President of the Republic of Kazakhstan.

- 2013 – the year of “Environmental culture and environmental protection” in the Republic of Kazakhstan.

- 2013 – “Coalition for green economy and development of the G-Global” was established.

- 2013 – “International innovative-educational center” Green Economy” was established to provide training on green innovations, technologies and promotion of green reforms and projects.

- 2014 – “The program of modernization of the system of solid waste management for 2014 – 2050” was developed and approved.

- 2014 – The Council for the transition to a “green economy” is formed by the President of the Republic of Kazakhstan.

- 2014-2015 – numerous competitions with grant funding were announced over the green technologies and innovation.

- 2017 – Kazakhstan hosts International Exposition EXPO-2017 with the focus on the theme “Future Energy”.

4. 2020-2030 years – development based on sustainable use of natural resources, use of renewable energy on the basis of high technologies. This will be the period based on the established green infrastructure, transformation of the national economy, oriented at rational water use, motivation and stimulation of development and broad implementation of renewable energy technologies, as well as construction of facilities based on high energy efficiency standards.

5. 2030 and further – the transition of the national economy to the principles of the “third industrial revolution”. Facing the prospect of a second collapse of the global economy, humanity is desperate for a sustainable economic game plan to take us

into the future. Here, Rifkin J. explores how Internet technology and renewable energy are merging to create a powerful "Third Industrial Revolution." He asks us to imagine hundreds of millions of people producing their own green energy in their homes, offices, and factories, and sharing it with each other in an "energy internet", just like we now create and share information online. Rifkin's vision is already gaining traction in the international community. The European Union Parliament has issued a formal declaration calling for its implementation, and other nations in Asia, Africa, and the Americas, are quickly preparing their own initiatives for transitioning into the new economic paradigm [13].

Research findings and results

Kazakhstan aims to diversify the economy with alternative, cleaner sources of energy and will reform its agricultural and industrial sectors to spur scientific innovation and the use of advanced technologies.

Such a strong government endorsement should stimulate economic drivers of green development. Of course, "greening" the economy of an oil-producing resource-based country requires sustained political commitment, significant long-term investments and a range of other enabling conditions.

Our paper is an effort to build a vision of evolution of green technologies' in Kazakhstan and start discussing current problems, possible solutions and perspective for the future. Apart from our classification of factors which interfere to the successful development of green technologies, we analyzed the answers of experienced experts, and then tried to focus on main issues mentioned below:

1. The demand for green technologies will consistently grow in Kazakhstan. This is not only due to the requirements of the market, but also due to an urgent need to achieve sustainable development. The sooner we realize this truth, the better. In the meantime, the demand for such technologies is provided by government agencies and private entities in very small quantities. Foreign companies see a huge untapped market in our country and try to take these niches first, while domestic companies are dependent on foreign technology.

2. The transition to green technology obsolescence of most difficult material and technical assets

in the country. While on the other hand, it should be a turning point in the modernization and renovation of the planned facilities. Unfortunately, the denials of the introduction of resource-saving technologies for the sake of personal interests were also revealed. And the development of scientific research in this area requires sophisticated laboratories and cooperation with industry.

3. The opportunity to train personnel of high profile has appeared in the major universities of the country. However, we must take into account that foreign companies coming to the market of Kazakhstan hire their own people to work directly with the technology, and the local staff for other jobs. This complicates the transfer of experience and knowledge. Also, we need to arouse young people's interest in engineering sciences from the school in order to grow up creative and imaginative people.

4. The mentality in Kazakhstan does not allow to sort garbage, or to save energy. However, in all developed countries, this process took some years, sometimes even up to 20 years. In addition, due to the different programs and initiatives that promote green economy, public awareness of the need for the introduction of green innovation in everyday life is steadily growing.

5. The positive trend is expected in the development of Kazakhstan regarding the green technologies. But we must take into account the fact that all the existing problems in this sphere must be addressed in an integrated manner, in other words systematically. It should actively deal with problems such as the commercialization of scientific and technical ideas, preparation of highly qualified personnel, the establishment of associations uniting members of one sphere, the elimination of corruption, literacy on the green economy of the population and businessmen.

Table 3 indicates some of interviewed experts' important comments on selected aspects to support our conclusions.

The green economy is more than just environmental in scope; it is also about development and the economy. From a development perspective there are a number of ways in which a green economy might benefit both developed and developing countries. Kazakhstan cannot remain aside from the sustainable development through green technologies; in fact it can be a new impetus for the future development of the country.

Table 3 – Interviewees’ views about the development of green technologies in Kazakhstan

№	Directions	Excerpts from an interview in key areas
1	Demand	<p>“While there is oil extraction and production, there will always be demand for cleaning soil from harmful wastes and pollutants” – E2</p> <p>“At the moment, the demand comes mainly from the state structures, but according to research, demand from private companies will only rise in the future, we are confident in it” – E1</p> <p>“Some clients do not always understand the specifics of the work and put forward the absurd requirements of the contract. As a result, we have to give up that kind of job” – E5</p>
2	Technologies	<p>“The opinion that green technology began to develop thanks to the EXPO-2017 is fundamentally wrong” – E4</p> <p>“Foreign investors interested in my unique adapted technology on alternative energy, while I could not persuade Kazakh authorities in its effectiveness” – E6</p> <p>“If this is a global problem, we usually buy proven foreign technology. And if the problem can occur in the long term, we do not mind to cooperate with research institutes [in Kazakhstan]” – E1</p>
3	Human resources	<p>“Our young people are very clever. Their potential is very high” – E6</p> <p>“Young professionals come to us, but they require a higher salary and are interested in obtaining an apartment, which is impossible in our private company” – E3</p> <p>“We happened to meet two Kazakh scientists with a great idea and started to cooperate” – E1</p> <p>“We need environmentalist-economists and ecologists with a legal background” – E4</p>
4	Mentality	<p>“The mentality will not change immediately. For example, it took twenty years to go to the sorting of waste in Europe” – E5</p> <p>“We put the containers for separate recycling throughout the city [Almaty]. Unfortunately, this initiative failed completely” – E5</p> <p>“It is undeniable that there have been cases where managers of factories refuse to adopt new technologies, because the innovations contradict the personal interests of some people” – E6</p>
5	Perspective	<p>“The prospect of green technologies in Kazakhstan is enormous. “We either will develop it [green technology] or fall behind the world for decades. There is no other way” – E4</p> <p>“Definitely, the progress is expected. But we need to solve problems systematically. Otherwise, it might not work” – E5</p> <p>“I think that recycling of household waste can be a great source of local development [for Kazakhstan]” – E1</p>
Note:	compiled by the author on the basis of research.	

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