INFORMATION AND ANALYTICAL MAGAZINE

QazaqGreen

KONRAD ADENAUER STIFTUNG

SOLAR POWER ASSOCIATION OF QAZAQSTAN

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"GREEN ECONOMY":

Kazakhstan and Central Asia

Chairman of the Board of Directors of SPAQ

NURLAN KAPENOV

Dear readers! Dear friends and colleagues!

Let me welcome you on behalf of Solar Power Association of Qazaqstan and report good news that our Association combined efforts for issue of our magazine and received support from the Konrad Adenauer Foundation.

As you know, in 2019-2020, our association initiated the issue of QazaqSolar magazine, which became an important event in the renewable energy sector of Kazakhstan and was acclaimed by colleagues. The magazine covered the most pressing problems of the development of RES sector. However, despite the fact that the magazine was conceived as a publication for "solar" energy, we have always covered a wider range of issues: development of a "green" economy, "clean" energy, environmental protection, ecology. All these areas are very closely related to each other.

In this regard, after constructive consultation with our partner- Representative Office of the Konrad Adenauer Foundation in the Republic of Kazakhstan – it was decided to expand the thematic coverage of the magazine and to publish it in a new format in a new format – as the magazine QazaqGreen. QazaqGreen magazine will be published in a large circulation and geographically cover the issues of building a "green" economy in the countries of Central Asia.

Of course, reason for this decision is also the important events that are taking place today in our country.

Firstly, indicator of Concept for transition of the Republic of Kazakhstan to a "green economy" in generation of renewable energy – 3% of total electricity generation, i.e. 115 renewable energy facilities, 1635 MW of installed capacity, 1.5 billion US Dollars of attracted investments and more than 1,300 jobs. The next target is to reach 6% by 2025, which means that the sector as a whole should double in size.

Secondly, in December 2020, the President approved amendments to the legislation on RES and energy sector, which provided new opportunities for development of the sector. This will solve the problem of shortage of balancing capacities through the construction of maneuverable capacities, establishing competitive tariffs for RES, ensuring the financial stability of FSC of RE, increasing the terms of PPA contracts to 20 years, and centralized purchase of flood electricity.

Thirdly, in early January 2021, the President also signed the Environmental Code, which introduced the principle of "the polluter pays and corrects". This means that the State creates such conditions that prevent nature users from impacting negatively on the environment. If the damage occurs, then the polluter will have to restore everything to its original state.

Fourthly, we all remember that in his address to the people of Kazakhstan in September 2020, the President indicated that "greening" the economy and environmental protection are one of 7 main principles of the new economic policy of the country, and in his speech at the Global Summit on Climate Ambitions, the President announced Kazakhstan's task – to achieve carbon neutrality by 2060.

Thus, our country has resolutely aimed at "greening" the economy, and this trend is gaining momentum. Of course, development of renewable energy sources is an important part. It is no secret that renewable energy sources in our country have become the driver of further development of the energy system of Kazakhstan. In fact, having exposed key problems, such as system imbalances and lack of maneuverable capacity, flows from neighboring states, obsolescence of generating equipment, insufficient reliability of the isolated Western zone and electricity shortages, and power outages in the Southern Zone, development of renewable energy and the country's commitments under the Paris Agreement encourage the Unified Energy System of Kazakhstan to keep up with the times and modernize.

It is no coincidence that at an Extended meeting of the Government of the Republic of Kazakhstan on January 26, 2021, the President of the Republic of Kazakhstan, K. Tokayev stressed that one of the most important conditions for further development of the country – the uninterrupted and reliable operation of the electric power system. In this regard, the Government of the Republic of Kazakhstan has been instructed to develop the Energy Balance of the Republic of Kazakhstan until 2035, which should take into account not only internal aspects – consumption, generation of maneuverable capacities, increasing the share of clean energy, but also plans for development of energy systems of our neighbors.

As I mentioned above, last year our country achieved a strategic target for the share of electricity generation from renewable energy sources – 3% of total generation. However, today there is a situation where the technical capabilities of the UES of Kazakhstan do not allow further development of renewable energy sources. This is confirmed by the low volumes for RES projects that were put up for

auction for selection of RES projects in 2020 (a total of 250 MW).

Thus, for example, last year, 55 MW were allocated for the implementation of solar power plant projects, which were divided into 3 small lots: 15, 20 and 20 MW each. For wind farms, volumes of 65 MW, divided into 15 and 50 MW respectively, were put up for auction. Auctions for 120 MW of installed capacity of hydroelectric power plants were held as part of two tenders for 20 and 100 MW, and the last auction was declared invalid. Volumes of 10 MW were drawn for the bioenergy plant.

In comparison: in 2019, the volume of tenders for selection of renewable energy projects was 255 MW, and in 2018 – 1000 MW. In order to achieve the target of electricity generation from renewable energy sources of 6% in 2025, in fact, the renewable energy sector needs to double in size, which makes it necessary to introduce new capacities. This means that about 450 MW of new renewable energy facilities should be introduced annually. Already now we hear from investors that the renewable energy sector in Kazakhstan is becoming less interesting. This situation can lead to monopolization of the market, disruption of trading and outflow of foreign investment.

It seems that, given the current situation, in 2021, the volumes for auctions for renewable energy projects will not differ significantly from last year. In case of delayed solution to the above-described systemic problems of the UES of Kazakhstan, and their solution will still take time, in the coming years, the volume of renewable energy sold through auctions will decrease. This gives rise to question: how are we going to achieve the target of 6% share of electricity generation from renewable energy sources by 2025? However, this target is specified in the Strategic Development Plan of the Republic of Kazakhstan until 2025 - one of the main documents in the state planning system.

In this regard, solution to this challenge requires immediate measures that, on the one hand, would solve the issues of the technical capabilities of the UES of Kazakhstan, and on the other- would allow the implementation of renewable energy projects within the framework of auctions. At the moment, such a solution could be the implementation of renewable energy projects with energy storage.

Moreover, it is necessary to take into account the development of distributed generation and, in general, the trend towards the decentralization of generation, which Kazakhstan joined not because of, but in spite of. We see that the demand and interest of the population (households and legal entities) for small-scale projects is growing. This interest is based on the large share of people living in the private sector, the desire to reduce and optimize their costs for electricity and water heating, problems associated with the inaccessibility of public infrastructure in remote regions, favorable natural and climatic factors, especially in the southern regions of the country.

At the same time, currently, the legislative framework, as well as main regulatory acts affecting the development of renewable energy sources don't provide incentive measures and mechanisms for supporting and implementing small-scale renewable energy projects by the population. Opponents will object: "And for what it is necessary to develop this area?" Our answer: "For people, for population, to meet the demand and requirements for generation of "clean" energy, which the citizens of our country have today."

In this regard, I would like to say that within the framework of the UNDP-GEF project "Reducing the risks of investing in renewable energy projects", last year, a simulation of the distribution grid of the Turkestan region, including the city of Shymkent, was conducted on integration of small renewable energy projects into the grid. The simulation showed that connecting the so-called home installations of solar power stations to the electric grid on a regional scale will help to increase the reliability of the grid as a whole, unload overloaded nodes and reduce electric energy losses. However, the potential of 5-10% of households is equivalent to construction of a large CHP with a capacity of 500-1000 MW.

However, companies developing this area are faced with problems of excessive requirements from the REC to the technical conditions for connecting renewable energy sources, which vary depending on the regions, contracts for purchase and sale of surpluses of generation of small renewable energy sources enter into force and surpluses begin to be balanced and paid from January 1 of the following year from the date of signing the contract, etc. It seems that the solution to these issues at the level of regulatory legal acts of the Ministry of Energy of the Republic of Kazakhstan would allow the sector to develop further. Moreover, there are ready-made amendments developed through the UNDP project.

Thus, today, the renewable energy sector, and therefore the entire electric power industry of the country, faces 4 main tasks.

1. Achievement of set strategic goals of 6% of the share of generation by 2025 in accordance with the Strategic Development Plan of the Republic of Kazakhstan until 2025.
2. Early implementation of maneuverable capacity projects, without which the achievement of the above indicator for RES is problematic.
3. Implementation of renewable energy projects with energy storage through the auction.
4. Stimulating and supporting the development of distributed generation.

The solution of these issues depends on all participants of the RES market, especially on the System operator and the authorized state body. Therefore, it is important to take appropriate measures today. Historically, we may not cancel or adjust the strategic course on "greening" the economy, initiated by Elbasy and supported by the President of the Republic of Kazakhstan K. K. Tokayev.

In this regard, we hope that on the pages of our publication QazaqGreen we will hear different opinions, and not only the statement of problems, but also the solutions considered. We invite you to an open discussion on the pages of our magazine.

We take this opportunity to express our gratitude to the Representative Office of the Konrad Adenauer Foundation in the Republic of Kazakhstan for its support of the QazaqGreen magazine initiative.

Thank you for your attention!

JOHANNES D.REY, HEAD OF THE REPRESENTATIVE OFFICE OF THE KONRAD ADENAUER FOUNDATION IN THE REPUBLIC OF KAZAKHSTAN

KONRAD ADENAUER STIFTUNG

Dear readers!

Let me welcome you on behalf of the Konrad Adenauer Foundation to the pages of the information and analytical magazine QazaqGreen!

This spring, we have decided to support the initiative of Solar Power Association of Qazaqstan to jointly publish a magazine that would cover not only the development of renewable energy, but also issues of environmental policy and the development of a sustainable economy. Our magazine will be published three times a year and distributed not only in Kazakhstan, but also in the countries of Central Asia.

Our decision is not accidental. Today, economies of many countries are undergoing major changes caused by a change in the paradigm of economic models. In 2011, the concept of the Fourth Industrial Revolution, which involves the mass introduction of cyber-physical systems in the manufacturing and processing industries was discussed for the first time ever at the Hannover Exhibition. Ten years later, these ideas, widely adopted around the world by politicians, businessmen, and scientists, became the part of not only many government programs, but also began to have a direct impact on changes in many areas: labor market, education, technology and lifestyle, communications, and so on.

The last year, when COVID-19 pandemic has been declared by WHO, has accelerated the transformation of economic paradigms. We are observing the "greening" of the economies of the leading countries, the introduction of economic incentives, for example, "carbon tax", carbon neutrality policy. Today, it has become important not only to establish the energy efficiency of electric appliances, but also to establish what resources were used to produce a particular product. The world is entering the stage of the so-called 4th energy transition, which supposes widespread use of renewable energy sources and displacement of fossil fuels.

Germany's experience in this regard is quite illustrative: the country has politically declared the rejection of nuclear energy and traditional coal-based generation. The share of renewable energy generation has already reached half of the country's energy balance. Germany rightfully occupies one of the leading places in the world in terms of investments in the renewable energy sector. Germany's share in the European Union in terms of installed capacity of wind and solar power plants is 32% and 37% respectively. Renewable energy generation systems are being successfully implemented by households and industrial facilities.

We are pleased to state that Kazakhstan is no exception and keeps pace with the global trends in "greening" the economy, which is historically based on hydrocarbons. In this regard, implementation of the Concept for transition of the Republic of Kazakhstan to a "green" economy, the development of a new Environmental Code, rapid development of renewable energy sources in recent years are a clear confirmation of this thesis. In addition, it should be mentioned that an important indicator – generation of electricity from renewable energy sources – amounted to 3% last year is achieved and country has far-reaching plans in this direction until 2050, when the generation from renewable energy sources will be 50% of the country's energy balance.

Indeed, we are also interested in the experience of other Central Asian countries. What environmental problems and challenges are facing the countries of the region today? How will a sustainable economy develop, waste disposal problems be solved, and energy transformation be implemented? I am confident that the readership will find answers to these and many other questions on the pages of QazaqGreen magazine.

Let me thank all the authors of articles and interviews for our magazine and encourage the audience to have a constructive discussion on the pages of our publication.

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KONRAD ADENAUER STIFTUNG

INTERVIEW

The beginning of the new year was marked by good news for the public of our country – the President of Kazakhstan signed the new Environmental Code of the Republic of Kazakhstan. Aigul Solovyova, Chairman of the Management Board of Association of Environmental Organizations of Kazakhstan ALE, tells about the innovations introduced in the document regulating environmental safety, what goals and objectives the new code sets.

Aigul Solovyova: The new Environmental Code

– Aigul Sagadibekovna, the President at the beginning of the year signed the Environmental Code of the Republic of Kazakhstan, adopted by the country’s Parliament. Please tell us what innovations does this document suggest and how is it important for our country?

– In the opinion of the public, which is engaged in and is committed to improving the environment in the country, the new Environmental Code, which will enter into force on July 1, 2021, is perceived as important and satisfying the needs of our people based on the fact that it has incorporated the best practices of the countries of the Organization for Economic Cooperation and Development (OECD). First of all, I would like to note the strengthening of the role of the public, since the codified act defines its participation in state decision-making. Such decisions include assessment of the environmental effectiveness of the acts adopted by local executive bodies, the conduct of state environmental expertise, and the receipt of environmental permits by industrial enterprises after EIA. The obligation of holders of environmental information to provide environmental information is established. It is worth noting that the Association contributed to the consolidation of these norms. We took part in the development of the Ecocode’s Concept, and then were fully engaged in the working groups of the Ministry and the Majilis of the Parliament when discussing the draft version. It is proposed to tighten the

has incorporated the best practices of the OECD countries

responsibility for legal entities, as well as individuals, within the framework of administrative and criminal liability. For example, for cutting down trees, the size of the administrative fine is increased by 5 times and in the case of repeated offenses, the fine increases to 1,500 MCI, including cutting down in specially protected natural areas.

The Code provides for the rejection of total environmental regulation, and it is cancelled for category IV, and declaration is provided for category III objects. The main focus of the regulatory authorities will be placed on large enterprises of category I and only for them mandatory environmental insurance is provided.

The principle of "the polluter pays" has been introduced, which obliges to correct the violation. The violator, according to the law, will have to make compensation for the damage caused to nature. For example, the Environmental Code of the Republic of Kazakhstan dated January 9, 2007 was based on the principle of "pay and pollute", which implied the issuance of a permit to pay for emissions. From 2025, the enterprises that intend that intend to obtain a comprehensive environmental permit, are required to switch to the principles of the best available techniques, including reducing the resources consumed, improving energy efficiency, strict monitoring of emissions, the use of low-waste, effective new technologies, technological solutions that minimize the impact on the environment, and etc. For the transition to the principles of BAT, the state "returns" to the enterprise the fee for reducing pollution into the environment, and they will receive comprehensive environmental permits (CEP) for emissions. They will not only define emission standards, but also prescribe measures to reduce emissions into the environment. In case of refusal to implement BAT, a progressive fee rate will be applied - by two, four and eight times. Large industrial enterprises must comply with environmental standards adopted by the Government of the Republic of Kazakhstan, which will make it possible to apply uniform requirements for all sectors of Kazakhstan in practice. Including for technologies imported into the country, although the previous code regulated a personal approach, without taking into account the impact of the industry on the environment.

– As part of the development of the Environmental Code of the Republic of Kazakhstan, a lot of work has been done by the Ministry of Ecology, the expert community, and the public to discuss its provisions. What are the next steps? What is the final result of the implementation of this document?

– The implementation of the code will require the development of regulatory legal acts, and there are about 150 of them. The Association is actively involved in this process. The adopted code provides for additional mechanisms for its full implementation, so it is necessary to unite the efforts of all stakeholders to achieve one goal – to reduce the impact on the environment.

The Ministry of Ecology, Geology and Natural Resources, as well as local executive bodies, should work to determine both country and regional target indicators of environmental quality (TIEQ), which was not previously practiced. Taking into account the totality of the tasks set and their solutions, it is expected to reduce the consumption of natural resources, the use of clean technologies and the

reduction of production waste. The introduction of environmental management will serve as a reliable tool for improving the efficiency of the enterprise, saving energy resources, and reducing the impact of production on the plant and animal world.

According to the code, it will be mandatory to install automated monitoring systems and environmental protection equipment, as well as to carry out measures to clean up the land on which the object is located. It should be noted that Kazakhstan has adopted many legislative acts that are to a certain extent aimed at protecting the environment. These include the Code on Natural Resources and Subsurface Use, water, land, and business codes, as well as the Law of the Republic of Kazakhstan "On Energy Saving and Energy Efficiency Improvement". But they all operate according to the industry principle.

– During the discussion of the new version of the Environmental Code, a controversy arose between the environmental community and representatives of traditional sectors of the economy, metallurgists, who today consume about half of the electricity on traditional fuel-coal. What is the main contradiction? How did you manage to overcome it? Is there a consensus?

– In my opinion, large businesses have a common understanding of the need to improve the environment, because their families and children also breathe polluted air. Together with the entire population, they consume water into which harmful substances are discharged and feed on products grown on degraded land. Another problem is the costs of modernizing production and there is some cunning on their part when they tell that those costs are huge and unaffordable. The dispute was mainly about the trillion-dollar settlements made by manufacturers who, according to their vision, should have invested in BAT. However, after consistent explanations from both the environmental community and the Ministry of Ecology, the debate gradually died off. One of the well-reasoned arguments from nature defenders was that the fixed approach is a global trend, and, in case of rejection of the path to switch to "green rails", you will have to pay border tax when exporting to the EU.

Developed countries are currently discussing its size and terms of collection, as they have seriously taken up cross-border regulation on the non-admission of products with a large carbon footprint. And businesses just need to draw conclusions and honestly answer the main question, which is better: to modernize and be competitive, or to pay out of their margins and lose the dynamics of sustainable development? Defending their interests without taking into account the needs of the population and not considering the issue comprehensively is the thing of the past. After all, the code has radically changed regulatory approaches. And the world community is tightening the requirements for goods produced with the use of faulty technologies, and the environmental safety of the enterprise makes it competitive.

– What else could we do in the field of environmental policy? As the RK President Kassym-Zhomart Tokayev said, can we work "ahead of the others", and not to extinguish fires? What is needed for that?

– Today, environmental policy is one of the first items on the agenda in many countries that are trade and economic partners of Kazakhstan. We have joined the Paris Agreement, developed an Environmental Code, developed renewable energy sources, identified the "greening the economy" as one of the main principles of the new economic policy, and solved the issues to minimize air pollution in large cities. At the same time, when you observe the international experience in this area, it seems that we are still lagging behind and every time we try to catch up. I would like to note that before the adoption of the code, Kazakhstan did not carry out calculations on target indicators, and little attention was paid to an integrated approach involving all industry departments. The new code sets tasks for all state bodies.

The Concept of Kazakhstan’s transition to a green economy and the ISO 14001 (eco-management) standards should play a huge role in the proactive factor, and the Environmental Code allows us to combine all these requirements and standards. An innovation in it can also include a reference book on the best available technologies, as well as conclusions and data on them, on the basis of which comprehensive environmental permits will be issued. Thus, all of the above will be harmoniously subordinated to one goal – to reduce the impact on the environment, and the introduction of a "close-loop" economy will strengthen the achievement of this goal.

A closed-loop economy involves sharing products and buying services, rather than goods, in which materials are used multiple times and are designed to last a long time. All this time, Kazakhstan has used a linear economy: goods are still produced from raw materials and sold in the maximum possible quantities, and eventually thrown away. With the adoption of the Code, it is possible to reuse the material in the manufacture of homogeneous goods and at the end of the service life or at an intermediate stage, which will lead to a minimum reduction in the amount of waste. In turn, this will allow the maximum use of waste as raw materials and classify them by analogy with the European Union.

– The President of the Republic of Kazakhstan K. Tokayev, speaking at the summit on climate ambitions, announced that Kazakhstan will achieve carbon neutrality by 2060. What does this goal imply for our country? What consequences or transformations will it entail for the economy? Isn’t it too ambitious?

– The achievement of any goals, including ambitious ones, should be spelled out in the strategic document and an action plan is needed for its implementation. As I know, the Head of State noted that Kazakhstan will develop a long-term development strategy aimed at achieving the goal of "reducing emissions and decarbonizing the economy". Work has already begun in this direction. In support of these intentions, I would like to emphasize that the development of the Environmental Code incorporated the obligations defined by international treaties in the field of environmental protection and signed by Kazakhstan.

The Paris Agreement is given special attention in the code, so it provides for the reduction of not only harmful emissions, but also greenhouse gases, including measures to adapt the country’s population to climate change.

The great hope that many things will change in our country and we will be able to move from declarations to real improvement of the situation, is also connected with the Presidential Decree No. 520 of February 26. It clearly defines National priorities in three areas until 2025, all of which are directly related to the issue raised: "The well-being of citizens", "The quality of institutions" and "A strong economy". With clearly embroidered 10 tasks "Fair social policy", "New model of public administration", "Active development of economic and trade diplomacy", "Fair and efficient state", "Building a diversified and innovative economy", and etc. Paragraph 2 clearly identifies 18 achievability targets with specific 5 anti-corruption indicators.

– In your opinion, do the current youth understand that in 30-40 years they will live in a completely different world, will the behavioral imperative of the "consumer" society change? Or while ordinary public is far from it?

– The world is changing. The past year since the WHO declared the COVID-19 pandemic, in our view, has accelerated these changes. We are seeing the "greening" of the economies of the leading countries, the introduction of economic incentives, for example, such as the "carbon tax", and the policy of carbon neutrality. Today, it has become important not only how energy-efficient a particular electrical appliance is, but also with what resources a particular product was produced. The world is entering the stage of the so-called 4th energy transition, which consists in the widespread use of renewable energy sources and the displacement of fossil fuels.

I do not think that our young people are far from this, because not only we, but also other countries went through the process of awareness and pragmatic calculations until the end of the 90s of the XX century. Since the beginning of this millennium, a policy of economic development and sustained economic growth has been launched. In the course of subsequent research, it only became clear that such an approach does not solve the problems of the development of society. In this connection, it was found that rather deprives it of new opportunities, dooms it to technological degradation and leads to a decrease in the quality of life of people. The OECD, which includes economically developed countries, conceived of alternative approaches to this dilemma, and their results were proof of this. At the level of econometric models and the theory of economic cycles, there was a need to integrate approaches to ensuring economic growth. By creating new production capacities, increasing investment and consumption with environmental policies.

The realization of this fact served as the starting point for the development of the OECD Strategy for "a green growth" in the following years and the elaboration of its parametric and indicative tools, which, under the current leadership of the Organization, became a turn towards pragmatism, a responsible and conscious attitude to the future of humanity. Studies have shown that to do this, a

significant part of the proven hydrocarbon reserves should never be extracted and used as fuel: from the proven reserves of coal – 80%; natural gas – 50%; oil – 30%. The first country to announce the termination of the issuance of licenses for the exploration and development of new hydrocarbon deposits was France. All countries are required to reach the peak of GHG emissions in the shortest possible time and start their absolute reduction. At the same time, developed countries should immediately take action, since GHG emissions cause adverse climate changes for humans, i.e. they cause damage to them, so they have a price.

Currently, there are also trading exchanges in our country, and within the framework of the legislation, the Association is working on the development of a platform for trading quotas and carbon units. This is very important for Kazakhstan, because the initiative announced by Kassym-Jomart Tokayev to plant 2 billion trees can also contribute to the market, as it absorbs greenhouse gas emissions. Based on the fact that there is a concept of the social cost of emissions, and it has a quantitative estimate of $ 37 per ton of equivalent CO2 and predicts that by 2020 it will grow to $ 42, and by 2050 - to $ 69 per ton.

The issue of energy saving and the introduction of motivational approaches to the development of RES is very important. After all, as a result, reducing emissions into the atmosphere and low-carbon content for our country are becoming priorities.

We have good examples of investments in energy efficiency, renewable energy, and pollution reduction. The Burnoe Solar-2 project, an ambitious solar park, is a positive signal that private interest is emerging, despite the current high dependence on coal and oil. For example, as of January 1, 2017, there are about 50 enterprises operating in the country that use renewable energy with a total capacity of about 300 MW, the share of electricity generated in 2016 was 1%, but we need to strive for more.

I think that we are also aware of the challenges that hinder the full development of RES. It is the environment and infrastructure that have not become the key determinants of national development and the starting point for innovation. At the same time, everyone knows that more than 70% of electricity is generated on outdated equipment of coal-fired power plants, and the industry itself emits 80% of carbon dioxide into the atmosphere. Currently, there is an intensive process of converting the CHPP to gas and switching to green technologies, and I hope that it will be given momentum after the introduction of the Environmental Code and other priority programs initiated by the President.

– Do you plan to promote environmental issues among the general population at the state level? How can we ensure that our citizens’ attitude to nature is based on the principles of "do not pollute", "clean up after yourself", "save for children" and become part of the culture of our society?

The Association of Environmental Organizations of Kazakhstan is working to inform students, school students, and the public. Including teams of industrial enterprises to explain the problems of climate change. As I mentioned earlier, the Code sets out goals to prevent and reduce the adverse effects and damage caused by climate change on human health, ecological systems, society and the economy, to reduce vulnerability to climate change, and to take advantage of the opportunities associated with climate change. It should be noted that the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan has been discussing the draft code in all regions of Kazakhstan over a year. Significantly, the promotion of environmental issues among the general population is certainly necessary, but I would like to note that one needs to start with himself and with the family where the children grow up…

– Thank you for the interview!

KEY INDICATORS
CONCEPTS FOR THE TRANSITION OF THE REPUBLIC OF KAZAKHSTAN TO A "GREEN" ECONOMY

Sector	Goal description	2020	2030	2050
Water resources	Eliminating water supply deficit at the national level	Provide water to the population	Provide water for agriculture (by 2040)	Solve water supply problems finally
	Elimination of water scarcity at the basin level	The fastest possible coverage of the deficit for the basins as a whole (by 2025)	No shortage for each basin	
Agricultural industry	Labor productivity in agriculture	Three-fold magnification		
	Wheat yield (t/ha)	1,4	2,0	
	Water consumption for irrigation (m^3/t)	450	330	
Energy efficiency	Decrease in the energy intensity of GDP from the level of 2008	25% (10% by 2015)	30%	50%
Electric power industry	Share of alternative sources in electricity generation	Solar and wind: at least 3% by 2020	30%	50%
	Share of gas-fired power plants in electricity generation	20%[2]	25%	30%
	Gasification of the regions	Akmola and Karaganda regions	Northern and Eastern regions	
	Reduction of the current level of carbon dioxide emissions in the electric power industry	Level of 2012	-15%	-40%
Air pollution	Emissions of sulfur and nitrogen oxides into the environment		European emission level	
Waste disposal	Covering the population with the removal of solid household waste		100%	
	Sanitary waste storage		95%	
	Percentage of recycled waste		40%	50%

Source: Decree of the President of the Republic of Kazakhstan dated May 30, 2013. "On the Concept for the transition of the Republic of Kazakhstan to a "green economy"

[1] *Solar power plants, wind power plants, hydroelectric power plants, nuclear power plants*
[2] *With the transfer in the largest cities of thermal power plants to gas, if there are available volumes of gas and an acceptable price for gas.*

INTERVIEW

The Federal Republic of Germany occupies a leading position in the world in the use and implementation of "green energy". The Head of the Department Asia and Pacific region of The Konrad-Adenauer Foundation (KAS), Dr. Peter Hefele talks about the resources that make it possible to do this, and what are the prospects for development of renewable energy market in the country and the world.

Peter Hefele:

We must become a zero-carbon society during **100 years**

– Today Germany is one of the leading countries in the implementation of renewable energy sources. In the first half of 2020, the electricity generation from renewable energy sources in Germany reached the level of more than 56%. What processes and trends in the development of renewable energy sources are currently taking place in Germany?

– Progress has indeed been remarkable in terms of RE production capacities, mainly wind and solar. Yet, for the last two, three years we could observe a shift in priorities. The “Energiewende” (energy transition) is no longer solely about increasing capacities. It requires a cross-sectoral approach, the digitalization of distribution and consumption (“smart solutions”) and trans-border harmonization within the European common market. In the field of energy production, we will see two different developments: a scaling-up such as even larger off-shore wind production plants and small-scale distributed smart systems on the level of communes and households. Intelligent grid systems and storage solutions are key.

> *Starting from the 1960s we still have a strong ecological movement in Germany. Public awareness about environmental issues is high and got even more important in the context of climate change.*

As RES are becoming a major factor in global energy politics, Germany has to review its foreign relations and take into account massive disruptions and redistribution of power in a new era of geopolitics, which will be shaped by the effects of decarbonisation, too.

– In light of the development of RES, an important issue is the use of RES by population and households. Germany is also a leader in this area. What was the key to the development of small-scale renewable energy projects among the population: government support, high electricity tariffs or the "green" trend in general?

– Starting from the 1960s we still have a strong ecological movement in Germany. Public awareness about environmental issues is high and got even more important in the context of climate change. There is broad consensus across almost all political parties that there is no alternative to urgently decarbonize our way of producing and consuming energy (and other natural resources). So far people have been willing to shoulder the financial burdens which come along with this transformation and sum now up to 30 billion EUR per year. There is a whole range of subsidies and administrative measures to rapidly increase the installation and integration of RES into the existing grid system. But due to the high costs of this strategy, reforms had to be undertaken to introduce more market-based instruments and at lower costs. Other nations have carefully observed this policy approach and will not necessarily follow the same path.

– Recently in Germany, it was announced that by 2035-2038 the country will completely refuse the production of electricity from coal. Earlier, Germany also refused nuclear energy. In fact, this has shaped the global energy transition agenda toward greening the energy sector. What were the main reasons for such revolutionary decisions? How do you see the energy future in 2050 in your country and globally?

– From an outside perspective, the steps were taken during the so-called "Energiewende" (energy transition) seem quite revolutionary. But they are actually in line with a longer transition of our energy system. Starting from the late 1970s, Germany has introduced a lot of measures to increase energy efficiency and support the installation of RES power plants. The transformation has sped up in the last decade due to the phasing out of nuclear power plants, which will cease operations next years and can be seen as a reaction to the catastrophe of Fukushima 2011.

Against the background of the ambitious goals of reducing carbon dioxide emissions by 65 per cent in 2030, it became clear that only by shutting down coal-fired plants, this objective can be achieved. With this double phasing out of nuclear and coal, we have to reinvent our whole energy system. And of course, many questions remain, i.e. how to provide stable and affordable energy; how to harmonize this decision within the framework of a common European energy market; and how to integrate other sectors such as transport or industrial production into these disruptive developments. All nations will – sooner or later – face the same challenges, and Germany will be a global pathfinder in this endeavour.

Against the background of the ambitious goals of reducing carbon dioxide emissions by 65 per cent in 2030, it became clear that only by shutting down coal-fired plants, this objective can be achieved. With this double phasing out of nuclear and coal, we have to reinvent our whole energy system.

– Today, in the energy community, we can often hear the opinion that it is necessary to develop "clean coal" technologies, introduce carbon capture technologies and install powerful filters in traditional plants. To what extent can this direction of development of a sustainable economy compete with the development of green energy?

– The concept of Sustainability is much broader than the sole use of renewable energy. It includes other aspects such as circular economy or even a social balanced development as laid out in the UN Sustainable Development Goals SDG. Any transformation policy will create – at least in a short-term perspective – winners and losers. Fuel-based economies, such as Kazakhstan, are in particular exposed to such risks. There is a broad consensus that we should achieve a zero-carbon society in the course of this century. But the discussion about "clean coal" as an intermediary step shows that ways and means are heavily disputed. Some voices argue that any investment into coal-based solutions will only prolong the transformation process and resources should rather be completely shifted to RES from now on. Others point to the fact that for ecological and social reasons, coal will still remain the major source of energy and improvements in the production and use of coal will equally contribute to emission reductions and better environmental standards. In my opinion, Kazakhstan has to do both: exploiting its huge sources of RES and improve the use of fossil energy through higher efficiency.

– Thanks for the interview!

INTERVIEW

Johannes D. Rey:
Countries that depend on fossil fuels shouldn´t be the loser **of energy transformation**

The Konrad-Adenauer Foundation is one of the largest political foundations in Germany and is widely represented in many countries of the world, including Kazakhstan.The Foundation supports various initiatives in the field of education, culture and art. The Head of The Konrad-Adenauer Foundation in Kazakhstan, Johannes D. Rey talks about the work of the Foundation in an interview with the magazine.

– The Konrad-Adenauer Foundation is one of the largest political foundations in Germany and is widely represented in many countries of the world, including Kazakhstan. The Foundation supports various initiatives in the field of education, culture and art. Are the issues of sustainable economy and renewable energy on the agenda of the Foundation?

– Indeed, the Konrad-Adenauer-Stiftung (KAS) is in charge of over 200 projects in more than 120 countries. Our leitmotif is “Shaping.Democracy. Together”. We are committed to maintaining peace, freedom and justice through political education. We promote free democracy, the social market economy, and the development and consolidation of the value consensus. Within the social market economy, my Foundation addresses particularly environmental issues. Since Germany has dedicated itself to energy transition, green economy, renewable energy and sustainable development became one of our main topics. Our mutual project on the establishment of an international magazine like Qazaq Green is the visual proof of our commitment to eco-political issues.

– Today there are big changes in the economic paradigm of many countries: digitalization, greening of the economy, energy transformation, etc. You have worked in different countries, in your opinion, what is the most difficult part of this transition? What aspects, in your opinion, of the transition have now been most successfully implemented in our country?

– The most difficult part of any transition lies in the political challenge to persuade the people. They have to be won over by a convincing political case. Especially the countries that still depend on fossil fuels on a large scale shouldn´t be the loser of energy transformation. Transition needs time and has to be implemented thoughtfully, together with and not against the will of the people. Political education plays a decisive role in this case!

TRANSITION NEEDS TIME AND HAS TO BE IMPLEMENTED THOUGHTFULLY, TOGETHER WITH AND NOT AGAINST THE WILL OF THE PEOPLE. POLITICAL EDUCATION PLAYS A DECISIVE ROLE IN THIS CASE!

– It is no secret that today, due to the change in economic models in the light of the transition to a sustainable or "circular" economy, the social order, the behavioral imperative of a modern citizen are changing, many professions are leaving the labor market. What role does the younger generation play in the above processes?

– They play the key role undoubtably. Might I quote Desiderius Erasmus? “The main hope of a nation lies in the proper education of its youth.”

HENCE, THE MAIN TARGET GROUP OF OUR EDUCATION PROGRAMMES IS THE YOUTH. ADDITIONALLY, THE KAS GRANTS 40 SCHOLARSHIPS TO GIFTED STUDENTS EVERY YEAR AND PLANS TO START A WORK WITH SCHOOLS AND PUPILS.

– Many countries today are faced with the problem of confrontation between "green" and "brown". Some advocate "green" energy, environmental protection, responsible resource consumption, others, on the contrary, gravitate towards traditional energy sources (coal, gas, oil), say that the "green" course will lead to the closure of many industries, unemployment, decrease in the competitiveness of products. In your opinion, how to reach consensus?

– I have already answered the question basically. Mutual understanding of diverse initial situations of each country can only grow in a regular dialogue. There is no need for anyone to take the moral high ground. Even Germany has to proof if it can manage the transition period towards green economy without any social dislocations.

As I am new in your country, it is rather difficult for me to say ad hoc which aspects are running most successfully here. But from what I have seen so far, I would say that the government is taking the right steps to implement the transformation. The country is working systematically to improve the business environment and develop business activities; in 2015, Kazakhstan joined the World Trade Organization, this gave the country equal rights in foreign markets; the Strategic Development Plan until 2025 launched the processes of the Third Modernization of the country; other important reforms are announced and running. Among them the new Environmental Code. Unfortunately, the pandemic has brought its corrections to the country’s plans and Kazakhstan is likely to take a long time to recover from it according to expert estimates.

RESULTS

OF THE AUCTION FOR THE SELECTION OF RENEWABLE ENERGY PROJECTS IN 2020

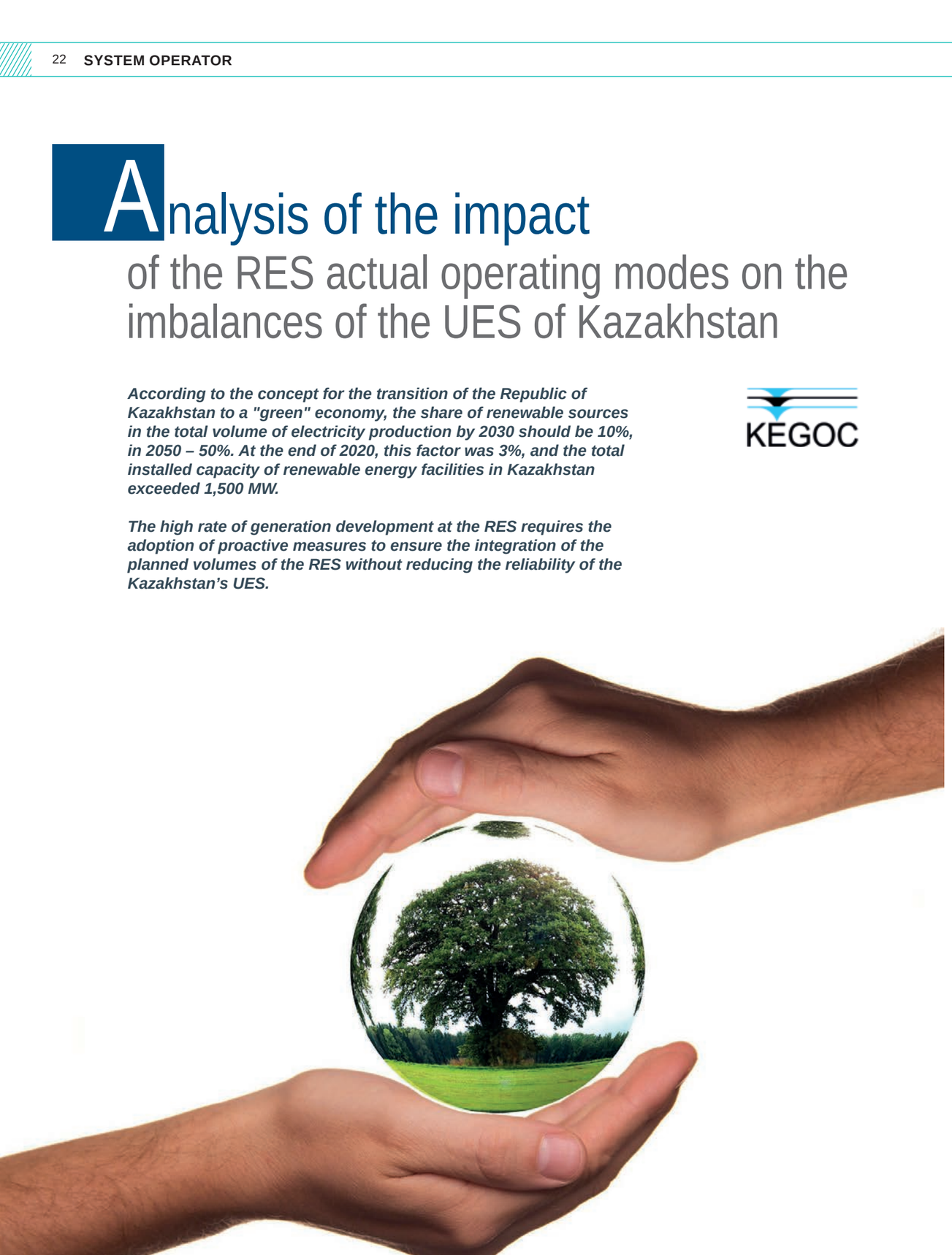
Date of the auction	Company name	Type of RES	Auction price tg/kWh (without VAT)	Installed capacity, MW
November 9, 2020	UBS POWER LLP (Kazakhstan)	HPP	13,48	1
	Jasyl quat LLP (Kazakhstan)		13,48	2
	TAUENERGO LLP (Kazakhstan)		14,98	2
	Altyn Esik Management Company LLP (Kazakhstan)		14,99	3
	Koksu-Kuat LLP ZHSHS (Kazakhstan)		15	4,5
	TAUENERGO LLP (Kazakhstan)		15,01	2
	Production cooperative "SEC "Yntymak" (Kazakhstan)		15,02	1,5
	DALA SOLAR LLP (Kazakhstan)		15,03	2
	MT & K Limited Liability Company (Kazakhstan)		15,2	5
November 10, 2020	UBS QZ LLP (Kazakhstan)	SPP	14,99	10
	UBS Solar LLP (Kazakhstan)		15,62	10
November 11, 2020	Greencity KZ LLP (Kazakhstan)	WPP	21.09	10
	Argest LLP (Kazakhstan)		21.53	4.95
November 23, 2020	The auction was declared invalid	BioPP	-	-
November 24, 2020	Eco Watt AKA LLP (Kazakhstan)	WPP	15.9	50
November 25, 2020	The auction was declared invalid	HPP		
December 8, 2020	HEVEL KAZAKHSTAN LLP (Russia)	SPP	14.58	20
December 10, 2020	HEVEL KAZAKHSTAN LLP (Russia)	SPP	16.96	20

Source: JSC KOREM

Analysis of the impact of the RES actual operating modes on the imbalances of the UES of Kazakhstan

According to the concept for the transition of the Republic of Kazakhstan to a "green" economy, the share of renewable sources in the total volume of electricity production by 2030 should be 10%, in 2050 – 50%. At the end of 2020, this factor was 3%, and the total installed capacity of renewable energy facilities in Kazakhstan exceeded 1,500 MW.

The high rate of generation development at the RES requires the adoption of proactive measures to ensure the integration of the planned volumes of the RES without reducing the reliability of the Kazakhstan's UES.



KEGOC JSC together with the USAID project's experts "Future Energy" conducted a study on the impact of the actual modes of renewable energy sources operation on the imbalances of the Kazakhstan's UES.

RESEARCH PERIMETER

The study covered 63 RES facilities with a total installed capacity of 1,250 MW (Table 1). There were analyzed the hourly, planned and actual generation of RES, the deviation of the balance of power flows at the border of the Northern and Western zones of the Kazakhstan's UES with the UES of Russia (imbalances of the Kazakhstan's UES) for 2020.

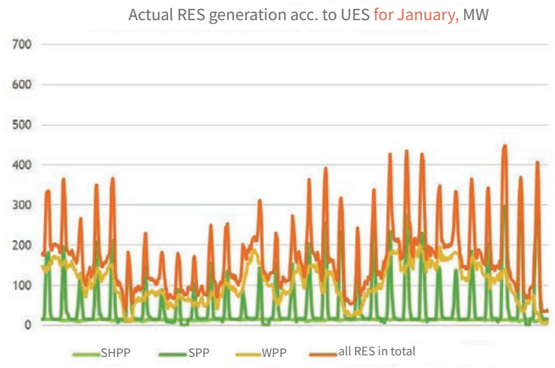
Northern Zone			Southern Zone			Western Zone		UES			
459			685			103		1248			
WPP	SPP	BioPP	WPP	SPP	SHPP	WPP	SPP	WPP	SPP	SHPP	BioPP
178	280	1	101	512	71	101	2	381	794	71	1

Table 1.
Installed capacity of RES facilities covered by the study [MW]:

The study was conducted according to the data of the AMRCS (Automated Meter Reading and Control System) and BEMS (Balancing Electricity Market Systems), that is, only the average hourly performance of RES and the power utility system was taken into account.

ASSESSMENT OF THE ACTUAL GENERATION BY RES FACILITIES

In 2020, the RES covered by the study produced 2,101 million kWh of electricity, with a planned production of 2,051 million kWh.
However, the profile of electricity generation by RES facilities during the period under review has a significant unevenness both in the context of days and in the context of months. Figure 1 shows the diagram of RES generation by type for the typical periods of the year (January, July). The maximum total peak capacity of all RES facilities was up to 700 MW (in May 2020), and the average base of RES generation in 2020 (guaranteed minimum total generation for all RES facilities) in the monthly context was 50 MW.



Maximum generation by type:
– SPP 367 MW
– WPP 200 MW
– SHPP 16,5 MW
Total for all RES: 447 MW

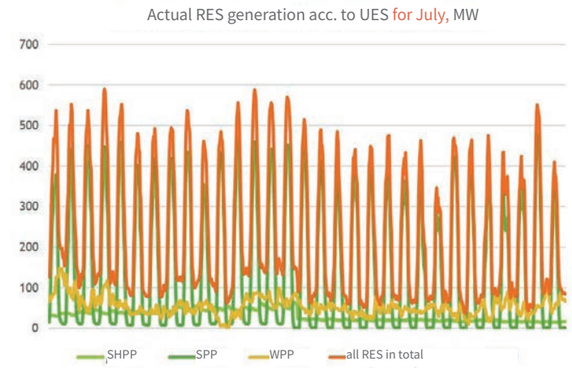


Figure 1.

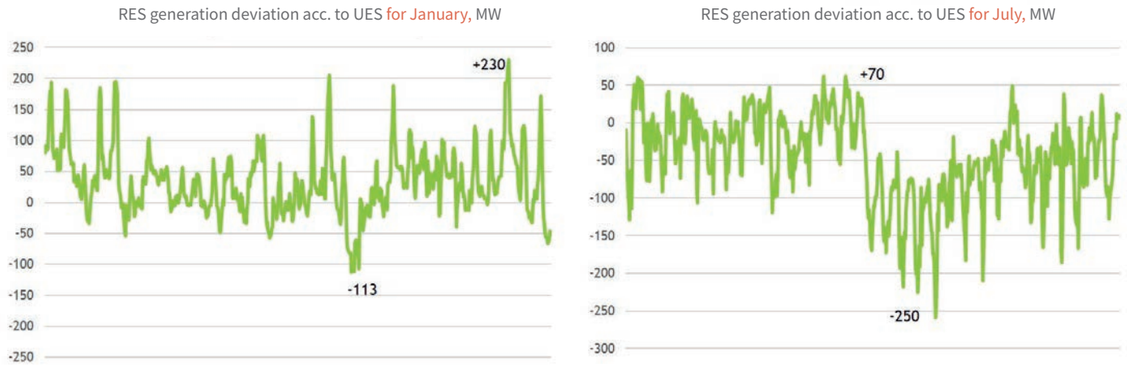
Maximum on by type:
– SPP 478 MW-
– WPP 148 MW
– SHPP 62 MW
Total for all RES: 590MW

ESTIMATION OF DEVIATIONS OF THE RES FACILITIES GENERATION FROM THE PLANNED VALUES

In accordance with the rules of the Kazakhstan wholesale electricity market, the subjects plan their regime day ahead. It is clear that in the context of the RES facilities, which generation is highly dependent on the flow of unstable solar and wind energy, planning is carried out with errors that lead to deviations of the actual generation of RES from the planned values on the operating day, which creates an additional imbalance of electricity production and consumption in the UES of Kazakhstan.

Figure 2 shows the diagrams of the total deviations of the actual RES generation from the plan for the typical periods of the year (January, July). As can be seen from the figure, with the maximum generation of RES in January of about 450 MW, the maximum deviations were up to 230 MW for re-processing of energy into the system and up to 113 MW for reduced production of electricity. In July, with the maximum generation of RES of about 600 MW maximum deviations were up to 102 MW for re-processing of energy into the system and up to 250 MW – for reduced production of electricity.
In the annual context, the range of deviations of RES generation from the plan was about ± 250 MW, the average values of deviations in the range of 200 MW for reduced production of electricity and up to 150 MW for re-processing. In relative terms, the deviation of RES generation from the plan was on average up to 30%.

Figure 2



Note: positive values of deviations mean that the actual generation of RES exceeds the planned values (unplanned delivery of electricity to the power system).

Due to the lack of flexibility of generation in the UES of Kazakhstan, due to the high share of low-maneuverable coal generation, and the lack of regulatory capacity, the attracted regulatory resources are not enough to fully compensate for the unstable generation of renewable energy sources and deviations of the regime of other market participants. The imbalances of the UES of Kazakhstan that are not covered at the expense of its own resources are compensated by the Russian energy system (in the form of unplanned balances of power flows at the borders of the two energy systems).
Further, studying the impact of RES on the UES regimes of Kazakhstan, work was carried out to determine the share of RES imbalances in the total imbalance of the UES of Kazakhstan, which is not covered by its own sources of regulation. Methodologically, the calculation was made as follows. Based on the readings of the AMRCS system for each hour of 2020, an unplanned balance of power flow at the border of the UES of Kazakhstan and the UES of Russia was determined, without taking into account flows from the UES of the Central Asia (the own imbalance of the UES of Kazakhstan). Also, the total difference between the actual and planned generation of the RES facilities (the imbalance of RES) was determined by the AMRCS and, accordingly, the share of RES imbalances in the total imbalance of the UES of Kazakhstan was calculated.

The results of this part of the study for the characteristic periods of the year (January, July) are shown in Figure 3. On average, in 2020, the deviations of renewable energy generation in the overall imbalance covered by the UES of Russia amounted to 20%. In some months, the share of non-balances of renewable energy sources in the total deviations of the UES of Kazakhstan reached a value of up to 30%. It is important to note that in accordance with the agreement on the parallel operation of the energy systems of Kazakhstan and the technologically permissible deviation of the balance of power flows along the borders of the UES of Kazakhstan and the UES of Russia from the planned values is ±150 MW, and the deviations of RES, even without taking into account the imbalances of other power system subjects, exceed the permissible value.

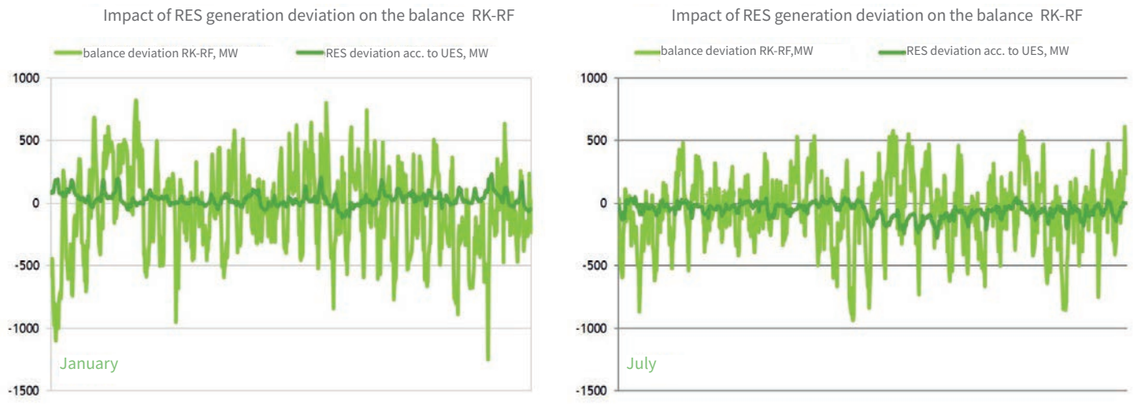


Figure 3

REGULATION OF THE RES FACILITIES

To ensure the reliability of energy supply to consumers, the reliability of the operation of the UES of Kazakhstan as a whole, the instability of renewable energy generation should be compensated by attracting the regulatory capabilities of the energy system.
Such regulation is carried out, starting from the planning of modes for the day ahead, and up to the regulation in real time on the operating day.

Figure 4 illustrates the basic, that is, at the planning stage for the day ahead, regulation of renewable energy sources (for example, one day on January 27, 2021). As you can see, in the daytime, when the share of SPP generation is high, customary power plants are regularly unloaded, and after 16 hours, as

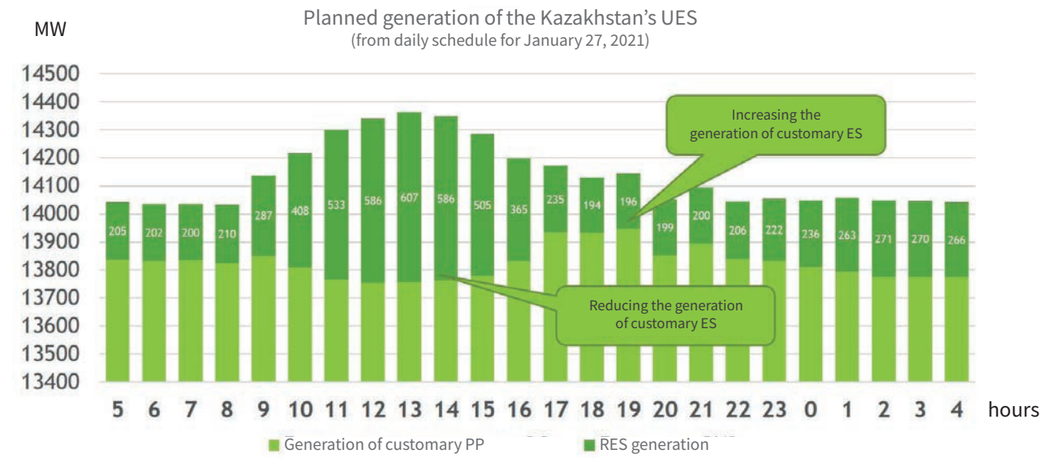
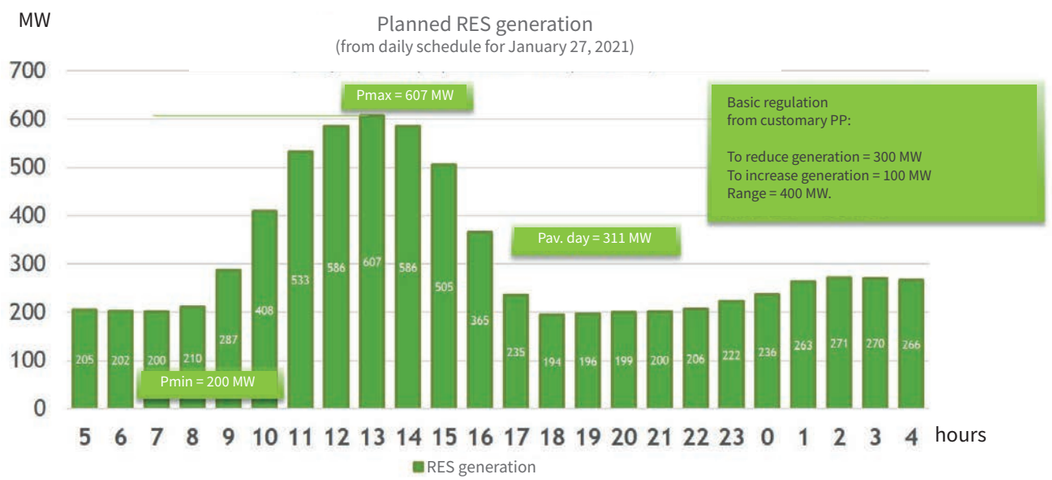


Figure 4

the natural generation of SPP decreases, customary power plants regularly replace the retired SPP generation.

Figure 5 shows the planned schedule of the RES generation (based on the example of one day on January 27, 2021). As you can see, the average hourly generation is about 300 MW, with a maximum of 600 MW and a minimum of 200 MW. Accordingly, the full integration of planned generation of RES

Figure 5



into the daily schedule required an increase in the number of customary power plants by 300 during the day MW and a reduction of 100 MW. That is, the attracted range of basic regulation at the planning stage was 400 MW.

Also, during the operating day, the system operator uses all the possibilities of regulation, giving commands for loading and unloading power plants. For example, the range of use of the reserve at epy Bukhtarminskaya HPP, in the context of the day, can be 400 MW, Moinak HPP – 200 MW, Ekibastuz GRES-1 – 200 MW. Other power plants are also used, if there is a reserve. However, as mentioned above, the available regulatory resources are not sufficient to fully compensate for the existing imbalances in the UES of Kazakhstan, which leads to the involvement of Russian regulation.

RESULTS OF THE STUDY

Let us briefly summarize the results of the study.

- The base of renewable energy generation is 50 MW with an installed capacity of 1,250 MW.
- The peak of generation in total for all RES facilities at the end of 2020 was 700 MW.
- The required volume of regulation of the operation of RES is 650 MW (for 2 MW of the installed capacity of RES – 1 MW of regulation).
- The basic regulation involved (at the planning stage) is about 400 MW.
- The amount of the required reserve to compensate for deviations of RES from the planned generation is not less than ±250 MW.

Institutional measures

- Introduction of a balancing electricity market
- Gradual increase in the share of spot trades "day ahead"
- Development of the auxiliary services market (stations, adjacent power systems, Demand Response)

System flexibility

- Construction of a new regulating capacity (gas + large hydroelectric power plants)
- Maximum development of the ALFC system

Digitalization

- Launch of pilot projects on the possibilities of using storage systems
- Research and modeling of the impact of RES on the Unified Energy System of the Republic of Kazakhstan
- Engaging Consumers in Regulation (Demand Response Research)
- Technical and economic dispatching of the production schedule
- Reducing the planning horizon from a day to 12 hours – 6 hours – 1 hour

Renewable energy

- Fixing the obligation for forecast and responsibility of RES for deviations
- Development of wind and solar generation through project auctions and RES zones
- Changing approaches to auction bidding (buying at certain hours, buying in a certain volume)

Of course, this list is not exhaustive and was mostly presented as possible options. What activities should be started with and how they should be implemented are, of course, open questions. We expect that market participants will be active and offer their options, which will also be widely discussed and considered

We are convinced that all market participants, including RES representatives, are interested in solving the problems of integrating renewable energy variables and maintaining the stability of the Unified Electric Power System of Kazakhstan.

АУЭС
NJSC Almaty University of Power Engineering and Telecommunications named Gumarbek Daukeyev

Carrying on the glorious traditions of AUPET

Rasim Nigmatullin,
Head of Training and Research Laboratory, Ph.D In Engieering Science, Assistant professor of Power Supply and Renewable Energy Sources Department, Gumar Daukeyev Almaty University of Energy and Communcation

Kazakhstan has significant reserves of fossil fuels, which account for about 4% of the world's total reserves. Therefore, the energy sector is one of the most developed sectors of the economy of Kazakhstan. In addition, it should be noted that our country also has significant renewable energy resources in the form of solar energy, wind energy, hydropower and renewable biomass reserves.
Bright sun shines 300 days a year across much of Kazakhstan, and luminous power is on average up to 1000 watts per square meter of the earth's surface. In this regard, Kazakhstan is considered as one of the most suitable countries in the world for use of solar energy.

Kazakhstan is located in the northern hemisphere. Quite strong air currents are observed across much of Kazakhstan, mainly in the North-eastern, South-western directions. The average annual wind speed is more than 6 m/s, which makes these areas attractive for the development of wind energy. According to experts, only potential of solar energy in our country is about 1500-1600 kwh/m2 per year, and the wind potential is estimated at 1820 billion kWh per year.

1996. Installation of solar-wind plant to supply power to facility of Kozhakazgan settlement, Kyzylorda region. The customer is Kazakhtelecom JSC.

2006, CPP VRTB -2.6 on the site of Kazakhtelecom JSC, Azhar settlement, simultaneously supplies power to the electronic equipment of the school, and the Internet.

Development of renewable energy in Kazakhstan and AUPET

It is necessary to note an important date for the development of renewable energy in Kazakhstan - July 4, 2009. It was on this day that the Law of the Republic of Kazakhstan "On support for use of Renewable Energy Sources" was adopted for the first time and the progressive development of the renewable energy sector in our country began.

The Expo-2017 exhibition, held in Astana, defined a new vector in development of energy industry of the Republic of Kazakhstan, aimed at decarbonizing the energy sector and developing "green" technologies.

Following the global trend of gradual transition to renewable energy sources, AUPET is gradually increasing its scientific and educational potential for development of this area. Thus, in 2018, AUPET became the first university in the Central Asian region to become the basic training center of the project under the management of "Tetra Tech Kazakhstan" for development of solar and wind energy. "Tetra Tech Kazakhstan" opened its representative office in the university and provided assistance in conducting seminars and training courses, provided financial assistance in purchasing complete equipment for mini solar and wind power plants and licensed software.

Renewable Energy Education Program

In 2020, employees of Department of Power Supply and Renewable Energy (Soltanayev A. M., Tergemes K. T., Arystanov N. N., Nigmatullin R. M.) together with partner enterprises developed a pilot Educational program "Modern and innovative technologies of renewable energy" for bachelors and undergraduates and first students have already started their studies this year under this program. This educational program is intended to prepare the right human resources for green energy in our country, having appropriate skills for a wide range of requirements of the developing energy industry in the Republic of Kazakhstan and abroad. Training of specialists having special knowledge in this field is very important

for integration of clean and affordable energy technologies into the country's energy sector. After completing the new program, the graduates will know the principles of converting solar energy into electrical and thermal energy, solar power and heat supply systems with calculation of parameters and control schemes for technological processes. They will know how to install, commission and operate the installations. In on-site training of students, the latest educational and laboratory installations are used, such as "Solar photovoltaic system with an uninterruptible power supply system", physical simulators of installations operating autonomously and online.

Almaty University of Power Engineering and Telecommunications strongly supports the state policy of training engineering personnel in demand for energy sector of the Republic of Kazakhstan and in October 2020, together with USAID, opened a training and research laboratory "Renewable energy sources and Energy Preservation" in laboratory facilities of Power supply and Renewable Energy Source Faculty.

Opening of Training and Research Laboratory (TRL) provides an opportunity for students, undergraduates and doctoral candidates at existing mini Solar and Wind power plants to improve their skills and technical expertise, gain access to educational resources and scientific research of partner companies, and give teachers the opportunity to exchange experience and improve the level of teaching in the new Educational Program on Renewable energy sources.

Establishment of TRL "RES and Energy Conservation" will allow training of highly-employable, qualified specialists in installation, commissioning and operation of renewable, "green" energy facilities, as well as improving skills of undergraduates, doctoral candidates and teachers to satisfy demands of new industrial and technological reality, which brings the automation of technological processes of generation and consumption of energy to the forefront.

For further development of areas related to use of renewable energy, it is planned to create a "Renewable Energy" landfill at the AUPET. This training area will use a 10 kW roof solar power plant (SPP), a 5+4 kW wind-solar combined power plant, a coherent Doppler lidar for monitoring wind conditions, and other modern equipment.

> *For further development of areas related to use of renewable energy, it is planned to create a "Renewable Energy" landfill at the AUPET.*

AUPET experience in development of first renewable energy projects in the Republic of Kazakhstan

Authors:
Bolotov Albert Vasilyevich,
Novokshenov Vladimir Stepanovich, Bakenov Kairat Asangaliyevich

As leader of Kazakhstan's system of training the technical specialists for energy sector, AUPET always sets long-term goals in terms of systematic training of specialists for national and multinational companies of the Republic of Kazakhstan. Over the past 20 years, under the leadership of the founder and first rector of the Alma-Ata Energy Institute (now AUPET), Albert V. Bolotov, several significant projects for construction of wind power plants have been successfully implemented at Industrial Power Supply Faculty (now Power supply and Renewable Energy Source Faculty). For example, a 40 kW wind power plant was built on the Talgar mountain crossing in Almaty region, as well as a 10 kW wind power plant near Zhana-Korgan in Kyzylorda region, and many others. Below are the works performed at the faculty with a brief description of the projects:

Cape Chelyuskin Lighthouse, the Arctic Ocean. Maintenance of Bolotov VRTB-2 CPP combined with photovoltaic panels for the Russian light-beacon system.

РЕСПУБЛИКА КАЗАХСТАН
(19) KZ (B) (11) 3355
(51)⁷ F 03 D 3/04,11/04

НАЦИОНАЛЬНОЕ ПАТЕНТНОЕ ВЕДОМСТВО РЕСПУБЛИКИ КАЗАХСТАН

ОПИСАНИЕ ИЗОБРЕТЕНИЯ
К ПАТЕНТУ

(21) 940647.1
(22) 16.06.1994
(45) 15.06.1999, бюл. № 6
(64) № (A) KZ, 3355, 10.06.1996, бюл. № 2
(76) Болотов Альберт Васильевич, Низовцев Валентин Михайлович
(56) А. с. СССР № 1204777, кл. F 03 D 3/04, 1984
(54) ВИНДРОТОРНАЯ ЭЛЕКТРОСТАНЦИЯ БОНИ-В
(57) Изобретение относится к ветроэнергетике и может найти применение для автономного энергоснабжения объектов и выработки электроэнергии в общую энергосистему.

Для повышения коэффициента использования энергии ветра и снижения капитальных затрат, вертикальный модульный виндротор с оптимальными параметрами проточной части и объемными лопатками совмещен с дуговыми направляющими аппаратами, имеющими электрические пластины, а генераторная часть состоит из электрогенераторов с разгонными муфтами и электронного преобразователя энергии и располагается вне виндротора. Варианты предусматривают способы установки и подвески ветроэлектростанции.

1993
- Applications for patents of the Republic of Kazakhstan were filed Windrotor power plant "Boni". Alternator

РЕСПУБЛИКА КАЗАХСТАН
(19) KZ (13) A4 (11) 25701
(51) *H02K 1/27* (2011.01)
H02N 1/00 (2011.01)
H02K 19/16 (2011.01)

КОМИТЕТ ПО ПРАВАМ ИНТЕЛЛЕКТУАЛЬНОЙ СОБСТВЕННОСТИ МИНИСТЕРСТВА ЮСТИЦИИ РЕСПУБЛИКИ КАЗАХСТАН

ОПИСАНИЕ ИЗОБРЕТЕНИЯ
К ИННОВАЦИОННОМУ ПАТЕНТУ

(21) 2010/1370.1
(22) 09.11.2010
(45) 16.04.2012, бюл. № 4
(76) Болотов Альберт Васильевич (KZ); Бакенов Кайрат Асангалиевич (KZ); Белоусов Сергей Альбертович (RU)
(56) Предварительный патент РК № 8066, кл. H02N 1/00, H02K 19/16, 1999
(54) ВЕНТИЛЬНЫЙ ГЕНЕРАТОР С КОММУТИРУЕМЫМ ВЫПРЯМИТЕЛЕМ (ВАРИАНТЫ)
(57) Изобретение относится к области электротехники, а именно, к вентильным генераторам, которые используются в источниках питания с нерегулируемой частотой вращения ротора генератора ветроэлектростанции, гидроэлектростанции, микрогенераторе. Предлагаемый вентильный генератор поддерживает заданную величину напряжения при широком диапазоне изменения скорости вращения ротора и имеет высокую точность поддержания напряжения на малых, средних и высоких оборотах ротора, при максимальном значении выходной мощности. Поставленная цель достигается путем выполнения обмотки якоря из нескольких параллельных ветвей, которые подключаются к схему выпрямителя. В зависимости от частоты вращения, генерируемые вентильные блоки коммутируются последовательно или параллельно, что позволяет суммировать напряжение последовательно включенных блоков, тем самым увеличивать напряжение на выходе.

РЕСПУБЛИКА КАЗАХСТАН
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ПАТЕНТНОЕ ВЕДОМСТВО РЕСПУБЛИКИ КАЗАХСТАН

ОПИСАНИЕ ИЗОБРЕТЕНИЯ
К ПАТЕНТУ

(21) 971116.1
(22) 24.12.1997
(45) 15.12.2003, бюл. № 12
(64) KZ (A) 8086, 15.10.1999, бюл. 10
(76) Болотов Альберт Васильевич; Новожанцев Владимир Степанович; Газиз Евгений Федорович; Бакенов Кайрат Асангалиевич
(56) Авторское свидетельство СССР № 1234928, кл. H 02N 24/12, 1986.
(54) ВЕНТИЛЬНЫЙ ГЕНЕРАТОР
(57) Изобретение относится к области электротехники, а именно, к вентильным генераторам, которые используются в источниках питания с нерегулируемой частотой вращения ротора генератора. Техническим результатом является обеспечение постоянного напряжения на выходах вентильного генератора при широком изменении частоты вращения ротора и нагрузки.
Это достигается тем, что в вентильном генераторе по первому варианту, содержащем несколько вентильных блоков, каждый из которых включает последовательно соединенные "m"-фазный выпрямитель, подключенный к одной из параллельных ветвей многофазной обмотки, выходы выпрямителей подключены параллельно к сети постоянного тока через полупроводниковые элементы, включенные в прямом направлении, кроме выходов крайних блоков, подключенных к сети непосредственно, между вспомогательными выходами предыдущих блоков и отрицательным выходом последнего блока включены коммутирующие элементы, а фазы параллельных ветвей первой обмотки соединены "звездой" или "многоугольником". Такой генератор может иметь дополнительную вторую обмотку, причем обе обмотки выполнены из "m"-фазных параллельных ветвей по одинаковое напряжение, сумма которых равна числу вентильных блоков, причем фазы одной обмотки соединены "звездой", а другой - "многоугольником".
Во втором варианте генератора каждый вентильный блок имеет дополнительно второй полупроводниковый выпрямитель, а в третьем варианте в вентильном генераторе, включающем признаки первого или второго вариантов, "m"-фазная обмотка якоря разделена на "N" групп, где N =m/K - целое число, K - число вентильных блоков в группе.

Graduates of AUPET successfully find jobs not only in Kazakhstan, but also in Russia, the European Union, the United States, the United Kingdom, Canada, and Israel. We, the first graduates of our university, are optimistic and confident about the future, continuing the glorious traditions of successful development of our university, passing on our rich experience and accumulated knowledge to the young and talented generation of our students, undergraduates and doctoral candidates.

Albert Vasilyevich Bolotov (15.09.1934-24.01.2021) – was a Kazakh scientist and inventor, the first rector of the Alma-Ata Energy Institute. Albert Vassilyevich is the inventor of a unique wind turbine, the first creator of wind energy sources in Kazakhstan, the author of more than 400 scientific articles and 106 copyright certificates for inventions. His passing away is a significant loss for the scientific and engineering community of Kazakhstan. The Solar Power Association of Qazaqstan expresses its condolences to the family and friends of Albert Vassilyevich.

New environmental Code: what to expect?

unicase

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On January 2nd, 2021, the President of the Republic of Kazakhstan signed a new Code: the Environmental Code of the Republic of Kazakhstan (hereinafter referred to as the Code) to introduce new mechanisms for environmental protection. The Code was under development for over 7 years, during which the working groups as well as the representatives of society made proposals and amendments. The adoption of the Code introduced amendments to the Tax Code and the Law On Permits and Notifications.

This publication focuses on general environmental regulation, waste management, implementation of best available techniques, and environmental impact assessments. The legislation comes into effect on July 1st, 2021, with the exception of some transitional provisions specified in article 418 of the Code.

According to the Ministry of Ecology, Geology and Natural Resources, the adoption of the Code will lead to a need for significant investments in order to introduce the best available techniques (BAT). The volume of these investments will become clear once the appropriate technical audit is carried out.

One of the major amendments to the Code included the addition of a specific description of the environmental regulation principles. The basic principles stated in Article 5 of the Code are:

- **The precautionary principle,** according to which the lack of certainty should not be a reason for the refusal to accept or postponement of taking effective and proportionate measures aimed at preventing the risk of causing significant and irreversible damage to the environment.

- **The principle of prevention and control,** according to which it is necessary to prevent and control environmental pollution, using the best available technologies at an economically reasonable price. It is proposed to amend the Entrepreneurial Code, in terms of conducting fact checks directly affecting the living conditions of the population.

- **The "polluter pays"** principle includes pollution prevention and control measures, but also dictates a responsibility to recover from environmental damage.

- **The principle of integration,** according to which achieving sustainable development of the state and environmental protection are an integral part of such development and cannot be considered in isolation from it (an example of one of the tools for implementing this principle is strategic environmental assessment).

- **The principle of public participation and involvement,** which requires the public to have access to environmental information, including data on hazardous substances and activities. According to this principle, the public shall be involved in the processes associated with the implementation of projects that have a significant impact on the environment (including when negotiating settlements, production facilities, roads, etc.).

The need to update the previous Code so that it is in line with international conventions and legislation of OECD/EU countries resulted in the introduction of the following new terms: waste, waste prevention, waste collection, waste accumulation, waste transportation, and landfill. Thus, the current Environmental Code replaced the concept of "temporary storage of waste" with that of "waste accumulation". Unlike temporary waste storage, waste accumulation involves the temporary storage of waste not only at the point of generation, but also at the facility where it will be subject to disposal or recovery operations. Thus, it infers that not only those who generated the waste but also the subjects who transported the waste to their facilities for disposal or recovery are entitled to accumulate waste.

> ***The concept of "waste collection" is defined as follows: the activity of organized reception of waste from individuals and legal entities by specialized organizations to further direct such waste for recovery or disposal.***

The concept of "waste collection" is defined as follows: the activity of organized reception of waste from individuals and legal entities by specialized organizations to further direct such waste for recovery or disposal. People carrying out waste collection operations shall ensure separate waste collection under the requirements provided by the Code and the authorized body.

The Code specifically introduced the separate collection of certain waste, divided into the following categories:

1) "dry" (paper, cardboard, metal, plastic, and glass); and

2) "wet" (food waste, organic matter, and others).

Best Available Techniques (BAT)

According to Article 113.1 of the Code, the best available technique is the most effective and advanced stage in the development of activities and methods of operation, which indicates the practical suitability in order to serve as the basis for the establishment of technological standards and other environmental conditions aimed at preventing or, if it is practically impossible, minimising the negative anthropogenic impact on the environment.

The Code gives a clear definition of what the best available technique really is:

a. 'techniques' does not only mean the technologies used but also the methods, processes, practices, approaches that apply to the design, construction, maintenance, operation, management and decommissioning of the facility;

b. 'available techniques' means those developments which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside Kazakhstan, as long as they are reasonably accessible to the operator;

c. 'best' means most effective in achieving a high general level of protection of the environment as a whole.

According to Article 113.3, the best available techniques are determined based on a combination of the following criteria:

1) the use of low-waste technology;
2) the use of less hazardous substances;
3) the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate;
4) comparable processes, facilities or methods of operation which have been tried with success on an industrial scale;
5) technological advances and changes in scientific knowledge and understanding;
6) the nature, effects and volume of the emissions concerned;
7) the commissioning dates for new or existing installations;
8) the length of time needed to introduce the best available technique;
9) the consumption and nature of raw materials (including water) used in the process and energy efficiency;
10) the need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it;
11) the need to prevent accidents and to minimize the consequences for the environment;
12) information published by public international organisations;
13) industrial implementation at two or more facilities in the Republic of Kazakhstan or abroad.

The Code also provides that the facilities of the first categories are subject to obtain integrated environmental permits. An integrated permit is a single document granting authorisation to operate all or part of an installation in a manner that guarantees that the activities carried out using the best available technologies and emission standards.

The Government is employing a "carrot and stick" approach by stimulating the new operators of facilities by exempting them from emissions payments. The same mechanism is envisaged for operating enterprises, but in order to be exempted from emissions payments, they need to develop and implement a program to improve environmental efficiency and introduce the best available techniques. However, if the enterprise decides not to use BAT, they will pay increased emissions payment.

By 2023, it is planned to develop the industry-specific BAT Guide which will be based on a comprehensive technology audit. Subsequently, in accordance with the Guide, from 2024 to 2025, it is scheduled to issue integrated environmental permits.

Reformed Procedure on the Environmental Impact Assessment (EIA)

One of the changes in the new Code is mandatory conduction of an environmental impact assessment for all types of economic and other activities that may have a direct or indirect impact on the environment and public health.

What are the main differences between the old and reformed procedure?

Old procedure

- All Categories (I–IV) were required to conduct the EIA.
- Public participation was required only at the first stage of the EIA.
- The local municipality was the sole decision-maker.

Reformed procedure

Conduction of the EIA will become mandatory only for enterprises activity of Category I.

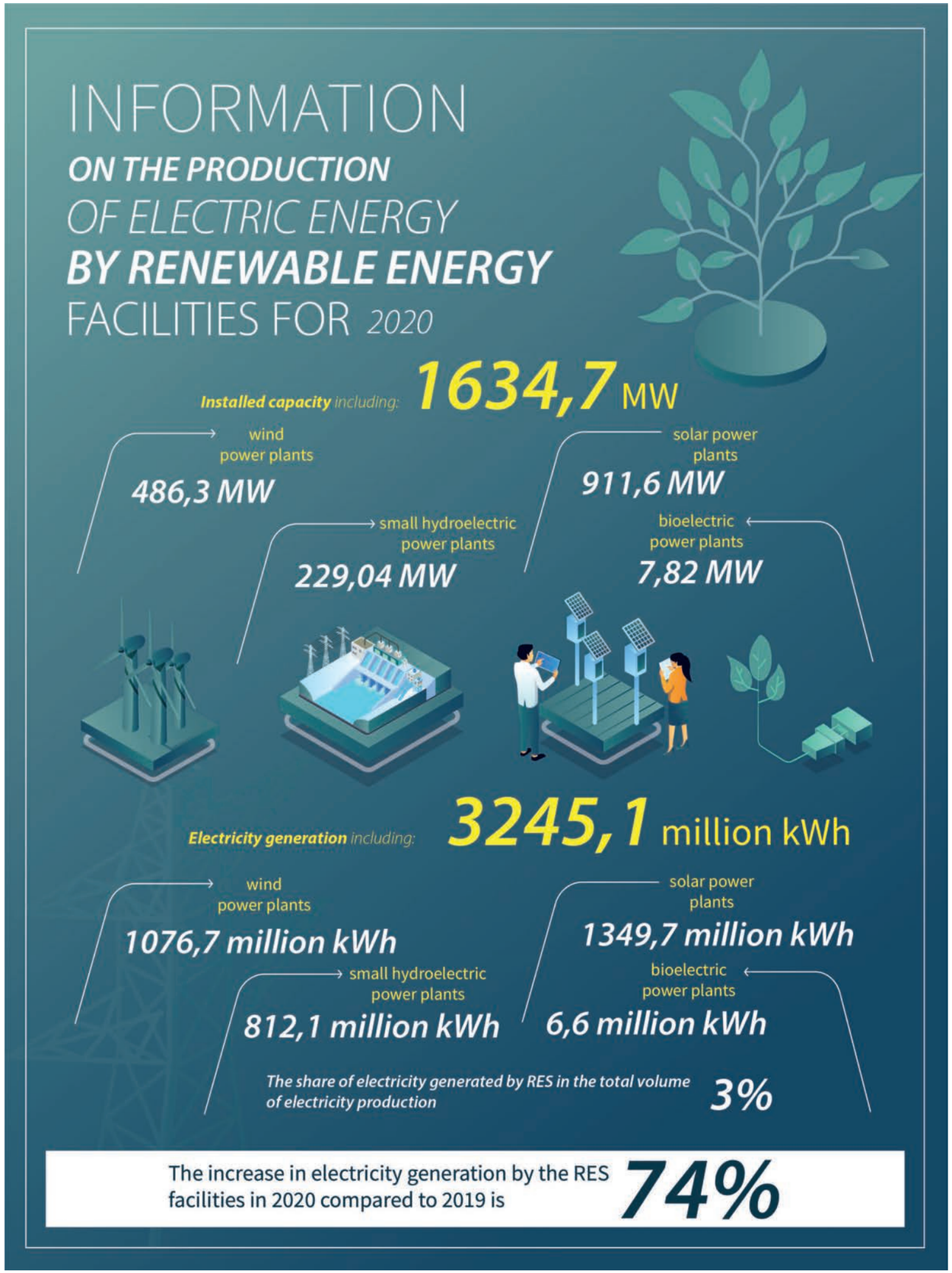
- Objects of Category II will be obliged to have a screening procedure and Category III to notification procedure, for objects of Category IV the conduction of the EIA is not required, and can be done voluntarily.
- Public participation will now be considered at every stage of the EIA. The role of the interested public when making decisions has been strengthened.
- Introduction of the Institute of Peer Review of the EIA: each stage of the EIA, from the submission of the application to the completion of the procedure, will be covered on the websites of the authorised ministry, as well as local municipalities and the media.

In accordance with Article 67 of the Code the following steps are required to obtain the EIA:

1) Consideration of the application regarding the planned project to determine its compliance with the requirements of this Code, as well as screening the impact of the planned activity (except for the entities that are not stated under Schedule 1 section 1);
2) Determining the scope of the EIA;
3) Preparation of the report on possible impacts;
4) Assessing the quality of the report on possible impacts;
5) Making an opinion on the results of environmental impact assessment and its accounting;
6) Post-project analysis of the actual impact during the implementation of the activity, if the necessity to do so is determined in accordance with this Code.

Amendments to the Code also had an impact on entrepreneurship. The performance of work (provision of services) for the processing, neutralization, utilization, and/or destruction of hazardous waste will require a specific license. However, the licensing requirement will not apply to entrepreneurs performing this work if it concerns waste generated by their own activities.
Business entities planning or carrying out entrepreneurial activities for the collection, sorting, transportation, recovery, and/or destruction of non-hazardous waste shall submit a notice at the beginning and termination of such activities to the authorized body in the manner established by the Law of the Republic of Kazakhstan On Permits and Notifications.

The new Environmental Code is a promising tool to combat and control the level of industrial emissions and to prevent catastrophic incidents in the facilities. It will keep entities accountable for the damage caused to the environment.



7 BASIC PRINCIPLES OF THE NEW ENVIRONMENTAL CODE OF THE REPUBLIC OF KAZAKHSTAN

THE FIRST PRINCIPLE IS
THE POLLUTER PAYS AND CORRECTS

1. It implies pollution prevention and control measures, but also responsibility for recovery from environmental damage. Thus, the state should create such conditions under which it is more profitable for nature users to take measures to prevent negative impacts on the environment than to pay environmental fines. In a word, the mechanism of "prevention". In addition, the polluter who has caused environmental damage is obliged to r estore the environment to its original level.

THE SECOND PRINCIPLE IS
NEW APPROACHES TO ENVIRONMENTAL IMPACT ASSESSMENT

2. According to the current Environmental Code, the requirement to pass the environmental impact assessment procedure (EIA) applies to almost all, that is, 19 thousand enterprises. Such an approach is ineffective and impractical. Therefore, the new Environmental Code proposes to apply this requirement only to 2.6 thousand enterprises of the "first category", which account for 80% of emissions. At the same time, the public participates in all stages of the EIA.

THE THIRD PRINCIPLE IS
THE INTRODUCTION OF THE BEST AVAILABLE TECHNOLOGIES (BAT) AND ECONOMIC INCENTIVES

3. To maximize the environmental situation, it is necessary to implement the best available technologies. For this purpose, industrial enterprises undergo a technological audit. They are offered technologies that will reduce emissions. Enterprises that have implemented BAT will be exempt from emission fees. If they do not switch to BAT, their emission fee rates will increase.

4. At present, the current legislation does not require spending on environmental protection measures of funds received from payments for emissions into the environment. Therefore, local executive bodies allocate from 0 to 400% for environmental protection, on average 45% only. The current situation with environmental payments and their spending has been repeatedly criticized by international experts. In this regard, the draft accompanying law provides for mandatory financing of environmental protection measures at the expense of incoming environmental payments in the amount of 100%.

THE FOURTH PRINCIPLE IS
TO DIRECT THE PAYMENT FOR EMISSIONS TO ENVIRONMENTAL MEASURES

5. In order to obtain timely and reliable information on the qualitative and quantitative composition of emissions and discharges, the draft Environmental Code provides for mandatory automation of industrial environmental monitoring with data transmission to the authorized body.

THE FIFTH PRINCIPLE IS
THE CREATION OF AN AUTOMATED EMISSION MONITORING SYSTEM

THE SIXTH PRINCIPLE IS
TO STRENGTHEN ENVIRONMENTAL CONTROL

6. The draft accompanying law proposes to amend the Entrepreneurial Code in terms of conducting inspections on facts directly affecting the living conditions of the population. These changes are aimed at rapid response to the facts of negative impact on the environment. The responsibility for environmental offenses is strengthened by increasing administrative fines by 10 times.

THE SEVENTH PRINCIPLE IS
TO IMPROVE THE MANAGEMENT OF PRODUCTION AND CONSUMPTION WASTE

7. The draft of the new Environmental Code focuses on the implementation of the principles of circular economy used in the OECD countries. Within the framework of this project, a waste hierarchy is envisaged, which is aimed at step-by-step waste management, that is, a sequence of measures aimed at preventing the formation, reuse, recycling, and disposal of waste. In order to reduce the number of unauthorized landfills, licensing of the activities of enterprises engaged in the processing and disposal of waste, and a notification procedure for garbage collection organizations will be introduced.

Effectiveness of Waste Management in Kazakhstan:

Problems and solutions

> ***Waste management is one of the most typical environmental issues, especially during the quarantine measures taken due to the threat of spread of COVID-19. Based on the World Bank, the waste generation will increase from 2.01 billion ton in 2016 to 3.40 billion ton in 2050 in the course of urbanization, economic development and population growth in the countries and cities. Currently at least 33% of this waste is recycled in the wrong way around the world.***

In Kazakhstan the waste management problem is no less critical. The government is taking various actions on the way of solving this problem. Thus, development of the efficient waste management system is one of the fundamental principles of the Concept for Transition of the Republic of Kazakhstan to “Green Economy”. According to this Concept, by 2030 a part of waste recycling should have been increased to 40%, and to 50% by 2050. According to the “Business Roadmap 2025”, list of the priority sectors of the national economy covers the field of waste collection, recycling, disposal and utilization.

What are the latest trends of development and modification of the Kazakhstani environmental legislation, including with introduction of the new Environmental Code? What are the reasons for inefficient measures taken and what are solutions to these problems - Learn more about this in articles of our authors.

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CURRENT SITUATION

According to the studies held by KB Strelka based on the Report "What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050" prepared in 2018 by the World Bank, in comparison with the developed countries, Kazakhstan is ineffective in terms of the waste utilization.

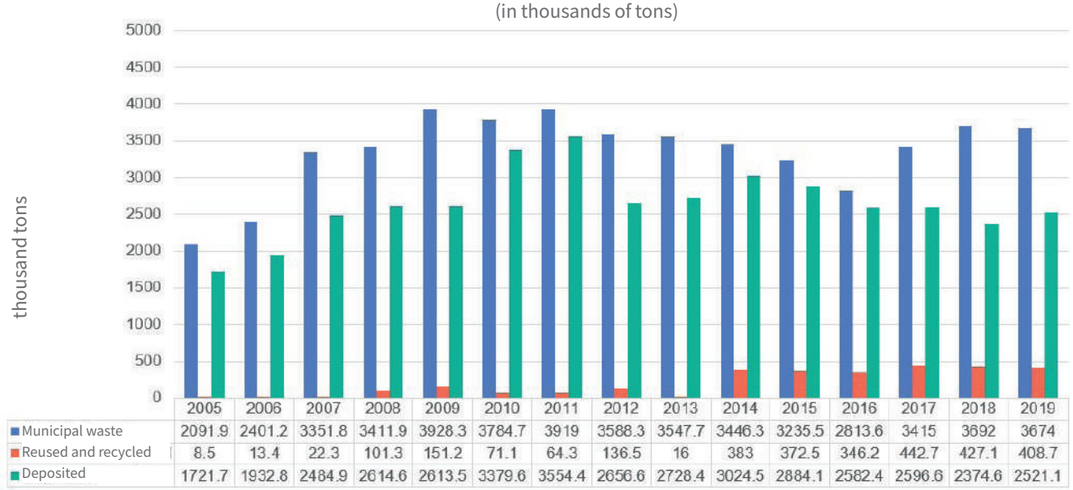
In the dissertation of A.G. Bekturova it is written that the volume of the solid domestic waste (SDW) in the country was approximately 5-6 million ton, and by 2025 the figure could reach 8 million ton according to the data of the Waste Management Department of the Ministry of Energy of the Republic of Kazakhstan as of 2018.

According to the Report of the Minister of Ecology, Geology and Natural Resources, M. Mirzagaliyev on the accomplished work, as of 2019 the volume of waste accumulated was 125 million tons of the SDW in Kazakhstan. Over 5 million tons of the SDW is generated per annum.

According to the Association of the Environmental Specialists: "There are 3,000 landfills used in the country, where 620 landfills which make 18% of them comply with the sanitary requirements, and 82% do not comply with the sanitary requirements of Kazakhstan". Generally a great deal of waste is buried, this does not solve the problem of their utilization or removal (disposal), and it only postpones and accumulates the existing volumes of waste. Urgency of the problem is clearly demonstrated by the statistics published by the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan.

Figure 1

Final waste disposal: recycling and disposal of municipal waste
(in thousands of tons)



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Municipal waste	2091.9	2401.2	3351.8	3411.9	3928.3	3784.7	3919	3588.3	3547.7	3446.3	3235.5	2813.6	3415	3692	3674
Reused and recycled	8.5	13.4	22.3	101.3	151.2	71.1	64.3	136.5	16	383	372.5	346.2	442.7	427.1	408.7
Deposited	1721.7	1932.8	2484.9	2614.6	2613.5	3379.6	3554.4	2656.6	2728.4	3024.5	2884.1	2582.4	2596.6	2374.6	2521.1

Reference: Association of Environmental Practitioners, Household waste management system in Kazakhstan, 14.07.2020, https://ecounion.kz/?p=3561

Reference: Association of Environmental Practitioners, Household waste management system in Kazakhstan, 14.07.2020, https://ecounion.kz/?p=3561

In the presentation of the Association of Environmental Specialists it is pointed out that 8618 unauthorized landfill sites have been found in 2018 in Kazakhstan, 4321 illegal dumping sites of which are still in use.

LEGAL CONTROL OF WASTE MANAGEMENT IN KAZAKHSTAN

Issue of the waste handling and management in Kazakhstan is regulated by the legislative and regulatory acts of various levels. The Environmental Code of 2007 and from July 01, 2021 – the Environmental Code of 2021 adopted on January 02, 2021 are the main regulatory legal acts in this area as of the date of this publication.

Main issues in terms of the waste management and handling regulated at the legislative level are provided below.

Ownership of Waste. Ownership of waste and its transfer are guided and governed by the Articles 283 – 285 of the Environmental Code (2007) and Articles 339 – 340 of the Environmental Code (2021). Issues of the ownerless hazardous waste as of the date of this publication are guided and governed by the Rules for the control of the ownerless hazardous waste recognized by the court decision as received into the republican ownership. In addition, these Rules for the control of the ownerless hazardous waste will be approved in the new revision in the nearest time due to adoption of the Environmental Code as of 2021.

Waste Classification. Waste classification according to the Environmental Code of 2007 is envisaged by the Articles 286 and 287. Moreover, the Waste Classifier which determines a hazard level and coding of waste is envisaged by the Order issued by the Minister for Environment of the Republic of Kazakhstan dated May 31, 2007. Waste classifier is intended for use in the waste handling system, including the accounting, control, rationing when handling the waste, licensing of the relevant types of activities, issue of permits for transboundary movement and emplacement of waste, designing of the environmental structures and implementation of the environmental measures, assessment of the social, economic, resource-and-material risk and damage in case of accidents and disasters. According to the Environmental Code of 2021, waste classification is regulated by the Article 338. Due to adoption of the Environmental Code of 2021, approval of the new revision of the waste classifier is also expected in the nearest time.

Extended Producers Responsibility. As well as in some other countries, for example, in Russia, an institution of the extended producers (importers) responsibility ("EPR") has been introduced in Kazakhstan from January 01, 2016 which is meant to be the responsibilities of producers (importers) ensuring the collection, transportation, recycling, neutralization, use and (or) disposal of waste generated after loss of the consumer attributes of certain products. In the Environmental Code of 2007, EPR and their implementation methods are regulated by the Chapter 41-1; and by the Chapter 31 in the Environmental Code of 2021.

In the context of the Environmental Code of 2007, the List of the EPR covered products (goods) is approved by the Order issued by the acting Minister of Energy of the Republic of Kazakhstan dated December 04, 2015. From 2016 the EPR requirements are applicable for the motor vehicles and vehicle components; from 2017 for paper, cardboard, metal, glass and combined package, as well as for the electrical and electronic equipment; from December 23, 2019 for the farming equipment. In the context of the Environmental Code of 2021, the List in the new revision is not yet approved as of the date of this publication.
Responsible organization, Operator ROP LLP ("Operator") has been established by the Governmental Decree of the Republic of Kazakhstan dated December 30, 2015 in order to implement the EPR principle. This organization is reporting to the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan. The Operator is responsible to establish the unified system of the integrated waste management of products (goods) and involve these wastes into circulation as secondary raw materials, promote the infrastructural development of the waste recycling industry with an extensive business involvement.

The EPR Strategy is implemented as follows: producers or importers of the EPR-covered goods shall sign an agreement with the Operator and pay to the Operator's bank account for arranging the waste collection, transportation, recycling and (or) disposal. Amount of fee is determined in accordance with the Calculation Methods.

Pursuant to the Article 285-2 of the Environmental Code of 2007/ Article 338 of the Environmental Code of 2021, the Operator transfers the funds received at their account to compensate the individuals and legal entities for the costs of separate collection and recycling of waste from the products (goods), compensation to producers of the food staples, as well as to encourage production of the environmentally friendly motor vehicles in Kazakhstan, for example by financing the use of energy resources by the producers or research and development, design and experimental developments and performance of the products testing.

Waste Burial and Requirements for Landfills. Requirements for the landfills area and durable waste dump are set in the Chapter 43 of the Environmental Code of 2007. "The List of waste to be disposed at landfills of various categories" has been approved by the Order issued by the acting Minister for Environment of the Republic of Kazakhstan dated August 02, 2007. Moreover the Sanitary Rules for Design and Maintenance of the Solid Domestic Waste Landfills have been approved by the Chief State Health Inspector of the Republic of Kazakhstan. In the Environmental Code of 2021, landfill requirements are regulated by the Chapter 25. It is also planned to approve the new revision of the List of waste to be disposed at landfills of various categories

Tariffs for Collection, Removal, Disposal, Recycling and Burial of the Solid Domestic Waste. Area of waste handling is regulated with the tariffs determined by the local executive bodies (Akimats) and the Operator in accordance with the "Methods for Calculating the Tariffs for Collection, Removal, Disposal, Recycling and Burial of the Solid Domestic Waste". Tariffs calculated are finally approved by the local representative bodies (Maslikhats). Individual tariffs are provided for each regional center and city of national status.

Waste Generation and Calculation. Procedure for calculation of rates for the generation and accumulation of the household waste in settlements is regulated by the Order issued by the Minister of Energy of the Republic of Kazakhstan dated November 25, 2014. For the purpose to account the waste, users of natural resources and entities involved in the waste collection, removal, disposal, recycling, storage and placement or discharge operations must submit the Waste Inventory Reports on annual basis to the regional offices of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan in accordance with the Order issued by the acting Minister of Energy of the Republic of Kazakhstan dated July 29, 2016.
Measures for the Green Space Conservation and Protection. Issues on the green space maintaining and protecting, as well as the land improvement are regulated by the Rules for the Maintenance and Protection of Green Spaces, the Rules for the Improvement of Territories of Cities and Towns.

SCOPE OF PROBLEMS OF THE WASTE HANDLING

For the purpose of reducing the volume of waste, Kazakhstan aims to more rarely resort to the landfill depositing and increasingly use such alternative methods of waste disposal, such as for example waste recycling. A matter of recycling is one of the most complex and critical missions in the waste management system.

> In the most part of the developed countries, waste recycling is such a profitable business, that some countries are not only successfully coping with the waste recycling locally but also buying waste from the other countries. However Kazakhstan started practicing it relatively recent and, as for now it may be said that Kazakhstan is still at the initial stage of development.

According to the Report issued by the Minister of Ecology, Geology and Natural Resources, Mr. M. Mirzagaliyev on the work done in 2019, 125 million tons of the SDW have been accumulated in the country, over 5 million tons of the SDW is generated annually. In Kazakhstan, the capacity of landfills is insufficient, and 83% of landfills do not comply with the environmental and sanitary standards; but as a matter of fact they are just unauthorized dumping grounds.

According to the Information on the waste reduction, recycling and reuse published on the official website of the e-government, since approval of the Concept for Transition of the

Republic of Kazakhstan to “Green Economy”, Kazakhstan has achieved the results in terms of the SDW recycling, which include but not limited to the following:

Improvement of the legislative and regulatory framework:

- From 2016, it is prohibited to bury (dispose) the mercury-containing lamps and devices, scrap metals, used oils and liquids, batteries and electronic waste at landfills;
- Prohibition for burial of the plastic, waste paper, cardboard and waste paper, as well as glass is effective from January 01, 2019.

Recovery of expenses for collection, transportation and recycling of the secondary raw materials:

In 2016-2018, more than 50 enterprises have been compensated for a total amount of about KZT 7 billion; volume of the vehicle components collected and recycled was 100,553 tons.

New enterprises:

- 1 enterprise of used antifreezes disposal based in Almaty, capacity of 5.4K tons/year;
- 1 enterprise of used accumulator battery disposal based in Pavlodar, capacity of 3K tons/year;
- 2 enterprises of used oils disposal based in Nur-Sultan and Karaganda, total capacity of over 20 K tons/year;
- 8 enterprises of used tires disposal based in Taldykorgan, Almaty, Aktobe, Ust-Kamenogorsk, Shymkent, Nur-Sultan, as well as in Atyrau and Karaganda regions with the total capacity of 16 K tons/year.

Waste Management Infrastructure:

- 9112 containers, where 346 containers are for collection of the electronic and electrical waste, 2321 containers for collection of the mercury-containing lamps and chemical power sources have been installed in a number of regions and cities of Kazakhstan, including the cities of the national status;
- 99 stations for collection of the secondary raw materials, and 39 stations for collection of the electronic and electrical waste have been established; separate collection of waste at various stages has been implemented in 51 cities and regions out of 204; waste sorting has been arranged in 30 settlements;
- -Waste sorting station of capacity of 50K tons/year has been launched in Mangystau Region; sort-line of capacity of 100K tons/year was constructed in Ust-Kamenogorsk city, and a waste sorting plant of capacity of 100K tons/year was launched at the SDW landfill in Uralsk city.

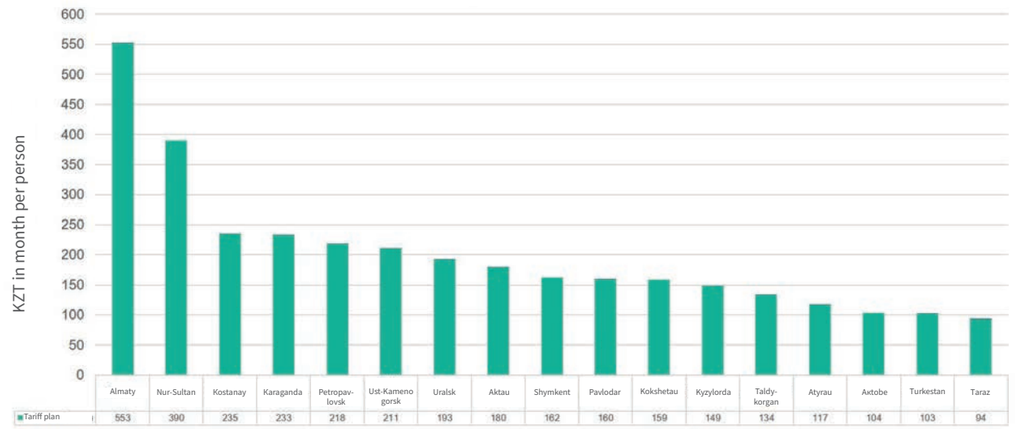
The mentioned measures allowed increasing a share of the SDW recycling from 2.6% (2016) to 11.51% (2018). However, this figure is still significantly lower than in the developed countries, where a share of recycling exceeds 30%.

There are many reasons why the share of recycling in Kazakhstan is still low nowadays and the waste management system is ineffective. All of these reasons are closely related to each other in any case. Such problems may be distinguished as major ones, as (1) low tariffs for the SDW collection, removal, disposal, recycling and burial; (2) lack of proper sorting of waste; (3) lack of the industry financing; (4) absence of a competitive environment; (5) underdeveloped market of the secondary raw materials, and (6) a systemic issue.

Low tariffs for the collection, removal, disposal, recycling and burial of the solid domestic waste. As pointed out above, field of the waste management is regulated by the tariffs approved by the local representative bodies (Maslikhats).

Tariffs for removal of SDW

Figure 2



Reference: Association of the Environmental Practitioners, “Household Waste Management System in Kazakhstan”, 2020, https://ecounion.kz/?p=3561

Tariff plan for waste removal services in the main regional centers and cities of the national status in Kazakhstan approved for 2020 is shown on Fig. 2.

Reference: Association of the Environmental Practitioners, “Household Waste Management System in Kazakhstan”, 2020, https://ecounion.kz/?p=3561

Charges paid by the population according to the established tariffs are the main compensation for the costs of waste removal companies for removal and disposal of the solid domestic waste. As of today, these tariffs as shown on the Fig. 2 are inadequately low, and generally they do not cover even the costs for the waste removal and disposal. This does not encourage the growth of interest to this field of activities on the part of business operators.

Lack of proper sorting of waste. To achieve high performance in the waste recycling in the country, first of all it is necessary to arrange the proper sorting of waste and institutionalize a separate collection of waste. According to Sergei Luschinsky, Director of LS-KOKSHETAU LLP, a company that arranges collection, transportation and recycling of the secondary raw materials, when a pre-sorted waste is delivered to the waste sorting plant, it can be recycled to 50%; in the absence of pre-sorting, the waste recycling indicator is only 5-7%.

According to Kazinform with reference to the Press Service Office of the Ministry of Energy: “Currently, a separate collection of waste at various stages has been introduced in 51 settlements out of 204 cities and towns throughout the Republic; sorting is arranged in 28 settlements (11 sorting lines, 17 manual sorting at the SDW landfills)”. Nevertheless, despite the installation of containers for the separate collection of waste, informational work with the population, and generally the environmental consciousness of the population in the country still remains at a low level.

According to the Article 505.1 of the Code of Administrative Offenses, an administrative liability in the form of warning or a fine for the individuals in amount of 20 MCI and from 30 MCI to 100 MCI for legal entities subject to the category of business entity is envisaged for violation of the Rules for improvement of territories of cities and towns, as well as destruction of the infrastructure facilities, destruction and damage of green spaces in the cities and towns. Violation of the Rules for improvement of territories of cities and towns includes the dumping of waste in a wrong place, without limitations. Since nowadays there is no mechanism for fixing these offenses, as a matter of practice the standard is either not efficient enough or just not working at all.

According to E. Nehring, lack of the environmental education makes a waste sorting ineffective in Kazakhstan: schools do not pay enough attention to the problem of waste sorting. A lack of automated sorting is due in no small part to the ineffective sorting of waste: since people are not sure if the waste they throw away will eventually

be recycled or sent to an “illegal dumping landfill”, many of them find no sense in separating the waste dumped.

Lack of the industry financing.
It is obvious that at this stage in terms of the waste recovery, Kazakhstan cannot compete with the developed countries without the foreign investments. However, despite the significant volume of waste and secondary raw materials for recycling, at this stage the foreign investors are not ready to invest in the Kazakhstani waste recycling industry.

According to Mr. Egor Zinger, the co-founder of the “Garbage Business” in Kazakhstan, the problem is that there are no preferences provided, in addition to the low tariffs for the business operators in the “garbage business”; and the governmental support for the environmental business projects is just of the declaratory signification. Thus, in his interview, Mr. Zinger states: “Think for instance of loans. Today the rates of Kazakhstani banks are 12% per annum, while in the Scandinavian countries these rates do not exceed 3%. But if it is about the environment related projects, and then their loans are given at a rate of 0.5% ! There are no such figures in our banking system; no financier will give you a loan at such a minimum rate!”. (Mr. Egor Zinger, “Why is garbage business in Kazakhstan not developed as in the Western world? Part 1” 02.05.2019).

Absence of a competitive environment. As has been demonstrated by the European experience, high performance in the field of waste recycling are generally and mainly achieved by means of private companies. According to the Report of DAMU Research Group LLP, a field of waste management in Kazakhstan is mainly directly or indirectly owned by the government, a private initiative is very limited; this hinders the development of natural competition at the market. According to researches by the Association of the Environmental Specialists, a share of waste recycling is higher in the large cities of Kazakhstan, since among other factors, there are more private structures involved in the collection of waste and their further recycling.

Underdeveloped market of the secondary raw materials. Among others, supply and demand at the secondary waste market is one of the most important factors driving the development of the waste recycling sector. According to the Report of DAMU RG Research Group LLP, nowadays many recycling companies in Kazakhstan encounter a problem of selling raw materials formed after the waste recycling. It is stated in the Report of DAMU Research Group LLP that: “...currently various mechanisms of influence – requirements for the mandatory use of recycled materials when releasing new products (in percentage terms) and concessional lending to these enterprises are used in the developed foreign countries”. Perhaps, the use of these measures could bring the positive results in Kazakhstan.

A systemic issue. Currently, the governmental regulation of the waste management issues in Kazakhstan are governed by several ministries such as the Ministry of National Economy, Ministry of Energy, Ministry of Ecology, Geology and Natural Resources, Ministry of Industry and Infrastructural Development, etc. It is stated in the Report of DAMU Research Group LLP that: “... each and every activity in the European counties related to the solid domestic waste management is carried out by the Environmental Agencies”. In many cases, assignment of issues for regulating the waste management system between several ministries that are not particularly related to each other complicates the process of the effective regulation.

TRENDS FOR DEVELOPMENT AND AMENDMENT OF THE ENVIRONMENTAL CODE

Since the country has started actively developing the issue of waste disposal relatively recently, the Kazakhstani environmental legislation, including those for the waste management issues is under continuous finalization and improvement. Among the most significant recent amendments, it is relevant to distinguish the amendments for introducing the "Waste-to-energy" Principle adopted in the Environmental Code and other legal acts on November 09, 2020 and entered into force on November 21, 2020.

An opportunity of the energy (power) disposal of waste is provided by the modifications in the form of their heat treatment in order to reduce the volume of waste and subsequent energy generation. Only those wastes that are not included in the list of waste not subject to energy disposal will be subject to incineration.

The guaranteed purchase of electrical power generated by the combustion plants by the Accounting and Financial Center Supporting the Renewable Energy Sources established at KEGOC JSC is envisaged as a mechanism to support the direction of energy waste management legislation, by analogy with other countries. It is expected that the Accounting and Financial Center will purchase the amount of energy (power) generated at the plant at prices determined in the course of trading. In this case, prices are adjusted according to index on annual basis based on the consumer prices and exchange rate of KZT. The auction ceiling prices for electrical power generated by the energy disposal of waste, the Rules for their determination and the list of waste not subject to energy disposal must be also be approved by the competent authorities in the near future.

In order to reduce the negative environmental impact of activities of the waste incineration plants, a number of requirements have been established for these plants based on the European standards. These provisions have also been incorporated with adoption of the Environmental Code of 2021, particularly in the Article 324 of the Environmental Code of 2021.

As expected, the adopted amendments and modifications will allow reducing the number of solid domestic waste and landfills in the country, and will have a general positive effect on the environment and economy of Kazakhstan.

New statutes of the new Environmental Code of 2021 are more focused on the environmental pollution, emissions, environmental permits and introduction of the latest technologies by the enterprises. The following major changes are provided in the area of waste management without limitation: delimitation of waste management organizations from other entities in order to establish the special requirements for the first ones, introduction of the principle of the waste hierarchy for the purposes of their separation at the source of generation, increase of the storage and accumulation life of certain types of waste, clarification of the concepts of waste "sorting" and "treatment", as well as the time of transfer of ownership of waste to the waste management organizations.

The envisaged modifications should have a positive effect on the existing environmental problems in Kazakhstan, which consequently will positively affect the population security and health, the environmental enhancement, and cultural development of an attitude of care towards nature, as well as development of the national economy.

Our team has an extensive experience in consulting the clients on issues related to the environmental legislation. We will be happy to assist you in any issues relating the potential risks and new opportunities in the context of the existing requirements and those expected for introduction of the legislation modifications.

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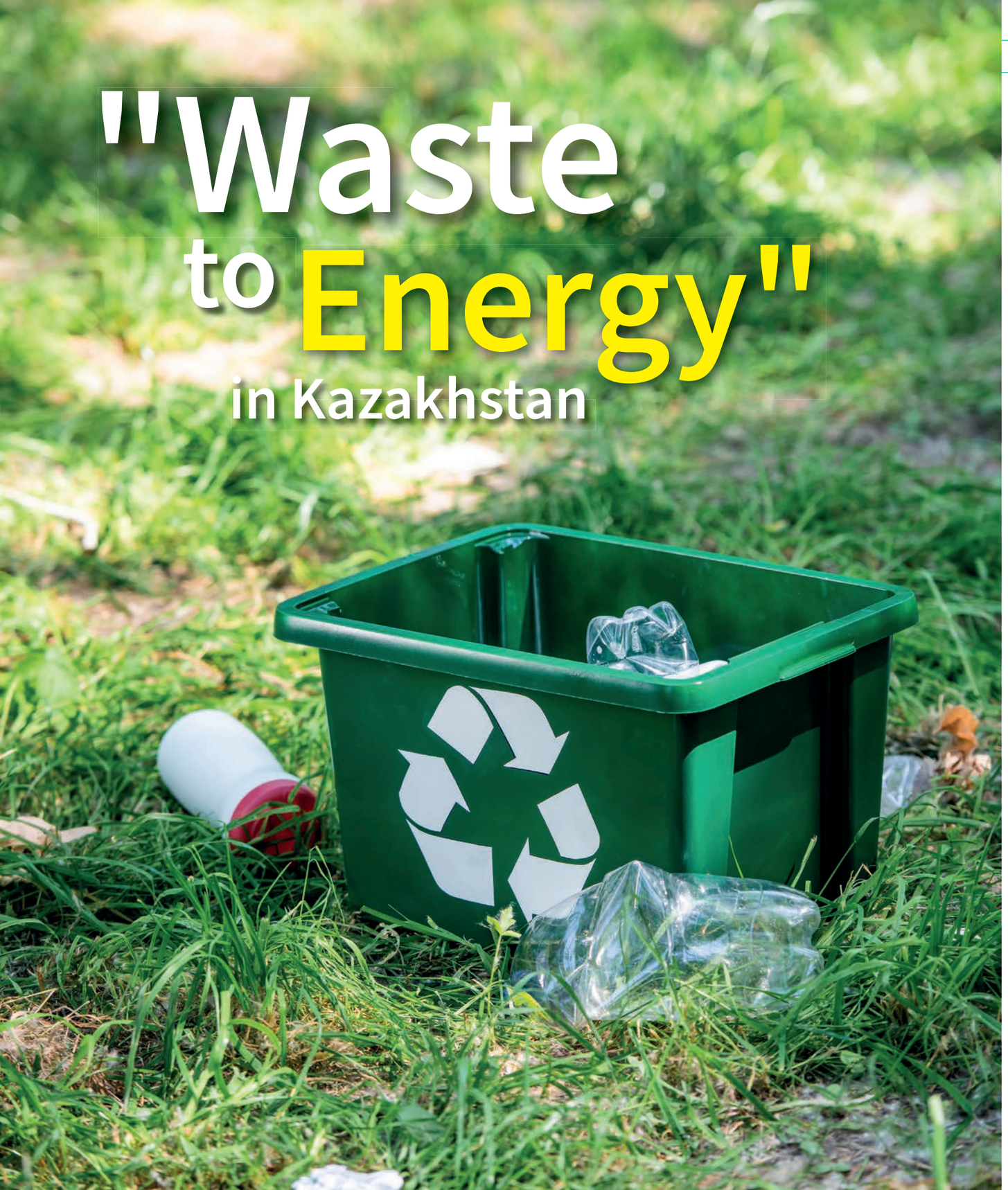
"Waste to Energy" in Kazakhstan



IN THE LIGHT OF THE NEW ECONOMIC PARADIGM, IN 2020 THE MINISTRY OF ECOLOGY, GEOLOGY AND NATURAL RESOURCES OF THE REPUBLIC OF KAZAKHSTAN RAISED THE PROBLEM OF SOLID DOMESTIC WASTE RECYCLING. AS MENTIONED ABOVE, ACCORDING TO THE CONCEPT FOR TRANSITION OF THE REPUBLIC OF KAZAKHSTAN TO A "GREEN ECONOMY", IN KAZAKHSTAN THIS INDICATOR SHOULD BE BROUGHT TO 40% BY 2030. ACCORDING TO THE MINISTRY, ONLY 14% IS RECYCLED TODAY. THE INDUSTRY IS NOT ATTRACTIVE FOR INVESTORS DUE TO LOW TARIFFS: TODAY, TARIFFS FOR GARBAGE COLLECTION IN KAZAKHSTAN ARE LOW AND DO NOT TAKE INTO ACCOUNT THE COSTS OF SOLID DOMESTIC WASTE RECYCLING.

In this regard, it was proposed to introduce the "Waste to Energy" mechanism, which provides for sale of electricity generated by waste incineration. At the same time, there are strict requirements for quality of emissions, similar to European directives. This mechanism will in a longer run reduce the volume of waste by up to 30% by 2025 and attract private investment.

According to the environmental department, currently in Kazakhstan, more than 120 million tons of solid domestic waste have been accumulated at 3200 landfills, and more than 5 million tons of new garbage are brought annually. Solid domestic waste recycling is growing, but it cannot cope with the rate of landfill filling, as a result, only in the regional centers (there are 14 of them in Kazakhstan, in addition to 3 cities of republican significance) there are more than 20 landfills overflowing with garbage.

To support the development of this industry, a mechanism for purchasing energy produced on a guaranteed basis will be used, similar to mechanism that is already used in Kazakhstan for electricity generated by renewable energy sources (RES). In other words, predefined volume of generation will be purchased from new production facilities at fixed rate during, for instance, 15 years.

According to the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan, the first auctions for construction of waste incineration plants in Kazakhstan will be held in 2021. The Ministry plans to launch such plants in six cities – in Aktobe, Atyrau, Almaty, Nur-Sultan, Taraz and Shymkent. In addition, work with potential investors has already begun, in particular, issues are being worked out with Akimats on provision of land plots, infrastructure and guaranteed loading of waste from these industries for at least 15 years.

In this March, draft Order of the Minister of Ecology, Geology and Natural Resources of the Republic of Kazakhstan "On approval of the maximum auction prices for electric energy produced by waste-to-energy" was published on the Open NLA portal. According to the draft Order, it is proposed to approve the maximum auction price for electric energy produced by waste-to-energy in the amount of 191.9 tenge/kWh (excluding VAT). It should be mentioned that in 2021, there will be auctions for selection of renewable energy projects, where, for example, the maximum auction price for solar power will be 16.96 tenge/kWh, and for wind power – 21.53 tenge/kWh. Taking into account the decline in this indicator for renewable energy auctions in the near future, the cost of electricity from renewable energy sources will become the cheapest source of generation in our country, overtaking customary coal-fired generation. However, addressing the issue of solid waste recycling is an integral part of building a circular economy and is an equally important indicator of the Concept for transition of the Republic of Kazakhstan to a "green economy".

According to ALE "Solar Power Association of Kazakhstan"

CHALLENGES OF SUSTAINABLE DEVELOPMENT IN CENTRAL ASIA:

through the example of the Kyrgyz Republic

Vladimir Korotenko,
PhD, Chairman of Ecological Movement "BIOM"

> ***The countries of Central Asia (CA) are located in a single ecological space of the basins of the Aral and Caspian Seas, which do not have access to the World ocean. Extensive use of natural resources, air, water and soil pollution reduce the favorable ecological space for life, limiting opportunities for "green" development, and have led to numerous problems that do not allow us to talk about an easy way to transition to Sustainable development (SD). A distinctive feature of Central Asia is the vulnerable nature of ecosystems.***

Strengthening the natural frameworks of environmental safety is an essential element for ensuring the survival and sustainability of both the Central Asian region and the planet as a whole. Only Life creates conditions for Living! Natural ecological communities can be called "factories of Life", as they create and regulate the state of the environment.

Transition to sustainable development in the region is closely related to preservation of fundamentals of natural regulation of the environment. Further we will consider the features of transition to sustainable development, through the prism of one of the Central Asian countries - Kyrgyzstan. The recent history of Kyrgyz Republic (as well as other countries in the region) is marked by permanent reforms. In addition, the environmental conditions in the country has worsened over the past decade, largely due to the difficulties and risks of overcoming economic crises: overconsumption of natural resources is increasing – deforestation, poaching, extensive use of arable land, neglect of reclamation and preventive measures. It is a paradox that, despite all of this, the unique mountain landscapes, the purest water and air, natural zones, are still preserved in the republic due to the difficult accessibility, have economic value, and represent a special commodity of international importance, the price of which will increase. The Republic is one of the 200 priority ecological regions of the world.

One of consequences of inclusion of Kyrgyzstan in the world trade systems is an increase in environmental hazards for the country's population. Products and goods produced without taking into account environmental risks appear on the tables of consumers. For example, toxic dishes and toys are common in our markets. The situation with ensuring the population's access to clean drinking water has worsened, and chemical compounds that are dangerous for the environment and people are used in agriculture. Delaying the solution to these problems affects the health of the population, especially women and children, and threatens the well-being of future generations of Kyrgyzstanis.

In order to solve these and other problems radically, it is necessary to immediately implement actions in the following main directions:

– effective introduction and control of compliance with environmental requirements for import and production of food and essential goods;

– conducting environmental expertise of draft laws on the basis of "Standards for conducting specialized types of expertise";

– development of system for early warning of public about environmental risks, especially in the context of the development of the mining industry.

Kyrgyzstan, like other countries, is already entering an energy crisis, despite the fact that Kyrgyzstan has several powerful power plants built in the Soviet period. However, outstanding management problems did not allow for necessary modernization in a short time. For transition period and beyond, one of the effective ways to overcome the crisis and mitigate its consequences can ***be a strategy for energy conservation and efficient energy consumption in the country. In addition, development of the renewable energy market can also give its positive results.***

For example, Kyrgyzstan has a significant potential for the sun's radiance, especially in mountainous regions, where the solar radiation index reaches 3,000 hours per annum. Solar energy can be widely used in local communities and become an alternative to cutting down forests and shrubs. In Central Asian countries, heating 1 sq.m of a room requires 5-6 times more energy than in European countries. Implementation of the transition to energy efficiency as the basis of sustainability is possible through the organization of the following actions: –

introduction of energy efficiency requirements for buildings under construction in construction standards;

– development and implementation of state and municipal programs on energy efficiency and energy conservation at all levels;
– providing legislative framework for favorable tax climate for organizations developing renewable energy (solar, wind, biogas, micro-HPP), for example, through incentive funds and tax incentives;
– support of scientific potential in development of new methods and approaches in the field of renewable energy and energy efficiency.

Organic (biosafe) agriculture and agro-processing can be considered as another cornerstone on the way to environmental sustainability for Kyrgyzstan. Half of the population of our country has its own land, there are more than 270,000 farms in the country, ranging from 2 hectares to 12 hectares of agricultural land. Despite of counterproductive factors – erosion, salinization, etc. – our country today has a huge potential for the production of "organic" products. We need modern "green" agro-and business technologies to increase productivity and sell our products to other countries.

Strengthening the natural frameworks of environmental safety is an essential element for ensuring the survival and sustainability of both Kyrgyzstan and the planet as a whole. In the conditions of Kyrgyzstan, maintaining the necessary level of diversity of living beings and communities is particularly acute due to the fact that high mountains with a predominance of steep slopes and surrounded by deserts cause extreme stress for them. This is why mountain ecosystems are so vulnerable and so difficult to recover from destruction, if recover at all. Kyrgyzstan is home to about 2 % of the world's flora and more than 3 % of the world's fauna. This is quite a lot, if we take into account that the country's area occupies only 0.03% of the planet's area, or 0.13% of the land area.

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The reduction of natural ecosystems leads to a decrease in the sustainability of the environment and the deterioration of its vital qualities. The basic premise described by academician V. I. Vernadskiy , consists in the fact that no species of living organisms can exist exclusively only among their own kind. Life is possible only in communities - biocenoses and in a certain set of conditions that characterize their habitat. He assumed that biocenoses originated earlier than individual organisms and species. The biotical cycle only gradually differentiated, forming separate species. But it is difficult to imagine how a biocenosis can function without its components-heterogeneous components of the organismal and species levels. Life cannot exist outside of biocenoses and the biosphere. The scientist has repeatedly emphasized that although the carriers of geochemical energy – organisms-are discrete, together they represent

a single whole that occupies a certain place in the geochemical and energy processes of the biosphere.

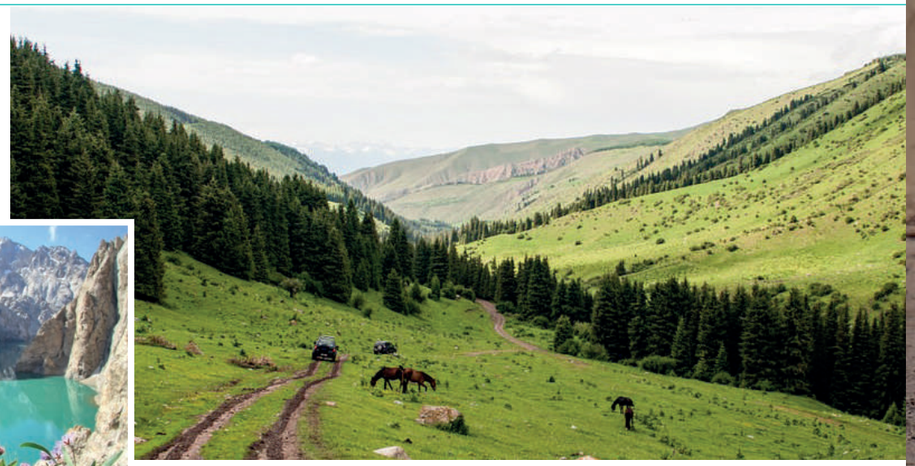
Thus, each species performs its own special functions and cannot be fully replaced by another. All socio-economic sectors of the country directly or indirectly depend on the state of biodiversity. First of all, it ensures the normal sanitary and hygienic state of the environment, on which the health of the population depends. In the agricultural sector, pastures that have retained their original set of species represent the greatest forage importance. In field-crop growing, horticulture, and forestry, the most sustainable and safe pest control measures involve the use of natural species that limit their numbers. Well-being of hunting and fishing industry directly depends on well-being of the objects of their activity. The same can be said about pharmacology using wild medicinal plants. An inexhaustible source for genetic and breeding work is the variety of wild ancestors of cultivated plants and species that can be successfully introduced into the culture. Among them are walnuts, apple trees, pears, plums,

apricots, pomegranates, grapes, raspberries, currants, tulips, onions, eremuruses, and other ornamental flowers and shrubs.
Due to high complexity and contrast of the geographical environment, there is a very high concentration of species in the country, there are two more species per unit area than the average for the planet and Central Asia. Mountain ecosystems play a significant role in soil formation, regulating runoff in the catchment area of river basins, protecting soils from erosion, cleaning up surface contaminations, preventing floods and mudslides, as well as landslides that cause great economic damage, amounting to millions of dollars, especially in the south of Kyrgyzstan, where the vegetation cover has been particularly severely destroyed. Due to their large area and role in formation of humus, mountain ecosystems can be a major sink for carbon dioxide, but only if they are preserved. Mountain diversity must be preserved!

However, objective data on diagnosis of the environmental situation shows that the symptoms of global negative processes are clearly visible on the territory of Kyrgyzstan today, primarily related to the degradation of land resources, man-made pollution and reduction of biological diversity. Although the country's share in the annual global greenhouse gas emissions is insignificant, and has even slightly decreased in recent years, but under the influence of global climate warming trends, the likelihood of future risks for country associated with the transformation of water resources, deterioration of the living conditions of the population and natural ecosystems increases. Consistent decline in biodiversity over a long period in Kyrgyzstan is caused by anthropogenic causes – violation of the habitat conditions of natural communities due to the intensification of economic activity or direct extermination. As a result, wild communities in the lowland zones and intermountain basins of the country have practically disappeared or are half-destroyed, and the development of high-altitude pastures has led to the displacement of herbivorous and predatory species of animals and birds on agricultural land. Use of mineral fertilizers and pesticides contributed to a sharp reduction in useful soil-forming organisms, invertebrates-pollinators, entomophages. Despite the above negative trends, Kyrgyzstan still has unique natural communities that need to be preserved. This can be achieved through the implementation of a number of priority measures:

- introduction of legal protection of natural ecosystems, prohibition of replacement of natural ecosystems with artificial (anthropogenic) ones);
- reservation of land for protected areas, expansion of the area of specially protected natural areas to 10% of the total territory of the

As a result, wild communities in the lowland zones and intermountain basins of the country have practically disappeared or are half-destroyed, and the development of high-altitude pastures has led to the displacement of herbivorous and predatory species of animals and birds on agricultural land.



country and more, as well as the introduction of a ban on reducing the level (category) of their legal protection;

– expanding the duties of responsible managers (at the level of deputies) of ministries, departments, enterprises and industries in the field of monitoring compliance with environmental management standards that prevent damage to nature in their subordinate units;

– improving the effectiveness of public involvement in environmental assessment and EIA procedures;

– introducing the provision on creation of ecological grids, and reservation of land for specially protected areas in law on specially protected areas;

– broad involvement of public in management of specially protected areas;

– introduction of new, innovative institutional mechanisms for management of state environmental expenditure programs, taking into account the best international practices, for example, the model of "Public Contract for Conservation of Biodiversity".

– creating conditions under which the primary users of land, forests, reservoirs, hunting and fishing areas are primarily interested in recording living objects. Introduction of system of rent payments for use of natural resources (possibly reduced to a comprehensive land tax) and tax benefits for those users who have provided the increment of biological resources and restoration of ecosystems.

Basis of a new approach to socio-economic changes necessary for transition to Sustainable development lies in formation of a new type of ecological (nature - centered) world view, where the central element of rethinking is natural foundations of development and the themes of the relationship between man and nature (civilization and nature, nature and society, nature and culture). Basic mechanism for formation of a new person and, accordingly, a new development paradigm is education, education for Sustainable development. The most important thing is that "Person is a whole world", and in order to achieve Sustainable development, it is necessary that this world be human and humane. The very concept of sustainable development carries an important educational factor, since here the person himself is placed at the center of development. All countries of the world are now taking the course to implement the Sustainable Development Goals, and everyone agrees that without an education system that creates the intellectual capital of the nation, achieving these goals is impossible. Accordingly, it is important to ensure that higher educational outcomes are achieved. One of the most important resources of education is its infrastructure. Children should be educated in clean, warm, safe schools. However, a number of schools still do not have clean drinking water, and school toilets are located outside the school. Also, many schools do not provide other necessary safety conditions (light, heat and energy efficiency, ventilation, etc.). These factors affect the health of children. In addition, non-compliance with such factors creates negative behavioral stereotypes in efficient use of resources, which are then carried over into their own homes and do not contribute to creation of safe and energy-efficient environment and sustainable development in general. Representatives of local communities are also poorly informed about modern environmental safety standards.

Education in Kyrgyzstan should not be a sphere of social costs and expenses, but a sphere of investment. Over the past few years, the country has been working on reform in education. A significant part of this process was development of new educational standards aimed at pragmatizing and humanization of education and focused on the needs and individual characteristics of the students. In this regard, it is considered necessary to expand competence-oriented reforms not only in schools, but also in the system of higher pedagogical and subject education. However, within the framework of new generation standards, both in schools and in the system of teacher's training in universities, the conceptual frameworks of sustainable development are not always properly reflected, which does not provide strategic support for country and global development.

For SD in education, it is necessary to work on implementation of the following steps:

– Develop and implement Education standards for Sustainable Development (ESD) as one of the components of system of evaluation and monitoring of education in Kyrgyzstan; Develop a National Program on ESD and a system of indicators to assess its progress;

– Support the development of special educational and informational materials on renewable energy and energy efficiency for local communities.

– Support the development and dissemination of ESD training tools and manuals;

– Integrate energy efficiency, renewable energy, sustainable development and climate change into existing and new educational standards;

– Develop a comprehensive strategy to raise public awareness about the ways to implement the ideas of sustainable development, green economy to improve the quality of life of population and preserve the natural ecosystems of the country. Establish regular coverage of these issues in the media.

The discourse that development can be changed and that other frameworks can be put into development is the basis for developing new mechanisms based on natural frameworks and taking into account the interaction of human with the environment, society and nature. When we talk about sustainable development, natural capital, the "real" green economy, and development trends, we must understand that we are talking about processes that affect more than one country, more than one generation, and more than one era. Transition to sustainability must be fair and inclusive for all. The Central Asian States face an urgent need

to develop and implement a coordinated set of actions to address the growing development challenges.

In conclusion, it is worth mentioning the prospects for cooperation, which we can and should do together, both at the regional and global levels:

- the main priority in ensuring the ecological stability of Central Asia is restoration of natural ecosystems in half of the region's territory;
- environmentally-oriented management, inclusion of an environmental component in all programs and strategies, and introduction of indicators of the state of natural ecosystems and biological diversity in strategies;
- creation of an effective user system for preparation and presentation of environmental information for decision-makers.
- launch of communication and discussion platforms in national languages on SD, green economy, correlation of sustainable development indices, etc.;
- expanding access to information, advanced technologies and resources that are the property of world leaders for effective resolution of national environmental problems;
- Strengthen the efforts on implementation of the Aarhus Convention. State and international organizations need to see public organizations not as recipients of services or organizations for formal approval, but as full partners and subjects of making, promoting, implementing and monitoring environmentally significant decisions.
- Strengthen the capacity of community organizations, self-help groups, entrepreneurs, and grids to negotiate their interactions on sustainable development and adaptation to the impacts of climate change;
- Develop and implement a set of measures aimed at ensuring the equal participation of all interested persons, especially women, service recipients and risk carriers, in decision-making processes on environmentally relevant issues;
- pay attention to the relationship between democratic governance and sustainable development. When building models and development programs, focus on the access of excluded groups to different types of resources, including natural resources.
- It is worth noting and supporting the EU Green Course initiative, which sets out the principles of commitment to cooperation between European countries and partner countries (including in Central Asia) to solve global problems.

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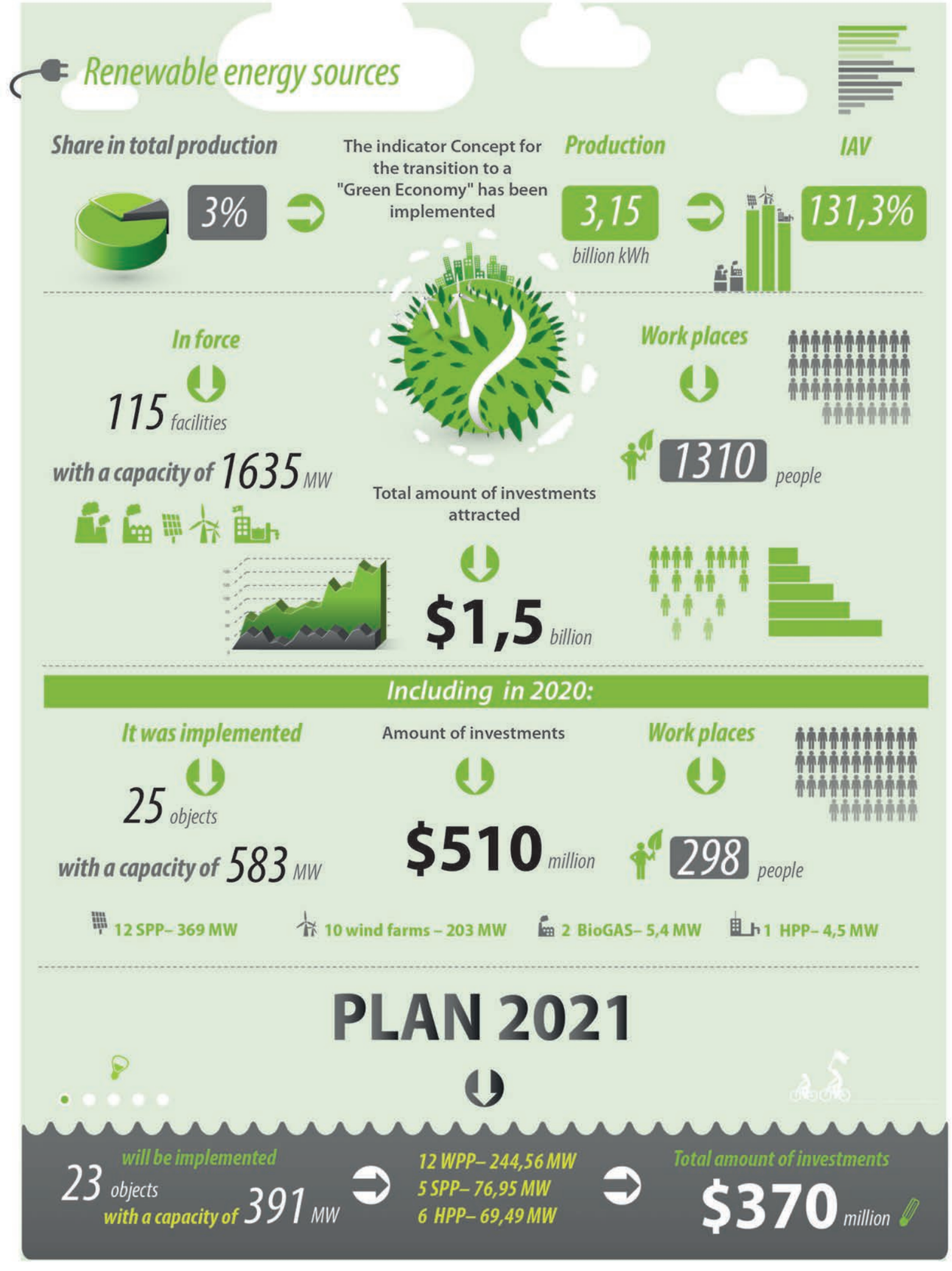

INTERVIEW

What trends in development of "green" economy are observed in Europe today? How are issues of energy storage solved, is the interaction of different industries important in development of "green" energy? We talked about this and many other things with Assem Bakytzhan-Augustin, Project Manager of Green Energy 3000 GmbH in Kazakhstan and Poland.

Assem Bakytzhan-Augustin:

Decarbonizing the economy is, first of all, a transformation of thinking

– Mrs. Bakytzhan-Augustin, tell us how active is transformation from the traditional model of development to the "green" economy in Europe today? What trends in the development of "green" energy are popular in the European Union?

– In Europe, no one has been discussing the topic "How important are the principles of a green economy?" for a long time. This discussion is long over. Now it is obvious to everyone that further development of the economy and adoption of business decisions must necessarily be based on the principles of sustainable development. In other words, economic growth should be linked to environmental and social goals. And this is not just a "green" political hype, this topic has long been in practice. Sustainable development has been central to European politics and economics for several years. In 2019, the European Commission adopted a very important document - "the Green Deal". This is the European Green Pact, the main objective of which is to achieve zero total environmental pollution by switching from the use of fossil fuels to renewable energy sources in the EU countries by 2050. And this is a brilliant proof of the importance of the "green" economy for the EU.

In general, Europe intends to decarbonize the economy through energy transformation based on renewable energy sources. At the same time, various forecasts and development concepts indicate that the main resources will be the sun and wind. But it is not enough just to build powerful WPP and SPP. Since they are variable generation by their nature, which leads to a number of questions and tasks. These tasks determine the current trends in the development of the sector. Trends such as electric mobility, development of autonomous regional cells and energy clusters, and the integration of short-term and long-term storage units. Let's not forget about PtX technologies, automated management systems, new measurement technologies that open up

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opportunities for use of high-frequency and high-precision data, protection of this data, the development of corporate PPA, allowing the development of renewable energy projects beyond the support of "virtual" stations. All of this is a search for an solution to the most important task that the growth of variable generation sources in the energomix brings – flexibility. Now we are not just talking about clean energy, but clean and affordable in geographical, economic and temporal terms and various industries.

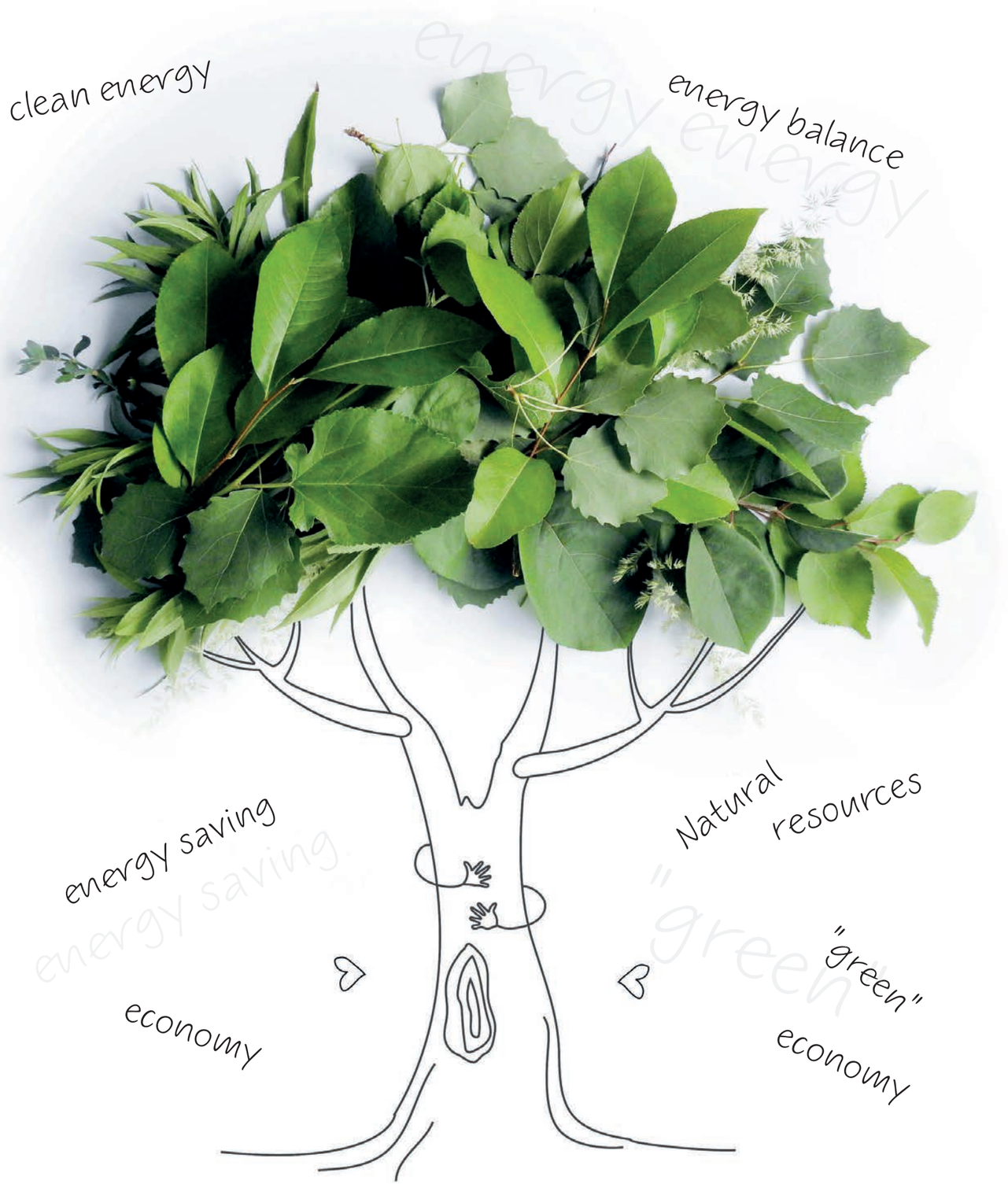
Of course, flexibility, the ability to react quickly to a situation, has always been part of the energy supply - its technical and economic forms. With the growth of RES in the energy balance, its importance for stability of the economy has increased significantly. After all, now the issue of flexible energy management has been added to the issue of flexible production. This situation makes all players in the sector think about the existing rules. And it forces them to look for new universal approaches and concepts of interaction along the entire "producer-consumer" line.

– In development of renewable energy, Kazakhstan has followed the path of a strategy for development of large-scale renewable energy projects. However, in many countries, we see quite different processes going on today: decentralization and the development of so-called distributed generation. What was the reason for this model of renewable energy development in the European Union?

– First, I would like to say that among European countries there are also regional differences due to many factors, such as natural resources, infrastructure, its history, economy, national laws and regulations.

As for development of RES sector, the focus was not only on industrial RES, i.e. multi-megawatt power plants. In Europe, huge potential and, consequently, the contribution to the energy transformation of micro and small plants for their own consumption was very timely recognized. Appropriate conditions have been developed that encourage individual consumers, whether an individual or a legal entity, to invest in their own panels or even entire micro-power systems. To see this potential and provide the necessary conditions is also the answer to the issue of flexibility that I mentioned earlier. It is about flexible access to clean energy in geographical and economic terms.

Building industrial wind power plants, searching for enough land for them, taking into account the environment, pulling kilometer-long transmission lines from them to the final consumer, losing a certain percentage of this energy along the way takes much funds and time. Then why not, in parallel with the development of the industrial sector of renewable energy, to provide opportunity to everyone who wants to produce their own clean energy? After all, the sunlight, thank God, is everywhere, and the wind, too, and they will never bill us!



For example, in Poland, consumers have long been producers of their own clean energy. This is true not only to individual households, but also to small and medium-sized enterprises, administrative buildings, and large industrial producers from various industries. Thanks to the pass system, i.e. wire transfer for electricity, the annual expenses of a household with an annual consumption of 4,500 kwh decreased from about 3,150 zlotys to 300 zlotys. And this is already a saving, isn't it? Thus, the cost of energy consumed from the grid is reduced, i.e., the initially high investment is returned. In addition, grids practically serve as storage unit. Since the excess energy produced in the summer and not consumed immediately can be consumed at night or in winter at a discount of 80%. At the same time, losses over long-distance grids are reduced, since about 40% of energy is consumed by "life" households.

On the basis of such self-supporting cells existing in one local environment, energy clusters have appeared in Poland. These include local government, local SMEs, and small households. One example of such a cluster is the gmina Michalowa in Podlasie, where a local system was created that could operate independently of the entire country's energy system. It consists of 2 biogas plants for cogeneration of heat and electricity in the amount of about 10,000 MWh and about 27,740 GJ., SPP 0.5 MWp, storage unit with a capacity of 600 MWh, micro-installations (for example, at a school

complex, households) and local electrical and heating grids.

As we can see, the emphasis on regionality not only encourages local governments and residents, but also enables a particular region to increase its competitiveness, use the potential of local enterprises or encourage the creation of new ones. After all, as is well known, it is small and medium-sized businesses that are the main driving force of the economy.

– Do you think the development of energy storage can solve the problems with balancing and storing energy?

– Energy storage is one of several options for increasing the flexibility of energy supply. But it must be said that energy storage is not just batteries. As you know, in terms of storage technology, there is a distinction between short-term and long-term storage, depending on their application. Short-term storage facilities can receive and release energy several times during the day. Usually, they only offer a limited amount of storage. Long-term storage should be able to store electrical energy for several days or weeks. For example, to cover the phases of a long pause of the wind and when the sun barely shines. Accordingly, there are many different technologies and methods. The decision on when and which method or technology to use should first be based on the current technological structure of each national energy system. Very deep technical and extensive market research is needed. As far as I know, KEGOC is currently conducting similar studies. Based on their results, a little later it will be possible to say which storage unit is more appropriate for relevant task.

– What kind of energy storage technologies are used in Germany?

- In Germany, the most common form of storage is hydro-accumulating power plants (HAPP), which are used as large storage facilities. Today, they operate with a total capacity of about 6.5 GW and a capacity of about 40 GWh. Thus, their share in the total installed generation capacity in Germany is about 5%.

In recent years, there has also been a significant increase in large-scale battery storage systems (GBSS). The total realized and planned capacity of GBSS in 2019 was about 550 MWh. This indicator does not include small private batteries to optimize consumption from households ' own solar panels. Although this sector of the industry is growing and developing very quickly. In parallel, the market for energy storage for industry is also actively developing.

These two types of storage cover different applications: while GBSS provide high performance with less capacity required to provide primary regulation, HAPP require more capacity compared to their performance and are therefore used more to balance fluctuations during the day or week.

As for development of battery technology, other possible functions that they can take on in the power grid are being actively discussed. Their use for primary regulation has already been established. Grid booster feature is likely to be tested in the first pilot projects. Grid booster concept provides for storing high-capacity electricity in reserve in case of an emergency: if an important grid resource of the transmission grid fails unplanned, the battery should start up within milliseconds and maintain the grid until quickly deployable generating stations are available.

The possibility of their wider use is also being discussed. For example, using private storage for local grid services. However, it is not yet clear what these services may consist of and whether they can actually be provided. In addition, it is unclear what incentives there may be for a private storage operator in this area. If financial incentives were used in this matter, they would most likely have to be very high, as they would have to compete with the economic benefits of self-consumption.

> ***If financial incentives were used in this matter, they would most likely have to be very high, as they would have to compete with the economic benefits of self-consumption.***

– Is there any government support for development of storage technologies?

– Yes, the state supports the development of storage technologies through various programs and research. For example, the "storage support Initiative" operating since 2012, supports a wide range of technologies, from private batteries in households and megawatt-range energy storage systems to long-term renewable energy storage projects. Special attention is paid to the wind-hydrogen compound, heat storage units and batteries in distribution grids. In 2019, the federal government allocated funds for the latter in the amount of about nine million euros.

But other support mechanisms also contribute very well to the widespread use and development of technology and, thus, its cheapening. Eliminating numerous additional electricity costs for auto-consumption (grid charges, duties, taxes) allows investing in private electricity storage systems. A number of federal states, municipalities, and public utility companies in Germany offer direct subsidies specifically for investment in private storage systems. The amount of subsidies varies greatly, but on average about 20% of investment costs are covered by subsidies.

For example, full or extensive exemptions from grid charges are applied for HAPP. No fees are charged for total storage consumption, including storage losses.

But I would also like to draw attention to another way of flexibility of supply and demand. It is not a technological solution, but a market solution - demand management mechanism. It allows the operator to stabilize the system using the potential of the system. Differentiated tariffs are the simplest form of such management, encouraging consumers to reduce or increase their consumption when necessary.

For example, in Poland, the peak demand for electricity usually does not exceed 200 hours per year. The construction of a new power unit that provides the necessary capacity is not economically justified at this time. It is much more efficient to use services, i.e. the flexibility of energy consumers, who can voluntarily release the necessary capacity in exchange for remuneration for various forms of cooperation (readiness and actual release). According to Enel X and EnerNOC, with well-built market mechanisms, the DSR potential in Poland is 10% of the peak demand, i.e. more than 2.5 thousand MW.

Large consumers can also participate in such cooperation: factories and plant, large-format stores, shopping centers, office buildings, farms, greenhouses, cold stores, and other smaller consumers, gathering under one representative unit. For

companies, participation in DSR services means not only additional earnings and increased competitiveness, but also greater control over their own electricity consumption and, thus, increased energy efficiency.

– In your opinion, how important is the interaction of different industries in development of "green" energy?

– Firstly, in order to effectively replace all fossil fuels, such as gas, coal and oil, electricity from renewable energy sources must also be used for transportation and heating. Thus, sector coupling is an important next step towards decarbonizing the economy.

Secondly, sector coupling makes it possible to use clean energy more efficiently by redirecting it to the transport and heating sectors, and thus can help regulate the system. For example, when energy from wind cannot be used or stored, power plants are usually shut down, and thus clean energy is not produced, it is lost. But if you use it with PtX technology, it increases its efficiency and limits greenhouse gas emissions.

Thirdly, it is another way to flexibility of supply and demand in the energy sector. By converting pure electrical energy into another form, we separate its production from consumption not only in time, but also geographically. Because with the help of PtG and PtL, it is possible to transport a resource to the place where it may be needed.

Think, for instance of electric cars, which are charged from common or autonomous grid. Let's call it direct interaction. Because the car consumes electrical energy directly, and not green gas as fuel, which was produced using electricity from renewable energy sources. According to the independent statistical agency Statista, the number of new electric vehicles registered in Germany as of 1.01.2021 was about 309.1 thousand units. This figure increased by 126% compared to the previous year.

Of course, the growth of electric mobility brings with it a number of issues. How does a large number of electric cars affect the distribution grids, especially when peaks occur due to simultaneous charging? Is it necessary and how to expand distribution grids? How to increase their manageability? It is obvious that it is necessary to spread a high-quality infrastructure of fast charging stations throughout the country. This also leads to changes in existing legislation due to the growth of new technology. How to organize all these changes at the pan-European level? As you can see, there are many questions and challenges, and they are very complex and multifaceted.
Let's consider another case - interaction of industries – the production of green hydrogen. One of the most promising projects in this area in Germany is the Salzgitter Wind Hydrogen project. The project was originated in the cooperation of three companies (Salzgitter Flachstahl GmbH, Linde AG and Avacon Natur). They intend to produce hydrogen using wind power and using electrolysis. It should be used in steel production to reduce CO2 emissions. It could also be supplied into the existing gas grid.

As part of this project, the steel mill will replace three existing blast furnaces with a combination of direct reduction units and electric arc furnaces. Such a transformation of steel production could reduce CO2 emissions by about 95% by 2050. That's a nice number, isn't it? At the same time, 7 installed wind turbines with a total capacity of 30 MW will produce electricity. And 2 electrolysis plants with a capacity of 1.25 MW, will produce about 450 m3 of high-purity hydrogen per hour. Hydrogen is already used in production of annealing steel and in hot-dip galvanizing plants. Industrial gas producer Linde currently supplies gas by road, and will continue to provide continuous supplies of hydrogen in the future. The installed equipment is currently in test operation. But we can already say that the results of this project will be breakthrough.

– In your opinion, how can we activate the process of decarbonizing the economy?

– I believe that the decarbonization of the economy is not just a technological transformation, but also a transformation of the population's thinking. It is the right and duty of every resident of every small settlement and huge metropolis to know how the energy they consume is produced and what exactly they pay for at each stage. Participate in development processes of the area where he/she lives. To do this, we all do not need to be engineers, environmentalists or financiers. It is enough to understand the picture and be able to ask the experts all the questions you are interested in. And therefore, it is necessary to carry out explanatory work, to bring the topic to broad discussion panels on different platforms. It is necessary to inform the population through all relevant mass media, to tell children in kindergarten and school about energy, about its direct and indirect impact on each person, on the economy of the country, region, etc. It is necessary to clearly show at what stages and how ordinary citizens can influence the decision on whether to build a wind turbine or not. And how they affect the environment and the economy of the country in this way. High-quality awareness of the population is fundamentally important in any changes. Decarbonisation of the economy will be stable and efficient only in this way.

– Thank you for the interview!

Forecasting of **generation by RES** electricity **facilities:** problems and solutions

Zhomart Mominbayev,
MBA, InTech-Forecast Project Manager, Director of Modern Innovative Technologies LLP

> *The main reason is the unreliability and daily unevenness of electricity supply from renewable energy sources.*

Current issues of forecasting electricity generation by renewable energy facilities

The basis of the balance of capacities of the Republic of Kazakhstan is eight national electric power stations and seven industrial power plants. The calculation of the forecast balance of electric power of the Unified Electric Power System of the Republic of Kazakhstan for an hour of combined maximum loads is made assumed that the available generation capacity of the Republic of Kazakhstan does not include the capacity of stations using renewable energy sources. The main reason is the unreliability and daily unevenness of electricity supply from renewable energy sources. Due to the instability of power output, RES stations are a very destabilizing factor for the System operator of the National Electric Grid of the Republic of Kazakhstan (KEGOC JSC).

Balance sheets and reserves

In 2020, the regulatory requirement for maneuverable capacity for balancing existing plants using renewable energy sources was 260 MW. If the need for maneuverable capacity to balance the green energy sector increases by 3 times in the coming years, the entire reserve of maneuverable capacity will be exhausted and the functioning of the National Electric Grid will noticeably deteriorate.

Along with the development of maneuverable generation as separate independent energy projects, KEGOC JSC makes proposals to include in the Technical Conditions for connecting RES facilities to the grid the provision of maneuverable sources to the System operator in the ratio of 2 MW of RES to 1 MW of maneuverable power. Exactly according to this mechanism the technical specifications for connection to the grid of the first stage of the 50 MW SPP "Balkhash" were obtained, which is implemented outside the auction mechanism. At the same time, the System operator purchases services for the provision of maneuverable power, but this payment compensates only part of the costs associated with the installation and maintenance of the ALFC system (automatic load-frequency control).

No less urgent issue for reducing the destabilizing impact of RES on the UES of the Republic of Kazakhstan is the compliance of RES stations with the stated plans for generating electricity for a day or more. In accordance with the rules of power grid, the actual generation should not deviate by +/- 10% from the reported plan. For customary stations, this norm is strictly regulated, but there have been eases in relation to RES which may soon end. The Law of the Republic of Kazakhstan "On Support for the Development of Renewable Energy Sources" specifies two points – the primary dispatching of electricity from the RES and the commercial settlement of imbalances by the AFC. At the same time, there is no information that in case of non-compliance of RES facilities with the planned output values, the System operator does not have the right to impose grid restrictions on the output of power.

Two projection models

There are two models for organizing the forecasting of electricity generation from renewable energy sources – decentralized, used in Europe, and centralized, used in China. In a decentralized model, RES facilities themselves predict the weather and output, and are themselves responsible for the results of forecasting. In a centralized model, the System operator (State Grid of China) provides all stations with a weather prognosis and is responsible for the accuracy of the forecasts. But at the same time, it also easy restricts the output from RES stations, if this affects the stability of the grid operation modes.

In Kazakhstan, the decentralized model of regulation of forecasts for electricity generation is taken as a basis, while at the stage of attracting investors and developing the RES market, the issue of compliance with the declared regimes did not cause much concern to the "green energy" representatives. However, even now the System operator is faced with the problem of inconsistency between the forecast data and the actual output. The responsibility of RES facilities will only increase with the introduction of a balancing electricity market and the growth of RES projects, which may lead to the need to adjust their financial and technical models. Currently, RES stations predict electricity generation for a day or more in advance, using third-party software, or independently, taking into account historical data and received weather forecasts. Often the prediction results look like as follows:

The meeting held on March 18 this year under the auspices of the Ministry of Energy of the Republic of Kazakhstan and KEGOC JSC on the topic "Forecasting of renewable energy production" showed the great work carried out by the System operator in this direction.

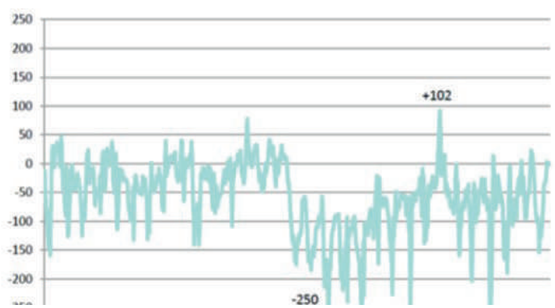
According to the presentation of KEGOC JSC, the volume of purchased/sold imbalances committed by AFC for RES Support LLP in 2020 in the simulation mode amounted to 660 million kWh in the amount of 21.3 billion tenge. That approximately corresponds to 20% of all electricity purchased by AFC for RES Support LLP from RES sources during this period.

Evaluation of deviation of RES generation values from targets

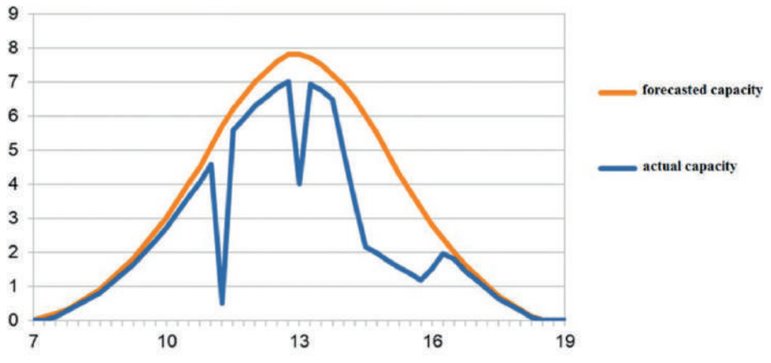
KEGOC

Deviation of RES generation values in UES, MW, January

Deviation of RES generation values in UES, MW, July



Note: Positive deviation means excess of actual RES generation over targets (unplanned power output into the mains).



InTech Forecast IT-program

In order to create a Kazakhstan software product aimed at deep customization for local conditions, reporting on the technical readiness of the station to issue power and the requirements put forward by KEGOC JSC, Modern Innovative Technologies LLP has developed an InTech Forecast IT-program with the receipt of the corresponding copyrights.

The program is being tested at the 10 MW Kengir SPP. The main elements of the program are historical weather and production data, as well as machine learning, which is necessary to constantly improve the validity of forecast data.

In the near future, the program will be ready to be launched both in Kazakhstan and in foreign markets. As a payment for the use of the IT product, it is possible to provide CO_2 units, which can also be verified by us with the involvement of a partner specialized organization. Thus, units of CO_2 that currently do not have an active demand can be involved in circulation as a means of exchange. And, of course, all operations will be performed in accordance with the Tax Code of the Republic of Kazakhstan. The program will be able to work, among other things, with such requirements of KEGOC JSC:

DUE TO EXISTING SITUATION IN THE REPUBLIC OF KAZAKHSTAN, 24-HOUR BALANCE AND SCHEDULES WILL BE DRAWN UP AS FOLLOWS:

March 15 – for March 16 and 17 March 16 – for March 18 and 19 ,
March 17 – for March 20 and 21 March 18 – for March 22 and 23 March 19 – for March 24 and 25

First of all, the program is aimed at working with solar stations, and it can be scaled to work with wind stations in future as well. In order to attract grant funds to co-finance the completion of the IT program, the development team, which in addition to programmers includes a specialist in commercialization, a marketer and a financier, in February this year applied to Center for Engineering and Technology Transfer JSC (from March 09, 2021, it was renamed to National Agency for the Development of Innovations QazInnovations JSC. Our application has passed the first stage and the documents for the second stage have already been submitted. We will definitely inform you about the results. In total, 661 applications for innovative grants were sent to QazInnovations, including 92 for GreenTech.

We are ready to actively cooperate with the participants of the electricity and capacity market to make our own contribution to the sustainable development of renewable energy projects in the Republic of Kazakhstan. We also hope that the InTech-Forecast program will occupy its niche in the market of software products for forecasting electricity generation by solar and wind power plants.

> *To integrate and increase the share of renewable energy sources, such as solar and wind power, it is necessary to ensure the flexibility of energy system, while maintaining reliability and supporting the efficient use of renewable resources. Use of energy storage systems is seen as the main solution that allows increasing the flexibility of the power system due to the possibility of rapid consumption of electricity, storage for a given period of time and further generation of electricity.*

Sanzhar Sharapov,
Head of Prospective Development and Projects Technical Support Department
Hevel EG

Prospects for development of energy storage systems

Main directions of the ESS

Currently, it is possible to identify several directions in terms of the use of ESS in the electric power industry:

- use of ESS in provision of services to ensure system reliability (Installation in-front of the meter (FTM));
- installation of ESS at the consumer in order to optimize the cost of electricity supply (Installation behind-the-meter (BTM));
- application of ESS as an element of the power grid infrastructure in order to ensure the reliability of electricity supply and delay investment in modernization/new grid construction;
- use of ESS as part of distributed energy facilities, especially in isolated power systems.

Compared to customary systems, energy storage systems at the power system level, such as hydro-accumulating power plants (HAPP), ESS based on stationary battery packs (electric-chemical generators) have a number of advantages, in terms of location independence, scalability of the solution, and possibility of placement in the immediate vicinity of any type of power plant. In turn, the HAPP requires at least special geological conditions.

Stationary ESS systems have a wide range of energy capacities, ranging from a few MWh to hundreds of MWh. Currently, there are a number of technologies that are used for grid stationary ESS. Since 2013, the balance has begun to be dominated by projects based on lithium-ion batteries, which by 2017 already accounted for more than 90% of the market.

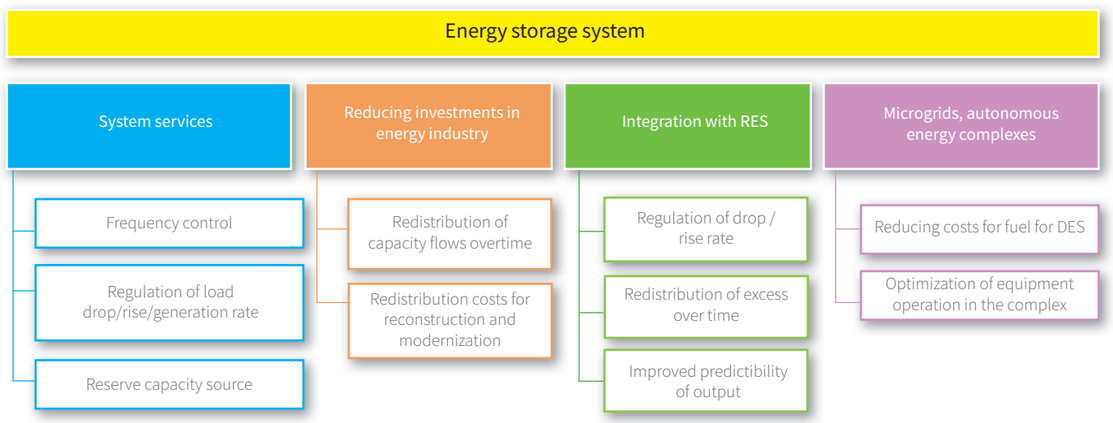
Solution for integrating the energy storage system with the ESS allows ensuring the reliability and quality of power supply, ensuring the redundancy of consumers, providing system services with a high degree of maneuverability and realize the full potential of a solar power plant. The solar power plant will meet the energy needs of the power plant during the day, and the excess solar energy will accumulate in the energy storage system and redistribute the power of ESS over time (participation in the evening load peaks), as well as provide a reserve of power in the event of an emergency shutdown of the line.

ESS functions in electric power system

Large grid electricity storage systems will play a key role in facilitating the next phase of the energy transition by increasing the share of RES in the electric power system. It should be noted that for system operators (operators of the power system and grids), the integration of ESS will allow conducting a number of system services, such as participation in the general primary frequency control (GPFC), providing a "hot" reserve of capacity in the system, regulating the rate of change in loads and capacities in the electric power system. Use of ESS allows reducing the cost of peak generating capacity, modernization of the grid infrastructure. As we said before, integration of large renewable energy sources into the energy system allows increasing the share of renewable energy sources that have a sharply variable and hard-to-predict power output profile, which in turn allows increasing the reliability of electric power system. Integration of RES+ ESS allows redistributing excess electricity over time, thereby allowing using renewable sources to the maximum. Moreover, the complexes based on RES and ESS already allow providing cheaper electricity to hard-to-reach regions and power systems isolated from centralized grids, the supply of which is provided by diesel generation with high fuel delivery costs.

A key distinguishing feature of ESS is the ability to participate in several tasks or perform a number of functions within different segments of the electric power complex.

Figure 1
The main areas of application of ESS grids



Types of system services

Participation in frequency control

For normal operation, the system must maintain a balance between the power generated and the power consumed, respectively, the resulting imbalance entails a decrease or increase in frequency in **the electric power system,** which is unacceptable. Traditionally, when regulating the frequency in the system, thermal power plants (CPP, GTPP, CCGT) and hydroelectric power plants (depending on the type of regulation) are involved. However, provision of these functions can negatively affect the efficiency of power plants. It should also be noted that the response time of the above types of plants can range from a few seconds to minutes. ESS, in turn, can provide similar frequency control functions, with a response time of milliseconds.

ESS are actually an alternative to peak generation, and their economy is determined by the ability to compete with large "system" power plants.

Regulation of the discharge rate and load surge/RES power

An increase in share of RES in the electric power system reduces the burden on other plants in the electric power system, but the unstable and sharply changing nature of the RES power profile can cause certain power fluctuations, which in the future will require keeping a “hot” reserve of power at maneuverable power plants. In order to integrate a larger volume of RES and ensure reliable and efficient operation of the system, ESS allows smoothing (regulating) the amount of power changes both directly at the RES facilities and when connected to other nodes of the system. With a sharp decrease (disconnection) of the load in the system, ESS is also able to provide a smooth decrease in the load. Thus, ESS is able to provide static and dynamic stability.

Reserve capacity source/Backup power source

In case of local damages and outages, temporary repairs of the grid infrastructure, ESS is able to provide local power supply with the function of uninterruptible power supply, which increases the reliability and quality of power supply to consumers.

Reactive power compensation and voltage regulation

Integration of ESS is carried out through the use of power converter technology, which allows using the ESS as a consumer or a source of reactive power and, accordingly, allows for local voltage regulation.

Reducing grid infrastructure costs

ESS installed in distribution grids can decrease the burden on power centers of distribution grids; provide additional reliability in the mode of an uninterruptible power supply (UPS) in the event of disconnection of high-voltage grid elements, as well as in case of short-term interruptions of power supply; and also improve the quality of electricity, stabilize the voltage. Due to the possibility of using ESS as an element of "peak" generation, it is possible to reduce the costs of the grid infrastructure, eliminating the reconstruction of the grid complex or substations.

Use of ESS directly at the consumer, have even wider functionality. The above functions also include:

- ensuring uninterrupted operation directly at the consumer in case of grid accidents;
- ensuring the quality of electricity to power the consumer’s equipment, depending on its sensitivity to the continuity of technological processes;
- providing additional peak power without the need to apply for technological connection to the grid company.

Integration of ESS with renewable energy sources

The main problem of RES-based power plants is the lack of possibility of delivering declared capacity due to the stochastic nature of renewable resources and the complexity of their forecasting. Moreover, depending on the climatic conditions, the output power of power plants based on renewable energy sources can be fluctuating in nature, due to a sharp change in the weather, for example, sharply variably cloudy leads to a sharp change in the power of a solar power plant, churlish blasts affect the production of wind power plants, etc.

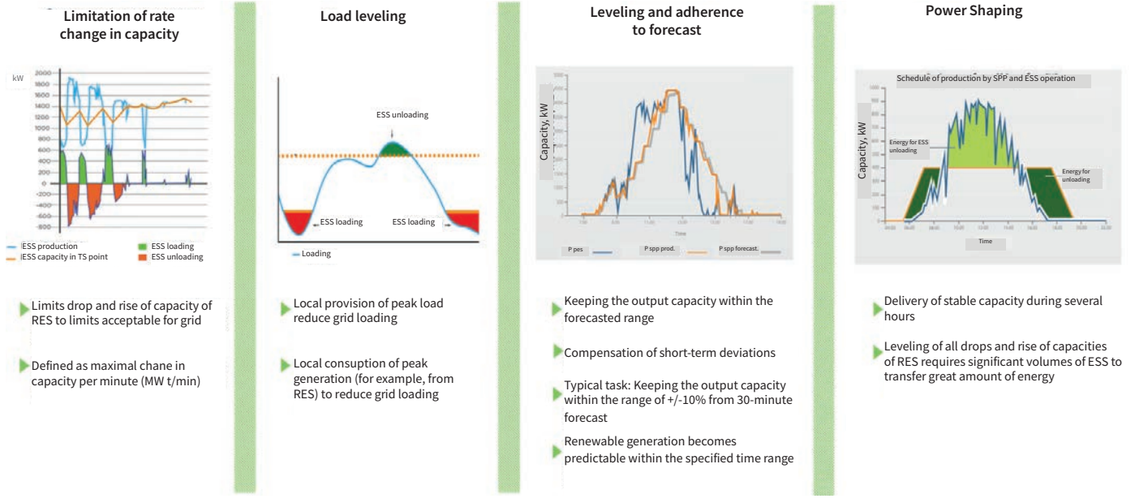
Based on the above, we can distinguish two areas of integration of ESS and RES:

- ESS directly within the RES power plant (including distributed generation at the consumer)
- ESS and RES within the local section of the power system/ power node or isolated power system.

Use of ESS within RES power plant allows ensuring the minimum declared power of the power plant, ensuring the predictability of the plant's output in the daily range and improving the accuracy of the planned schedule of power output. ESS will allow redistributing the generation profile during the day, accumulating excess electricity depending on the scheme of integration of ESS at the power plant, and reducing the fluctuating nature of renewable energy generation. In case of use of ESS and RES at the consumer allows minimizing/eliminating flows to the external grid and optimizing operating modes of own equipment.

Examples of daily operation profiles of ESS and SPP with different functions are shown in Figure 2.

Figure 2
Examples of daily operation profiles of ESS and SPP with different functions



In case of use of ESS within the local section of the electric power system with a large volume of RES, they can provide an additional volume of RES generation and solve problems with the quality of electricity supplied to the grid. Peak of renewable energy production does not coincide with the peak of consumption, forming surpluses in some periods. ESS allow eliminating the daily imbalance between the production of renewable energy and demand for electricity, and, thereby, further increasing the share of renewable energy in the balance of electric power system.

Also, as mentioned earlier, ESS will allow reducing the cost of grid infrastructure, ensuring the redistribution of power from renewable energy sources during the day, eliminating the flow of power from energy-deficient areas (during certain operating hours), eliminating the cost of reconstruction of tie-stations and preserving the volume of environmentally friendly electricity in the region.

It is necessary to separately consider the use of energy complexes based on RES and ESS for power supply of isolated electric power systems (objects distant from centralized power supply grids). Impracticability of building long power lines to supply relatively low-capacity facilities makes the decision to use energy complexes based on renewable energy sources or a combination of RES and ESS a competitive solution today. ESS acts as a guaranteed source of power and voltage, and in combination with an automated control system allows optimal using the RES to ensure reliable power supply. Integration of ESS and RES systems for parallel operation with diesel generator plants allows saving expensive imported diesel fuel, reducing operating costs by switching off diesel generation at certain hours of time or optimizing the load schedule for diesel generator plants.

Hevel EG has already implemented a number of projects in Russia (see Figure 3) with use of ESS, both at the system level (modernization of existing 5 MW ESS with use of 580 kWh ESS, construction of 10 MW ESS and 4 MW/8 MW*h ESS), and at the autonomous level (for isolated regions) of hybrid SPP complexes+ ESS for fuel economy at diesel power plants.

Figure 3
Examples of implemented SPP+ESS projects of Hevel EG

ESS technologies

Currently, the lithium-ion technology-based ESS are a proven solution for problems of integrating RES into the electric power system, performing system services (frequency, voltage regulation, etc.).

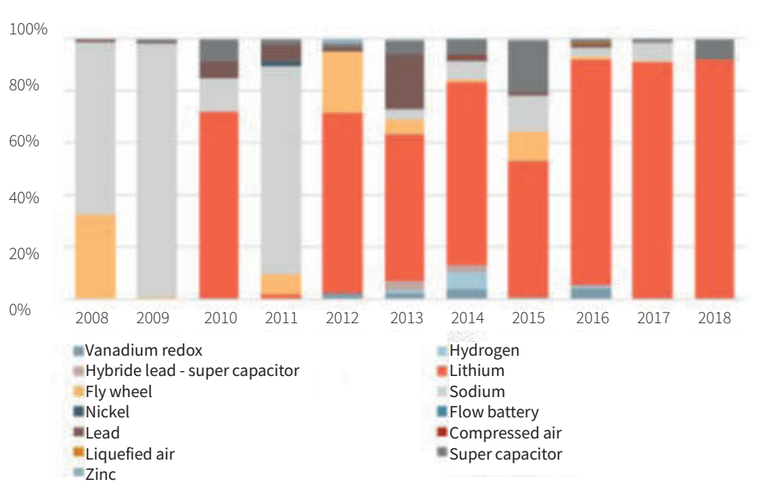


Figure 4
Structure of implemented projects by technology

Source: DOE database, analysis of Foresight Fund JSC.

The main battery technologies that are used in projects can be divided into the following groups.

1) Lead-acid and alkaline batteries

Lead-acid, nickel-iron and nickel-cadmium batteries are traditional technologies of electrochemical batteries, the technology of which has been known since the beginning of the last century.

There are modifications of technologies that can bring the number of cycles of battery pack to 5 and 10 thousand, respectively.

2) Sodium-sulfur batteries (NaS)

It is also a fairly old proven technology that has a number of drawbacks that have led to their displacement largely from the market by lithium-ion technology. In the working order, the electrolyte must be heated to 300-350°C, which leads to a relatively high energy consumption to maintain the battery in operation, and also takes time to bring it into working condition. In addition, the high temperature of the electrolyte makes the battery a fire hazard, given the high corrosivity of the expanded sodium anode. Currently, there are new developments in the field of low-temperature batteries based on sodium salts.

3) Lithium-ion batteries

Lithium-ion technology drives are the dominant technology today. Currently, the projects include the following main types of Li-Ion-based technologies:

- Lithium Titanate (LTO)
- lithium-iron-phosphate (LFP)
- lithium-cobalt oxide (LCO)
- lithium-nickel-cobalt-aluminum (NCA)
- lithium-manganese-cobalt (NMC)
- lithium-magnesium oxide (LMO)

4) Flow batteries

This is a relatively new technology with a growing market share. The first projects began to appear starting in 2012, which is two years later than the first relatively large projects based on lithium-ion technologies. Due to the development of renewable energy technologies, which are characterized not only by daily but also seasonal generation irregularities, interest is aroused by flow-through redox-vanadium batteries and systems based on the hydrogen cycle.

5) Super capacitors

Storage devices that have a huge (up to several hundred thousand cycles) cycling resource, but a small capacity and a high cost per kWh. Super capacitors are designed to respond quickly and deliver power in short periods of time, which is relevant in the case of a large share of renewable energy sources.

6) Electromechanical storage devices

Like super capacitors, they are a storage system with a very small storage capacity. Flywheels are a niche solution that can be used for consumers who value quality, or in combination with diesel – as a backup source.

7) Compressed air systems

Such systems are capable of providing power for a long time. Compressed air is a technology used, usually, in the wholesale market for quite large groups of consumers.

Figure 5 shows the distribution of technologies by the type of functions.

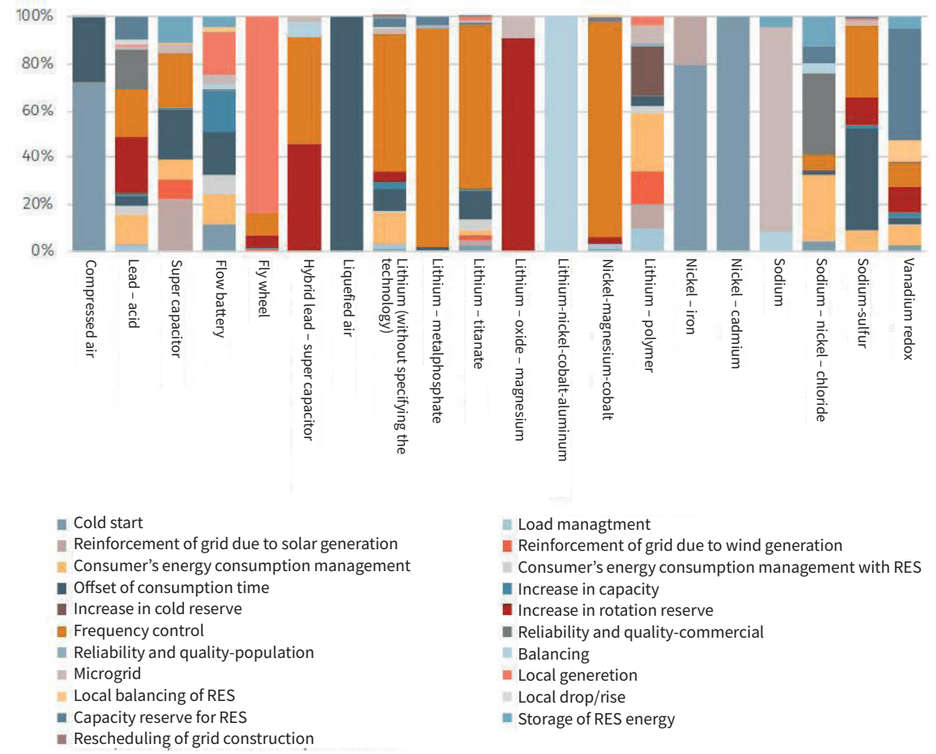


Figure 5
Distribution of technologies by types of tasks performed

Source: DOE database, analysis of Foresight Fund JSC.

To sum up what has been said

Use of ESS allows increasing the flexibility of the power system, increasing the share of renewable energy integration and providing a number of functions for system operator in order to improve the reliability and quality of electricity. This affects the rapid development of ESS technologies around the world. At the moment, the most widely used and developed technology is storage systems based on lithium-ion technologies.

However, the integration of storage systems also requires an increase in the number of projects, their application requires study and development at all stages, such as:

- development of technical solutions and development of technologies that allow efficient and economically justified using the ESS, depending on the purpose in the electric power system;
- elaboration of regulatory documentation and removal of administrative barriers by all participants of energy industry (system operator, grid companies and power supply companies, power generators, operators of the electricity and capacity market);
- elaboration of transparent market mechanisms for stimulating and enabling the implementation of ESS projects.

IMPLEMENTATION OF RENEWABLE ENERGY PROJECTS IN KAZAKHSTAN

I. Participation in the auction

1. Check the auction schedule

Order of the Minister of Energy of the Republic of Kazakhstan No. 202 of May 21, 2020 "On approval of the auction schedule for 2020"

2. Register at the website of KOREM JSC, conclude an agreement and undergo a training on the use of the trading system

- title documents *
- documents on the land plot
- documents on the connection point

* Foreign legal entities shall provide the equivalent documents with notarized translations of each document into the Kazakh and Russian languages

3. Financial guarantee for auction participation

- for auctions without documentation - 2000 KZT per 1 kW of installed capacity
- for auctions with documentation - 5000 KZT per 1 kW of installed capacity

4. Auction participation

- FSC provides envelopes with financial guarantee
- observers gather in the hall
- 30 minutes before the auction, the envelope is opened, and the data is entered into the system
- trading session opens (accepting and changing bids)
- trading session closes, auction results

5. Auction results

- auction winners
- auction prices
- volumes of selected capacity

II. Post-auction activities and project implementation

1. Inclusion in the RE Facilities Siting Plan and the List of Energy Producing Organizations Using RES

The Ministry of Energy of the Republic of Kazakhstan shall include the winners in the RE Facilities Siting Plan and the List of Energy Producing Organizations Using RES within 5 working days from the date of receipt of the Register of winners from the organizer

2. PPA conclusion

The winner submits an application for the conclusion of the PPA to the FSC within 60 calendar days from the date of inclusion in the List of Energy Producing Organizations using RES

3. PPA financial guarantee

The amount of financial guarantee of the fulfillment of the terms of the purchase agreement is 10,000 (ten thousand) KZT per 1 (one) kW of installed capacity

4. Project implementation terms (from the date of PPA conclusion)

- for SPP - 24 months
- for WPP and BioPP - 36 months
- for HPP- 48 months

5. Registration of land rights, design and survey works

- land plot selection
- obtaining the permit to use the land plot for design and survey works
- design and survey works (D&S)
- obtaining the land plot rights
- obtaining the water use rights (for HPP)

6. Grid connection

- request to identify the closest connection point to the energy transmitting organization
- development of power generation scheme
- obtaining technical specifications for a connection to the electric grid
- approval of the power generation scheme by the system operator
- conclusion of an agreement on RE facility connection

7. Preliminary project procedures and design

- obtaining source materials to develop construction projects
- approval of schematic design with the construction authority
- development of project documentation (Feasibility study, Design and estimate documentation), approval, expert examination of DED by a design institute (state or private)
- installation and construction works

8. Environmental Permit

- environmental impact assessment (Ministry of Ecology)
- environmental emissions permit (egov.kz)

9. Investment preferences under Entrepreneurial Code

10. State registration of the right to a constructed renewable energy facility

- inclusion of identification and technical information on newly created immovable property in the information system of the legal cadastre (egov.kz)

III. Commissioning *

** SPP as an example*

1. The contractor notifies the customer of the facility's readiness for commissioning

2. The customer asks to provide (within 3 days):

- contractor -declaration of compliance
- technical and designer supervision - conclusion on the quality of the works performed
- technical supervisor- conclusion on the quality of the completed construction and installation works

3. Substation commissioning

Grid connection:
- Acceptance in Commercial Operation of Automated Commercial Energy Metering System (ACEMS) and registration in the ACEMS register
- signing contracts for system services with SO and REC
- compliance with technical conditions for grid connection
- notification of FSC about carrying out complex tests in set period
- successful completion of complex tests
- connecting the substation to the grid

Substation commissioning:
- signing of the commissioning act by the customer, general contractor, authorized technical supervisor
- registration of the act with the justice authorities
- registration of rights to immovable property
- creation of a facility's technical passport
- sending documents to FSC in the set period

4. Solar park commissioning

- signing of the commissioning act by the customer, general contractor, authorized technical supervisor
- registration of the act with the justice authorities
- registration of rights to immovable property
- creation of a facility's technical passport
- sending documents to FSC in the set period

Learn more: USAID, guidance for investors on the RES projects implementation in Kazakhstan, 2018

Energy systems storage in the world:

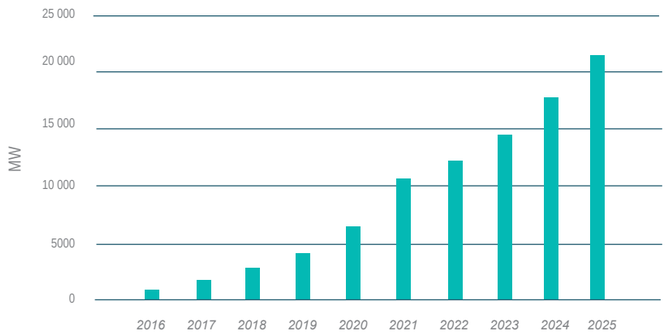
trends and forecasts

Despite the fact that the physical principles used in ESS have been known for a very long time, and the "lithium" technological revolution in low-power batteries and capacities for wearable technologies started more than a quarter of a century ago, ESS with relatively large capacities (more than 10 kW) and output (more than 10 kWh) became widespread and began to massively change the energy industry less than five years ago. According to RUSNANO, the installed capacity of stationary ESS (excluding HAPP) reached 5 GWt2 worldwide by mid-2017.

By 2017, storage device market for all applications has already reached $2.6 billion and by 2025 will total $82 billion per year with an annual growth rate of up to 60%, of which up to $50 billion per year will be accounted for by stationary ESS connected to power systems.

The energy storage market is one of the most promising high-tech markets in the world, demonstrating exponential growth rates. McKinsey Global Institute has included this type of technology to the list of twelve most important technologies for development of the world economy. According to the forecast of Bloomberg New Energy Finance, for the period 2016-2030, the volume of investments in energy storage systems will exceed $100 billion.

Forecast of the installed capacity of electricity storage systems in the world involved in grid and system services, cumulative MW



Source: Navigant Research

According to Navigant Research, by 2025, market for energy storage systems used in grid and system services will exceed $18 billion, and market for storage devices installed in commercial and industrial facilities will exceed $10.8 billion.

Yernar Bilyalov,
Director of Central Asian
Renewable Energy Resources LLP

McKinsey reports that the constant drop in battery prices will allow for a rapid increase in capacity of renewable energy sources. According to the McKinsey Global Energy Perspective 2021 report, as many world leaders pursue policies to support decarbonization and lower technology costs, renewable energy will account for about 55% of the world's energy by 2035.

According to analysts of well-known consulting company, demand for oil and gas worldwide may recover when the COVID-19 pandemic finally ends, but will likely never return to the pre-pandemic level of growth, while renewable energy sources combined with batteries are becoming increasingly cost-competitive compared to fossil fuels. McKinsey also predicts that the share of energy consumption accounted for by electricity will grow significantly from 19% today to 30% by 2050, with renewable energy sources dominating from 2030.

In addition, the rapid growth of renewable energy sources, which will account for 55% of the world's electricity generation by 2035, will be achieved through constant fall in battery prices. McKinsey's extensive work in the field of batteries based on a multidimensional analysis of technological innovation, value chain integration, electrification across all sectors, and new financial solutions that reduce the cost of capital, demonstrates the reduction in costs by up to 90%.

Which countries are leading the way in implementing energy storage systems today?

Over the past 20 years, global installations for deploying electrochemical energy storage systems have grown exponentially. In mid-2017, 78% of total storage system deployments accounted for the United States with a capacity of 680 MW, the Republic of Korea (432 MW), Japan (255 MW) and Germany (132 MW).

In the next three to five years, the energy storage industry in these leading countries will be able to boost, which can be compared to the rapid growth models that are evident in solar and wind technologies.

According to Wood Mackenzie's new forecast, global energy storage capacity will grow at compound annual growth rate (CAGR) of 31% by 2030. By the end of the decade, the United States will account for half of the world's installed energy storage capacity. By 2030, the total market capacity will grow to 741 GWh.

China, which ranks second after the United States, is also expected to see exponential growth in total storage capacity. WoodMac expects China to account for 21% of global capacity by 2030.

On the other hand, growth in Europe is expected to be slower than that of its global counterparts.

The UK and Germany will continue to dominate the storage market until 2025. Frequency response auctions remain a key source of revenue. France and Italy are also becoming more active markets, opening up markets for capacity and additional services. Spain and the rest of continental Europe are expected to follow it with potential help from the European Commission and its green recovery plan.

> ***In the next three to five years, the energy storage industry in these leading countries will be able to boost, which can be compared to the rapid growth models that are evident in solar and wind technologies.***

Declared, concluded, or under construction capacity, by technology type

Country	Electro-chemical	Electro-chemical capacitor	Lithium-ion batteries	Flow batteries	Vanadium-flow batteries	Lead-acid batteries	Metal-air batteries	Sodium batteries	Total (KW)
USA	500 398		61 959	3030	20 250	21 500	14 250		621 397
Australia	122 010		9400						131 410
Germany	30 000		92 000	210					122 210
India	110 000		125						110 125
Korea			48 500						48 500
Canada	12 150		12 010	4000	500				33 160
Egypt			30 000						30 000
Italy		1920	20 000	1950				4000	27 870
Kazakhstan				25 000					25 000
Great Britain	1000		20 300	140					21 440
Top 10	775 558	1920	294 304	34 330	25 250	21 500	14 250	4000	1 171 112
MID	784 258	2920	333 404	34 965	25 250	21 500	5650	4800	1 212 747

Source: IRENA 2017, US DOE, 2017.

It is noteworthy that according to 2017 IRENA report, with reference to the US Department of Energy, Kazakhstan already has a small experience in implementing a RES project based on flow battery technologies.

According to the IRENA Electricity storage and renewables: costs and markets to 2030 report, an additional 1.2 GW of Battery ESS projects (i.e. announced, concluded, or under construction capacities according to the "Global Energy Storage Database") are expected to be added over the next few years. Half of this ESS capacity is built in the US (51.2%). Other major countries on the list include Australia (10.8%), Germany (10.1%) and India (9.1%).

How does this happen in the EU countries?

In the European Union, the main prerequisites for use of electricity storage systems are decarbonization and decentralization of its generation. Prerequisite: increase in generation of "green" electricity and participation of households in this process.

In order to promote further decarbonisation, Directive (EC) 2018/2001 on promotion of use of energy from renewable sources dated 21 December 2018 provides for achievement of 32% of RES in EU countries by 2030. Accordingly, the use of "green" energy in the European Union will continue to grow. In addition, demand for residual capacities, in particular for energy storage, will increase.

To simplify their application, the EU adopted the Directive on General Rules for Internal Electricity Market 2019/944 in June 2019. The document is part of EU's "Clean Energy for All Europeans" legislative package. It provides for measures for transition to clean energy, as well as increasing the flexibility of energy system and participation of consumers in the energy markets.

Directive on General Rules for Internal Electricity Market 2019/944 defines an "energy storage system" as: the deferred final consumption of electricity at a later time than when it was generated, or conversion of electrical energy into a form of energy that can be stored, storage of such energy and its further conversion into electrical energy, or use as another energy carrier.

Directive provides for a broad definition of "energy storage systems", covering both conversions to electrical energy and conversions to other energy carriers. This is a broader definition than that offered in other EU countries, where the definition only involves a reconversion to electricity.

Electricity storage systems in the EU countries are used for following purposes:

- using without limiting borders in order to promote competition and supply electricity at the best price;
- stimulating the purchase of electricity from storage systems by providing a regulatory framework and providing incentives for purchase of electricity storage services;
- non-discriminatory participation in purchase of auxiliary services of electricity storage systems.

In addition, according to Directive on General Rules for the Internal Electricity Market 2019/944, system operators shall not own, develop, manage or operate electricity storage systems. In the new electricity market, energy storage services must be market-based and competitive. Therefore, cross-subsidization between electricity storage services and regulated distribution or transmission functions should be avoided.

Development of storage systems in Russia

In 2017, Russia's starting position in formation of ESS market has improved due to the launch of targeted work in this direction. Working group under the Ministry of Energy adopted a Concept for development of energy storage systems market in Russia, formed the projects of road maps "Development of energy storage systems market in Russian Federation" and "Improvement of legislation and elimination of administrative barriers" for NTI "Energynet", which contains initiatives to regulate the use of ESS.

An important achievement was approval of Action Plan ("road map") on April 28, 2018 to improve legislation and eliminate administrative barriers in order to ensure the implementation of NTI in direction "Energynet". In particular, the document contains measures to remove barriers in the use of energy storage devices.

Within the framework of Russian Investment Forum 2018, Rosseti PJSC presented a draft Strategy for development of digital power grid complex of Russia until 2030, one of the priorities of which is to ensure the readiness of the grid infrastructure for development of practice of using ESS, RES, and distributed generation.

Establishing NTI Competence Center for New and Portable Energy Sources at the premises of Institute of Problems of Chemical Physics of the Russian Academy of Sciences and Skoltech has begun. Within the framework of newly established Institute of Arctic Technologies of MIPT, applied laboratories for energy storage technologies and hydrogen technologies have been opened. Approved and launched NTI projects important for ESS market in Russia: development and testing of Internet of Energy architecture and creation of kinetic (solid-state) energy storage system (SSSPS) "Energozapas".

Development of storage systems in Ukraine

SPP and WPS are characterized by unstable electricity production, which depends on weather conditions. Therefore, for stable operation of an energy system with a large number of RES, it is important to provide residual capacities.

However, their lack also can not be a surprise. In accordance with the Law of Ukraine "On Market of Electric Energy" and Rules of Supply Safety, the Ministry of Energy and Environmental Protection was entrusted with the duties of monitoring the safety of supplies:

- publish a report on results of monitoring the safety of electricity supply every two years until July 31;
- conduct an annual risk assessment of safety violation for the next year.

However, Ministry of Energy and Environmental Protection still has not yet provided conclusions on the risk assessment.

Due to uncertainty of auctions for producers of electricity from renewable sources and reduction of "green" tariffs from 2020, at the end of 2019, there was a significant increase in the number of RES facilities. According to NEC Ukrenergo, as of January 2020, the installed capacity of renewable energy facilities was 4.97 GW, where: 76.29% - SPP; 20.85% - WPP; 2.87% - biofuel stations.

A significant increase in RES was predictable, given the following: in October 2012, according to the decision of the Council of Ministers of Energy Community D/2012/04/MC-EnC "On implementation of Directive 2009/28 / EC and Amendments to Article 20 of Treaty establishing

the Energy Community" Ukraine has committed itself to achieve the RES share of 11 % by 2020; in October 2014, the National Action Plan for Renewable Energy for period up to 2020 was approved, taking into account the target of 11 % share of RES; the law on introduction of auctions and reduction of "green" tariffs from 2020 adopted in April 2019 also encourages investors to complete renewable energy projects by the end of 2019.

On February 13, 2020, the Verkhovna Rada Committee on Energy and Housing and Utility Services considered the draft law "On Amendments to the Law of Ukraine on Electric Energy Market" (on security of energy supply, balancing of energy system and energy storage system)".

This draft law was registered by the People's Deputy Yu. A. Kamelchuk on December 12, 2019 under the number 2582. For electricity market participants, the latter aspect is very important, since the lack of regulation of storage systems does not allow the introduction of these technologies in the market of Ukraine.

Draft Law No. 2582 contains a narrower definition of an Energy storage technologies as a complex connected to a transmission or distribution system for the purpose of selection, accumulation, including by converting (physical, inertial, chemical, hydrogen and other technologies) previously produced electrical energy, its storage and further output.

The main innovations that are specified in the draft law No. 2582 include the following:

- a new participant of the electric energy market is being introduced – operator of the storage system;
- competitive procedures for construction of generating capacities are supplemented by electricity storage systems;
- activities of the storage system operator are subject to licensing for storage systems of more than 5 MW.

An interesting condition for participation of the operator of storage system is provided for the operator of the transmission system. Thus, the latter cannot be an operator of the energy storage system with a few exceptions. In particular, it is possible for transmission system operator to operate an energy storage system with a total capacity of up to 250 MW in cases where such services is not available

on the market and solely for the purpose of providing dispatching services (in particular, to ensure operational security, balancing and other measures aimed at meeting the requirements of integrity of the transmission system).

In October 2019, NEC Ukrenergo signed two memoranda for implementation of projects related to storage systems:

- Memorandum of cooperation with the French transmission system operator RTE on establishment of a 200 MW storage system.
- Memorandum with the European Bank for Reconstruction and Development on implementation of electricity storage systems project.

These memoranda provide for installation of 240 MW of electricity storage systems by the transmission system operator.

Experience in implementing energy storage projects in Kazakhstan

According to publicly available sources, a pilot project has been implemented at Kapchagai solar power plant with a capacity of 2 MW using the EnergyPod energy storage system in order to stabilize energy generation during weather changes. Capacity of the Energy Pod installation is 20 kW, the output is 50 kWh. This volume is enough to provide electricity to ten standard private houses (100-200 sq.m.) for 5-6 hours.

Regarding the technology of application, provided data specify that the installation is able to fully discharge and charge, that is, it has a 100% depth of discharge. In the course of the research, 15 thousand charge and discharge cycles were carried out. Thus when charged twice a day, the battery life will be 20 years. The technology itself belongs to the American start-up "Primus Power".

The project was implemented by Primus Power LLP and financed by Kazyna Capital Management JSC jointly with the Russian-Kazakh Nanotechnology Foundation (RKNF) for the amount of about $7 million.

In addition, implementation of the first such project in Kazakhstan opens the way for further development of energy storage systems, which should not lag behind the global trends in the industry. While energy storage around the world is still an emerging market, energy analysts note that stakeholders – whether end-users or large equity investors-are interested in continuing to invest in the sector, and it seems they will not be deterred by the effects of the pandemic and the economic recession.

> ***In the course of the research, 15 thousand charge and discharge cycles were carried out. Thus when charged twice a day, the battery life will be 20 years.***

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RENEWABLE ENERGY **IN KAZAKHSTAN:** TO GENERATE **IMPOSSIBLE** TO ACCUMULATE

Timur Shalabayev,
Executive Director
SPAQ

The importance of development of energy storage systems for the Republic of Kazakhstan

Today, there is a situation where the technical capabilities of Kazakhstan's UES do not allow further developing the renewable energy sources, due to the imbalances that RES facilities bring into the system, taking into account the lack of maneuverable capacity. This is confirmed by the low volumes for RES projects that have been put up for auction for selection of RES projects over the past 2 years. Thus, for example, in 2020, 55 MW were allocated for implementation of solar power plant projects, which were divided into 3 small lots: 15, 20 and 20 MW each. For wind farms, volumes of 65 MW, divided into 15 and 50 MW, respectively, were put up for auction. Auctions for 120 MW of installed capacity were held within the framework of two tenders for 20 and 100 MW, and the last auction was declared invalid. Volumes of 10 MW were drawn for biofuel power plant.

Strategic Development Plan of the Republic of Kazakhstan until 2025 establishes an indicator that provides for a 6 % share of energy generation by RES, so in order to achieve it, RES should grow at least 2 times based on results of sector development in 2020. In this regard, a logical question arises: how are we going to achieve a target of 6% share of energy generation by RES by 2025?

Solution to this challenge requires active measures that, on the one hand, would solve the issues of the technical capabilities of the UES of Kazakhstan, and on the other hand, would allow the implementation of renewable energy sources projects within the framework of auctions. Currently, such a solution could be implementation of renewable energy sources projects with energy storage. Energy storage systems are a rapidly developing class of high-tech devices that offer fundamentally new opportunities for development of electric power industry. They make electrical energy stored and portable, which eliminates the need for strict simultaneous processes of its generation and consumption – fundamental limitation on ensuring the balance of power, which was a key factor in formation of modern architecture of the world's existing power systems. In this article, we will try to understand the main processes that occur in the world as part of the development of renewable energy sources with energy storage systems.

Energy storage systems as maneuverable capacities

On December 7, 2020 the President signed the Law of the Republic of Kazakhstan "On amendments and additions to certain regulatory acts of the Republic of Kazakhstan on support of use of renewable energy sources and electric power industry". Amendments adopted for the first time in many years of discussions reflected the standards for development of maneuverable capacities.

Today, the surplus of electric power (3000 MW) is accompanied by a shortage of maneuverable capacities in the Republic. Electricity consumption during the day is uneven, with an increase in the evening hours and a decrease at night. This accordingly requires the operational variable operation of power plants. Obvious imbalances "by their nature" are also introduced by RES stations. Development of maneuverable capacities to attract them to regulation of production-consumption imbalances will

allow redirecting the purchase of part of the services to compensate deviations to the power plants of Kazakhstan, instead of using Russian regulation.

According to the adopted amendments to the Law, the following definition is given: "A generating unit with a maneuverable generation mode – a generating unit with a regulating electric power". Yes, based on this, the energy storage system itself is not a maneuverable capacity, because it does not generate electricity, but together with a project using renewable energy technology, for example, wind turbines or solar stations, such a solution would have the necessary ability to regulate.

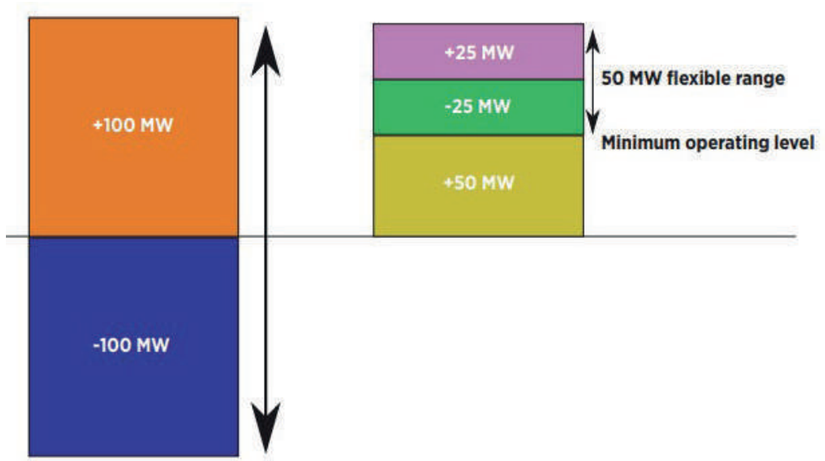
Back in 2015 International Renewable Energy Agency IRENA has made a very interesting comparison of energy storage systems with a traditional gas turbine station. Thus, according to the report, in the context of regulation, batteries are often referred to as a rapid response resource. Response time can refer to the time it takes for an energy resource to initially respond to a utility signal, or to the time it takes to reach the desired final state. In any definition, the battery reacts quickly. This is because an energy storage battery can charge and discharge energy in seconds or less, faster and more accurately than thermal power plants.

The power supply system benefits in several respects from the rapid and precise power change provided by the battery. The battery can quickly and accurately compensate for short-term power deviations from variable renewable energy generators to maintain the system frequency.

The battery pack offers all of its negative and positive capacities for regulation, as well as a higher rate of linear change in the power generated than fossil fuel power plants. In contrast, a fossil fuel burning plant is limited to a minimum operating level requirement below which operating and maintenance costs will be affected.

The battery life requires less capacity than that of a fossil fuel regulation generator due to its positive regulation performance. This is because the battery pack is faster, more accurate, and able to provide full power for positive and negative regulation ranges. These indicators allow them to be used more often than a fossil fuel generator for regulation due to the growing limitations of these resources.

100 MW energy storage battery (left) vs. 100 MW gas turbine (right)



Source: IRENA, 2015, Vassallo, 2013

> ***Back in 2015 International Renewable Energy Agency IRENA has made a very interesting comparison of energy storage systems with a traditional gas turbine station.***

In addition, fossil fuel-based regulatory services may cause higher requirements because they are slower to respond to the operator's signal. In this case, they require an increased and unnecessary frequency reserve than a resource that can provide more accurate regulation.

In addition, energy storage batteries can eliminate the need to keep fossil fuel turbines online. This avoids the greenhouse gas emissions from these additional conventional generation plants. If the additional regulation is carried out in natural gas or diesel power plants, rather than on a battery, the comparative emissions can be significant. Regulation frequency provided by traditional installations can also accelerate equipment wear due to the requirements for changes in frequency regulation power generated. This will increase the maintenance costs of these plants and therefore the total cost of additional services.

It is clear that the conventional thinking of state bodies and the system operator in order to implement the standard adopted at the legislative level for the development of maneuverable capacities will drift towards

traditional ways of solving the problem through the development of gas turbine power plants and large hydroelectric power plants, which, by the way, are also not RES.

However, in this situation, it is necessary to make a balanced decision based on an accurate comparative analysis of various scenarios and technologies, which would take into account, in addition to economic and technical aspects, the issues of emissions, environmental protection and commitments made by our country to reduce greenhouse gas emissions and goals for achieving carbon neutrality.

Drivers of development of energy storage systems in the world

According to the analysis of development of RUSNANO savings systems, the main drivers of development of the market and practice of NEA using in the world were – in order of importance – five main factors:

1. Reduction in cost and mass distribution of generation based on RES, effective large-scale use of which is impossible without NEA.
2. Development and beginning of mass distribution of private electric transport.
3. Mass commercial development of lithium-ion batteries, serving as building blocks of the most common NEAs today, and a sharp reduction in their cost.
4. Development and reduction of the cost of power electronics capable of efficiently converting current from DC to AC and vice versa, as well as development of communication systems that allow coordinating and managing a significant number of objects in the power system.
5. An increase in the demand for peak generating and grid capacity (including due to an increase in the share of more uneven household consumption in the total balance of electricity consumption), leading to an increase in the cost of power for consumers and to inefficiency of power systems.

Today, energy storage systems themselves are one of the main drivers of global energy development, accelerating and facilitating its digital transition: development of free energy exchange, p2p energy and capacity markets; use of distributed energy resources and their aggregators, demand response management; growth in share of renewable energy in the energy balance, including through distributed and microgeneration; development and mass distribution of electric vehicles, unmanned aerial vehicles and other electric vehicles.

Foreign analytical agencies also consider NEA as a component of new energy and smart energy technologies, the market of which is expanding in the context of growing investment in new energy: over the past 10 years, the volume of the global NEA market has almost tripled.

Types of accumulation technologies

There are many different batteries available on the market today, and the specifications and performance vary depending on the technology, manufacturer, and suppliers. Their discharge time ranges from one second to a day, and their capacity ranges from one kW to tens of MW. In addition, each technology has variations depending on the voltage level, the desired depth of discharge, maintenance and load requirements. Therefore, there is no single battery technology that serves a specific application, but rather a variety of options depending on the decision criteria.

Nomenclature of the power storage family in the US Department of Energy database (mid-2017)

Electro-chemical	Electro-mechanical	Hydro-accumulating	Thermal	Chemical
Electro-chemical condenser	Storage of energy from compressed air	Closed-loop hydraulic accumulator	Thermal storage of chilled water	Hydrogen storage systems
Li-ion battery	Flywheel storage system	Open-loop pumping circuit hydraulic accumulator	Concrete thermal energy storage	Liquid air energy storage unit
Redox battery	Superconducting magnetic energy storage		Thermal temperature storage	
Vanadium redox battery			Use of ice to store energy	
Lead-acid storage battery			Thermal storage of molten salt	
Metal-air battery				
Sodium-ion battery				
Sodium-sulfur battery				

Source: Electricity Storage and Renewables: Costs and Markets to 2030, IRENA, 2017

However, it is the lithium-ion energy storage batteries that are of interest to solar and wind power plants around the world. As a group, lithium-ion batteries have the advantage of high specific energy, as well as high energy and power density compared to other battery technologies. They also demonstrate high speed and high discharge power, excellent circular turn efficiency, relatively long service life, and low self-discharge rate. First introduced by Sony in the early 1990s, rechargeable lithium-ion batteries quickly became the most important technology for consumer electronics.

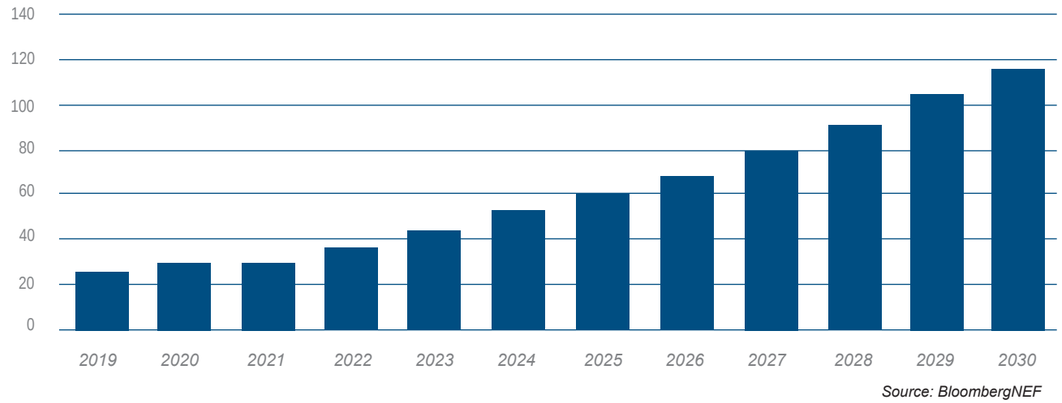
Moreover, lithium-ion battery technology is becoming more and more affordable. According to the 2019 battery price survey, BNEF predicts that the average price of energy storage batteries will be close to $100/kWh by 2023, compared to $156/kWh this year. In general, there has been an 87%

drop in prices since 2010, when prices were around $ 1,100 per kWh in real terms.

To date, a combination of factors continues to reduce the costs: new packaging designs, lower production costs, order size, increased sales of battery-powered electric vehicles, and continued penetration of high-energy-density cathodes.

BNEF forecasts that the battery market will be worth $116 billion a year by 2030, and this does not include investments in supply chain. Drop in prices bodes well for electrification efforts, especially in transportation. According to BNEF, by 2024, prices for energy storage batteries will be so low that electric cars will begin to reach price parity with conventional cars in some regions.

Annual growth of the lithium-ion battery market, billion $



Source: BloombergNEF

Fall in prices goes with increasing market share in the BNEF analysis, which shows that total battery demand will reach 2 TWh in 2024.

"To generate impossible to accumulate": where to put a comma?

Today, one of the main tasks of the UES of Kazakhstan is to solve the problem of balancing. In general, this problem does not technically make it possible to further develop renewable energy. Apparently, a potential solution for RES would be, in addition to the construction of generating capacities with a maneuverable generation mode, implementation of projects with energy storage systems. Indeed, there are other regulatory tools, for example, such as demand response, which allow to lessen the burden on the system during peak loads. But so far, all possible solutions are either on paper, or are being discussed in heated disputes, or are expected by players of the renewable energy market.

Today, we realize that the time for action has come! As the President of the Republic of Kazakhstan Mr. K.K. Tokayev said in his Address to the People of Kazakhstan in 2020: "The competitiveness of future leading states is originated with the era of crises and fundamental changes… The challenges of the time force us to constantly develop, improve, and become stronger."

Taking into account the current state of electricity generation based on RES in Kazakhstan, everyone may choose where to put a comma in the proposed title of the article. After all, I would like to see the possibility of further implementation of RES projects, and development of energy storage systems.

Instead of concluding, let's focus on the most significant barriers to the development of storage systems, to which experts give prominence and currently hinder the start of the market and which should be eliminated by the policy of the state and business in this area:

1. Lack of reference and fairly well-known successful practice of using energy storage systems (even at the level of singular example) causes reasonable doubts about the systems and therefore seem a risky technological solution;

2. Distrust of potential consumers to the cost and technical characteristics of storage systems, including those claimed by foreign manufacturers; due to the novelty, distrust to the level of its readiness, to the real cost and operational life;

3. Complexity of demonstration of effectiveness of energy storage systems in limited-scale projects at the level of individual households or enterprises, occurrence of economic effect only upon implementation of complex projects at the level of districts or industrial sites;

4. Imperfection of current regulatory and technical regulation of electric power industry in terms of its lack of adaptation to the use of energy storage systems, especially on the basis of modern technologies.

List of References:

1. Order of the Minister of Energy of the Republic of Kazakhstan No. 202 dated May 21, 2021. "On approval of auction selling schedule for 2020"
2. Decree of the President of the Republic of Kazakhstan dated February 15, 2018 No. 636 "On approval of the Strategic Development Plan of the Republic of Kazakhstan until 2025"
3. Electricity storage systems market in Russia: development potential. Expert and analytical report, Moscow, Rusnano, 2018.
4. KEMA, 2010; California Energy Storage Alliance, 20115. KEMA, 2010
6. https://renen.ru/kazahstan-obyazuetsya-dostich-uglerodnoj-nejtralnosti-k-2060-godu-prezident-tokaev/
7. Electricity storage systems market in Russia: development potential. Expert and analytical report, Moscow, Rusnano, 2018.
8. https://microgridknowledge.com/battery-energy-storage-prices/

SOLAR FEST QAZAQSTAN

INTERNATIONAL BUSINESS FESTIVAL ON RENEWABLE ENERGY

Solar Fest Qazaqstan is organized in the heart of the National Park Burabay in the Rixos Borovoe hotel

Solar Fest Qazaqstan was supported by:

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SOLAR POWER ASSOCIATION OF QAZAQSTAN

Utility-scale SOLAR POWER STATIONS in Kazakhstan

Burnoye Solar – 1 SPP

- Project capacity: 50 MW;
- Expected power generation: 73.18 million kWh;
- Location: Zhualy district, Zhambyl region;
- Area: 150 ha (substation + solar park)
- Investors: Samruk-Kazyna Invest, United Green LLP (Great Britain)
- Financial Institutions: European Bank for Reconstruction and Development, Clean Technology Fund

Status:
- Cost: USD 135 million
- Commissioned in April 2015

Equipment:
- 220/10 kV substation: Siemens, Alstom, Schneider Electric;
- Inverters: 32 Schneider Electric inverters;
- Solar panels: 192,192 SolarWorld modules.

Burnoye Solar – 2 SPP

- Project capacity: 50 MW;
- Expected power generation: 78.9 million kWh;
- Location: Zhualy district, Zhambyl region;
- Area: 74 ha (solar park)
- Investors: Samruk-Kazyna Invest, United Green LLP (Great Britain)

Status:
- Cost: USD 77.7 million
- Commissioned on June 4, 2018

Equipment:
- Extension of 220/10 kV substation: Siemens, Schneider Electric;
- Inverters: 16 Sungrow inverters;
- Solar panels: 185,174 Jinko Solar modules.

Gulshat SPP

- Project capacity: 40 MW;
- Expected power generation: 57.9 million kWh
- Location: Gulshat village, Karaganda region;
- Area: 100 ha (substation + solar park);
- Investors: Risen Energy (China)
- Financial Institutions: European Bank for Reconstruction and Development

Status:
- Cost: USD 46 million
- Commissioned in February 2019

Equipment:
- 110/35 kV substation: TBEA
- Inverters: 530 string Huawei inverters
- Solar panels: 122,960 Risen Energy modules

Zadariya SPP

- Project capacity: 14 MW;
- Expected power generation: 21.6 million kWh;
- Location: Arys village, Turkestan region;
- Area: 30 ha
- Investors: UrbaSolar (France)
- Financial Institutions: European Bank for Reconstruction and Development, Clean Technology Fund

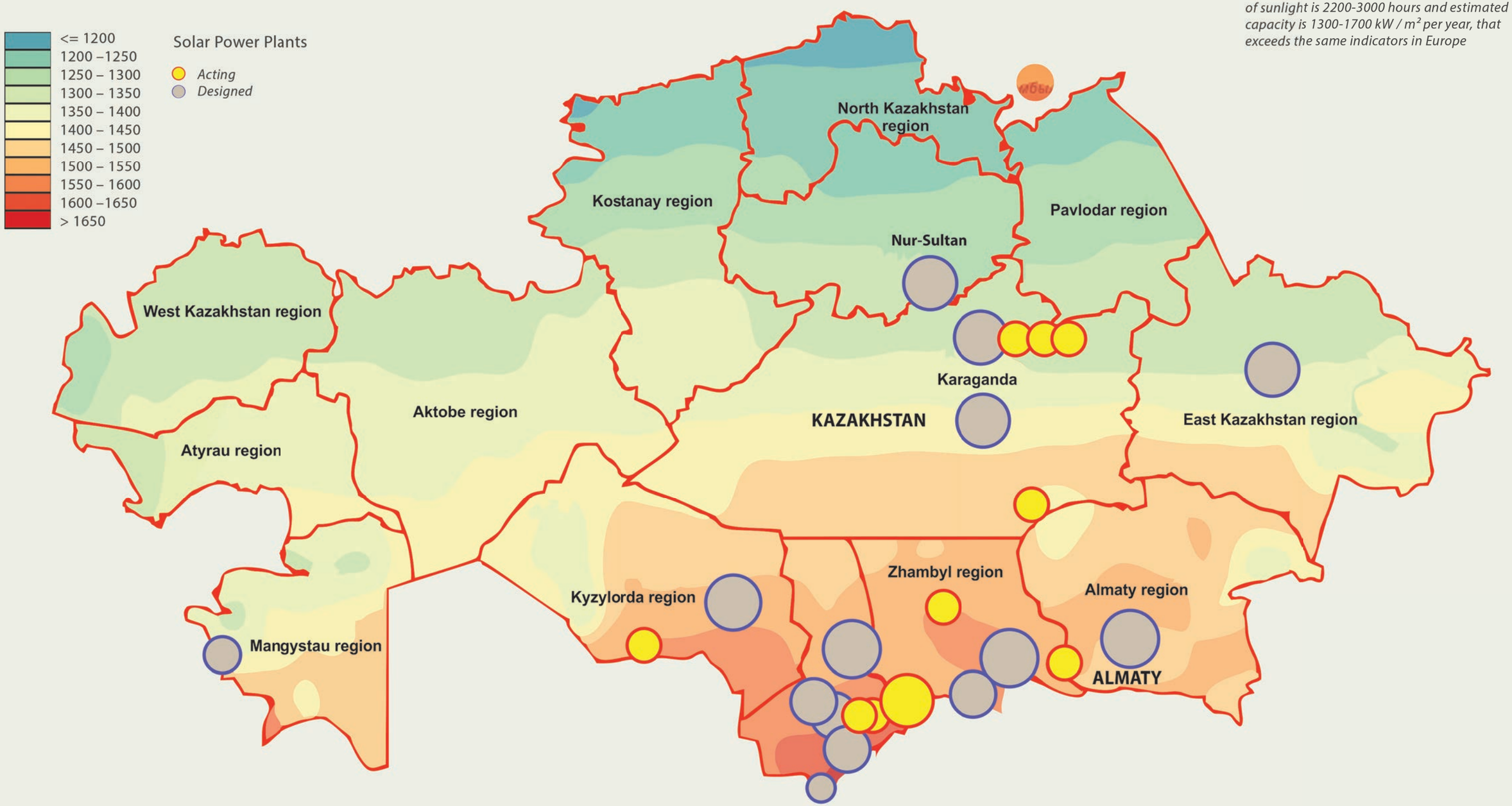
Status:
- Cost: USD 12.7 million
- Construction and installation work is underway;
- Commissioning is planned in autumn 2019

Equipment:
- 35/10 kV Substation: Alageum Electric;
- Inverters: 6 SMA inverters;
- Solar panels: 50,000 Trinasolar modules.

Solar Atlas of Kazakhstan

Total radiation on horizontal surface (source – NASA SSE), kWh / m²/ year

This map with Solar Atlas of Kazakhstan demonstrates the high potential of solar insolation in Kazakhstan – annual duration of sunlight is 2200-3000 hours and estimated capacity is 1300-1700 kW / m² per year, that exceeds the same indicators in Europe



It is important to notice, that the effectiveness of helio collectors mostly depends on number of clear days per year, rather than on average annual temperature

Thus, responding on the most popular question – yes, in winter they work no worse than in summer, the daylight just shorter in winter

FORECAST BALANCE OF ELECTRIC ENERGY OF THE UNIFIED ELECTRIC POWER SYSTEM OF THE REPUBLIC OF KAZAKHSTAN

IN THE PERIOD 2021-2027

01

FORECAST — *bln. kWh*

	2021	2022	2023	2024	2025	2026	2027
Electricity consumption	108, 9	111,8	114,9	117,7	120,3	123,5	126,5
Electricity generation	115,4	123,6	124,0	127,6	132,3	132,6	132,3
Existing stations	114,1	114,1	113,3	112,8	110,9	109,5	105,7
Planned	1,3	9,5	10,7	14,8	21,4	23,1	26,6
including RES	0,6	3,1	3,9	4,4	5,2	6,0	6,8
Deficit (+), excess (-)	-6,5	-11,7	-9,1	-9,9	-12,0	-9,1	-5,8

02

The Northern area

FORECAST — *bln. kWh*

	2021	2022	2023	2024	2025	2026	2027
Electricity consumption	70,9	72,5	74,2	75,7	77,0	79,0	80,8
Electricity generation	86,9	90,3	90,2	93,6	95,8	95,8	95,7
Existing stations	86,1	86,1	85,5	85,0	83,1	82,0	78,9
Planned	0,8	4,2	4,7	8,6	12,7	13,9	16,9
including RES	0,3	1,3	1,7	2,1	2,3	2,6	2,8
Deficit (+), excess (-)	-16,0	-17,8	-16,0	-17,9	-18,8	-16,9	-14,9
Flows with the Southern area of the RK	-10,8	-9,9	-10,2	-10,9	-11,1	-11,4	-11,6

03

The Southern area

FORECAST — *bln. kWh*

	2021	2022	2023	2024	2025	2026	2027
Electricity consumption	23,7	24,3	25,0	25,7	26,4	27,0	27,7
Electricity generation	12,9	14,3	14,8	14,8	15,2	15,6	16,1
Existing stations	12,6	12,6	12,4	12,4	12,4	12,4	12,4
Planned	0,3	1,8	2,4	2,4	2,9	3,3	3,7
including RES	0,3	1,8	2,3	2,3	2,7	3,1	3,6
Deficit (+), excess (-)	10,8	9,9	10,2	10,9	11,1	11,4	11,6

04

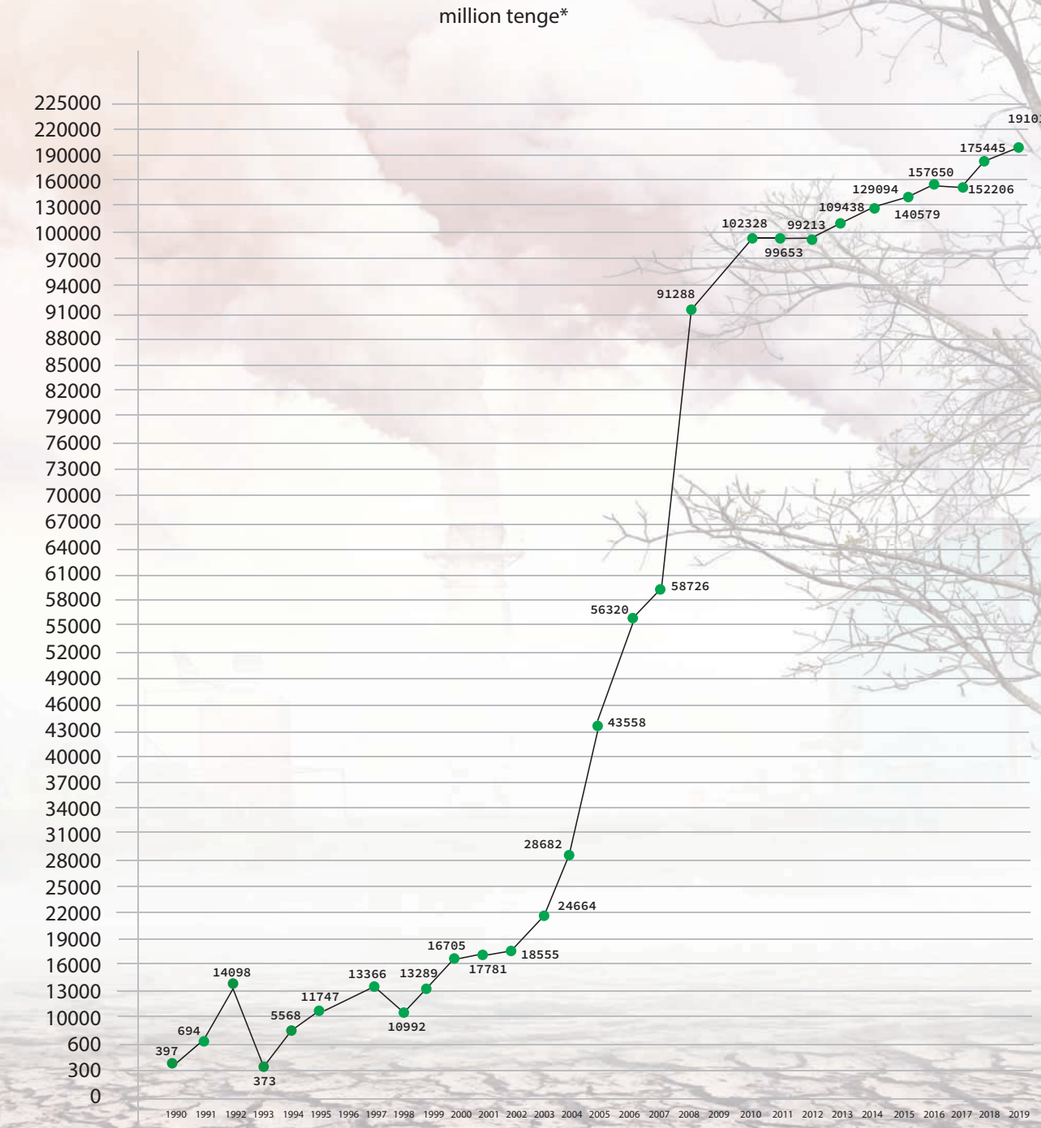
The Western area

FORECAST — *bln. kWh*

	2021	2022	2023	2024	2025	2026	2027
Electricity consumption	14,4	15,0	15,6	16,3	16,9	17,5	18,0
Electricity generation	15,6	18,9	19,0	19,2	21,3	21,1	20,5
Existing stations	15,4	15,4	15,4	15,4	15,4	15,2	14,4
Planned	0,2	3,5	3,6	3,7	5,8	6,0	6,1
including RES	0,0	0,0	0,0	0,0	0,1	0,3	0,4
Deficit (+), excess (-)	-1,2	-3,9	-3,4	-2,9	-4,3	-3,6	-2,5

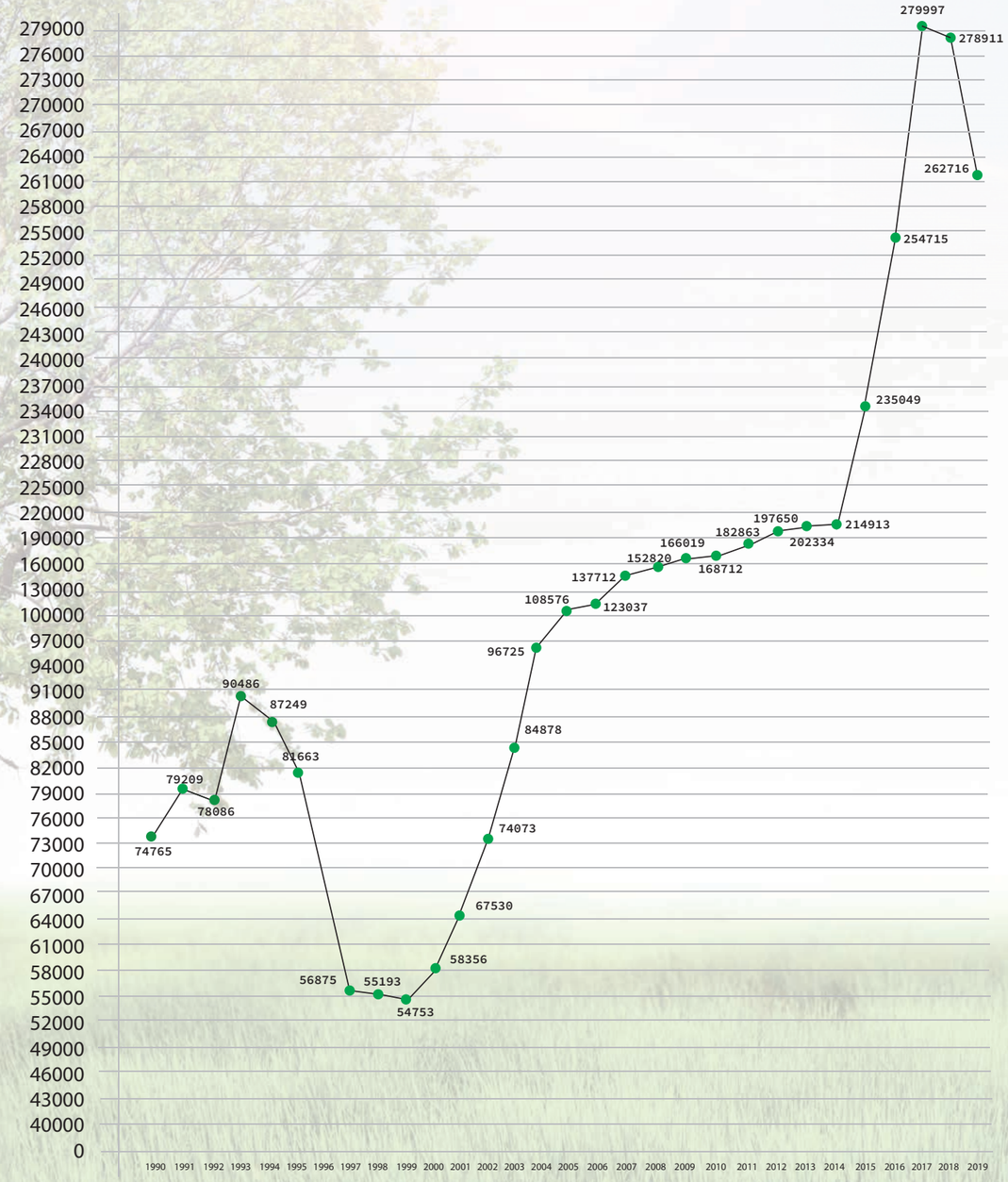
"Appendix to the Order of the Minister of Energy of the Republic of Kazakhstan dated January 12, 2021 No. 6
http: //adilet.zan.kz/rus/docs/V2100022051

CURRENT COSTS FOR for environmental protection,



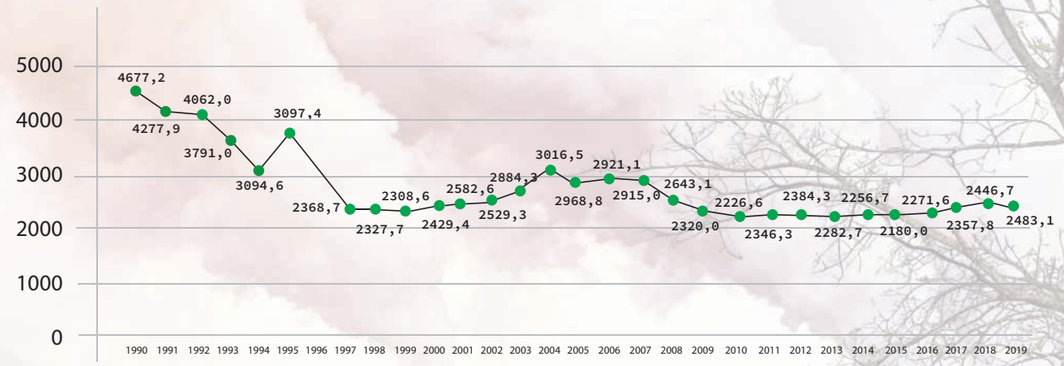
*) until 1993 - rubles

NUMBER OF STATIONARY SOURCES OF POLLUTION, UNITS



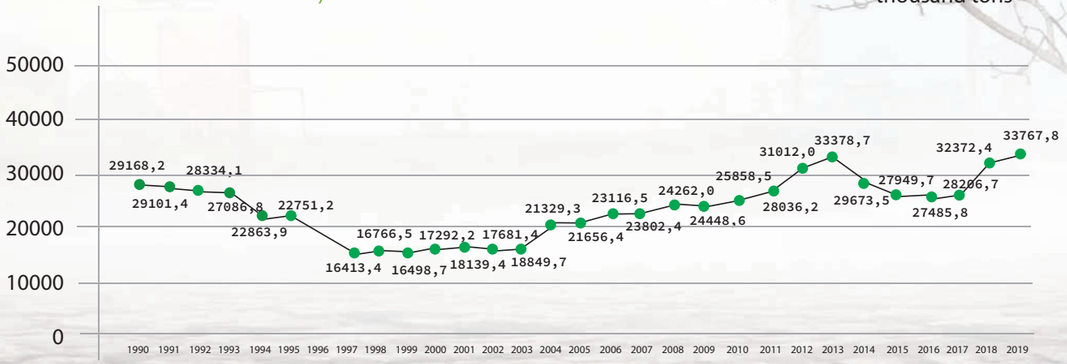
EMISSIONS OF POLLUTANTS FROM STATIONARY SOURCES INTO THE ATMOSPHERE,

thousand tons



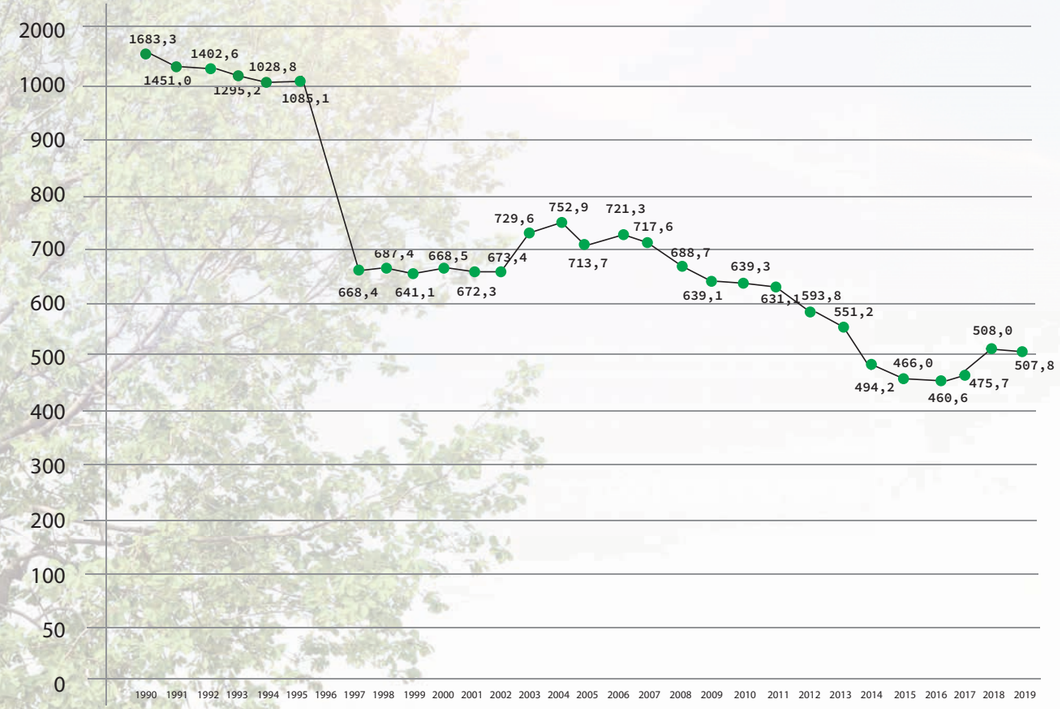
POLLUTANTS CAUGHT AND NEUTRALIZED,

thousand tons



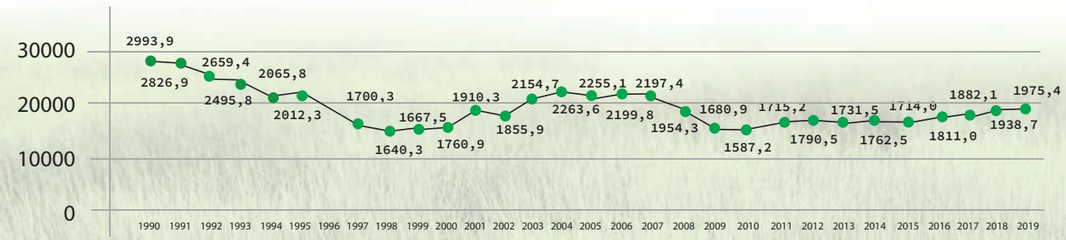
EMISSIONS OF SOLID POLLUTANTS,

thousand tons



EMISSIONS OF LIQUID AND GASEOUS POLLUTANTS,

thousand tons



Source: Agency for Strategic planning and reforms of the Republic of Kazakhstan Bureau of National statistics

TEAM OF ASSOCIATION

PLATFORM FOR NATIONAL AND INTERNATIONAL PLAYERS IN SOLAR ENERGY INDUSTRY

SOLAR POWER ASSOCIATION OF QAZAQSTAN

ASSOCIATION AS INFORMATIONAL RESOURCE

The Association is a resource that will allow members of the Association to receive information about changes in legislation immediately

Association is a resource that creates public opinion, and also contributes to the promotion of renewable energy. It will allow you to form a positive image around an event in the activities of both a member of the Association and the Association itself

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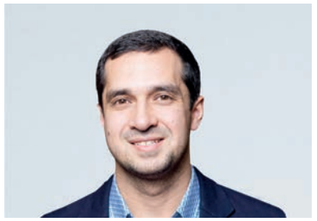
Member of the Board

NURLAN KAPENOV
Chairman of the Board of Directors

SANIYA PERZADAYEVA
Independent Director

KALIYA KHISSAMIDINOVA
Chairman of the Executive Board



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