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Low-Carbon Development Concept of Samruk-Kazyna JSC

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Content

Introduction

This Low-Carbon Development of Samruk–Kazyna Concept *(hereinafter - the Concept)* was developed as part of the implementation of the strategic task of reducing the carbon footprint of Samruk-Kazyna JSC *(hereinafter -the Fund)* and portfolio companies *(PC)*.

The Concept is aimed at implementing a socially just and economically sound transition to low-carbon development in order to promote carbon neutrality by 2060.

The Concept defines the vision, goals, as well as the key directions and objectives of the Fund for the possible achievement of carbon neutrality by 2060 for the Fund and portfolio companies.

The transition from an industrial agenda to a climate one is the global trend of development in the present-day world. The attention of the international community is focused on significant changes that are based on the transformation of energy consumption and changes in the global economy.

At the initial stage, motivational incentives for decarbonization were based on arguments about the frightening effects of climate scenarios. At the next stage, the countries initiated economic tools of stimulating energy transfer. Today, the international community has realized the importance of the climate agenda, which has resulted in a change of paradigm in thinking.

Heads of the State and representatives of business communities understand the need to reduce the impact on the environment and strive to find constructive solutions. Investors are also aware that environmental risks are becoming investment risks that affect the long-term sustainability and value of companies. Governments and major multinational companies, including energy and oil companies, around the world declare goals on achieving carbon neutrality. International financial organizations completely refuse to finance coal production.

Countries' efforts to prevent global temperature rise are reflected in a number of international agreements that define commitments to reduce the carbon footprint for each of the participating countries.

In 2015, 196 countries, including Kazakhstan, signed the Paris Agreement within the framework of the 21st session of the Conference of the Parties to the UN Framework Convention on Climate Change, making commitments to reduce greenhouse gas emissions. The Republic of Kazakhstan has made a commitment to reduce greenhouse gases by 2030 from the 1990 level by 15% unconditionally *(25% conditional target depending on additional foreign investment, access to technology, etc.)*.

The world community confirmed these commitments at the 26th session of the Conference of the Parties to the UN Framework Convention on Climate Change *(COP-26)*, held this year in Glasgow *(Great Britain)*. More than 30 thousand participants from about 200 countries, including Kazakhstan, took part in COP-26.

Transition to low-carbon development has become particularly relevant for Kazakhstan, given the goal of achieving carbon neutrality by 2060, announced by the President of the Republic of Kazakhstan in December 2020 at the Climate Ambitions Summit.

The management of the Fund has identified sustainable development as one of the key priorities, and transition to low-carbon development is a strategic task aimed at increasing the sustainability and strengthening the competitiveness of the Fund. At the same time, untimely taking measures can result in significant reputation and financial risks for both the Fund and the economy as a whole.

In Kazakhstan, the trends today are already aimed at tightening carbon regulation. The entry into force of the new Environmental Code from July 01, 2021, as well as the updating of the Code of Administrative Offenses on Environmental Issues entails the risks of paying fines for "brown" productions. It is planned to reduce the country's carbon budget by 1.5% annually from 2021 to 2030, which will increase financial pressure on emitting enterprises. In compliance with the requirements of the Environmental Code and by-laws, the requirements for the monitoring, reporting and verification system regarding greenhouse gas emissions and their absorption, actions to mitigate the effects of climate change have been strengthened.

The risks associated with stricter environmental requirements arise not only at the country level, but also at the international level. In the competition for the most attractive markets, the policy of "environmental protectionism" is becoming increasingly widespread, within the framework of which barriers are being formed that restrict the import of technologies and products that pose an increased risk to global warming and the environment.

One of these documents was the "road map" – the "Green Deal for the EU". The Deal fixed interim targets for reducing harmful emissions into the atmosphere by 2030 and achieving carbon neutrality by 2050, and also marked the tightening of the terms of emissions trading allowances in the EU. The Carbon Border Adjustment Mechanism *(CBAM)* aimed at implementing the Deal involves levying customs fees on imported goods to the EU depending on their carbon footprint.

The tightening of carbon regulation will concern not only the direct export of Kazakh products to the EU countries. Significant volumes of minerals and metals, for example, are exported to China, where they are processed and exported as finished products to the EU, the USA and other Western countries. Consequently, the introduction of “environmental protectionism” tools will affect the entire value chain. In this regard, the introduction of European CBAM may significantly reduce the export potential of the Fund's portfolio companies involved in the export of oil and petroleum products, gas, uranium, zinc and lead concentrates and other products. In general, the economic model based on fossil fuels will become increasingly unstable, and external pressure for change will increase.

The ongoing changes in Kazakhstan and in the world may lead to a decrease in export potential and investment inflows, deterioration of investment attractiveness and competitiveness, which will generally affect the long-term sustainability of the Fund. These challenges, in addition to the environmental component, have important social and economic significance for Kazakhstan.

Moreover, the global pressure on coal companies and the decommissioning of coal burning plants is an important factor for the Fund, since coal mining, generation and use of electricity generated through coal burning takes a significant share in the production processes in the Fund group.

The energy transition is already having a significant impact on international energy markets, leading to a gradual change in consumption balances – the share of coal is decreasing in favor of increasing consumption of uranium and natural gas.

The Fund should consider the new climate agenda, on the one hand, as a challenge to the traditional energy system, on the other hand, as new opportunities for growth. For example, the development of gas generation will entail investments in field exploration, construction of gas processing plants and gas infrastructure.

With a systematic and balanced approach, energy transition will accelerate diversification of the portfolio and development of new industries, create new jobs, improve the skills of personnel, gain access to finance and investments, as well as ensure transfer of advanced technologies and knowledge.

1. Analysis of the current situation (carbon footprint of the Fund)

The Fund Group of companies includes enterprises of the oil and gas and transport and logistics sectors, chemical and nuclear industries, mining and metallurgical complex, energy and real estate.

The carbon footprint *(direct and indirect CO_2 emissions*) of the Fund group by the end of 2021 is estimated at 57.8 million tons of CO_2 *(direct – 47.0 million tons of CO_2, indirect – 10.8 million tons of CO_2)*. The volume of direct greenhouse gas emissions increased by 17% compared to the previous 2020 *(40.4 million tons of CO_2)* and by 14% over a three-year period from 2018 *(41 million tons of CO_2*).

The contribution of direct CO_2 emissions from the Fund's portfolio companies to country-wide emissions is estimated at 13.3% according to 2021 data.

It should be noted that current data may provide an incomplete picture of the carbon footprint of the Fund's group of companies:

1) The system of accounting and collecting information on greenhouse gas emissions is established only at entities where installations are quota-based, that is, the volume of GHG emissions exceeds 20 thousand tons of CO_2 per year. Accordingly, data on installations with emissions of less than 20 thousand tons of CO_2 per year may be incomplete and/or unreliable;

2) The collection of data on greenhouse gas emissions is mainly carried out only within the scope of Scope 1, that is, direct emissions. Almost all portfolio companies lack a data collection system for Scope 2 and 3;

For reference:

Scope 1 (Category 1): Direct greenhouse gas emissions from sources owned or controlled by the company, for example, emissions from combustion in boilers owned or controlled by it, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled technological equipment.

Scope 2 (Category 2): Covers indirect greenhouse gas emissions resulting from the production of electricity consumed by the company.

Scope 3 (Category 3): all other indirect greenhouse gas emissions arising in the company's value chain.

3) Data accounting is conducted mainly on CO_2, methane and nitrous oxide emissions are not fully taken into account, which are also part of greenhouse gases in accordance with international standards *(according to regulatory standards of the Republic of Kazakhstan, methane and nitrogen oxide emissions are accounted for as pollutants, not greenhouse gases);*

4) Manual collection of emission data is carried out, with calculations of emissions based on standards and coefficients. At the same time, possible deviations in the operation of the installations are not taken into account.

In this regard, it is necessary to unify methodological approaches for the collection and accounting of data on greenhouse gases, taking into account the industry specifics of each portfolio company within the Fund. This approach should be aimed at improving the timeliness and quality of

data, covering various types of greenhouse gas emissions, both by coverage and by types of greenhouse gases and installations. Moreover, it is necessary to establish automated information collection.

This will make it possible not only to compare data between companies, but also to prepare for reporting in accordance with national and international norms and standards, as well as to verify data by third-party organizations, for example, to calculate the carbon footprint of products within the framework of Carbon border adjustment mechanism *(CBAM).*

1.1. Direct greenhouse gas emissions and production indicators of the Fund Group

In order to achieve Kazakhstan's stated goals to reduce greenhouse gases, the Environmental Code provides for a quota system for installations with emissions of more than 20 thousand tons of CO_2.

Quota–based installations account for about 40.4 million tons of direct CO_2 emissions, non-quota based - 6.6 million tons of CO_2.

As for the Fund's Group, the operators of quota installations are 22 organizations from the groups of companies JSC "Samruk-Energo", JSC "NC "KazMunayGas" and JSC "NC "QazaqGaz". At the same time, starting from 2023, it is expected to switch to the category of quota installations of Tau-Ken Temir LLP and ShalkiyaZinc JSC *(Tau-Ken Samruk NGC JSC)* in connection with reaching the design capacity.

The consumption of primary energy resources and petroleum products by the Fund's group of companies is **19.2 million tons of coal equivalent** *(hereinafter - c. eq.),* which is about 18.5% of the total consumption of primary energy resources in the country *(Appendix 2, Tables 1 and 4):*

- coal – 12.4 million tons of c. eq;
- gas *(natural and associated petroleum gas)* – 4.0 million tons of c. eq;
- liquid fuel – 2.0 million tons of c. eq;
- boiler fuel – 0.7 million tons of c. eq.

A high proportion of the use of coal for electricity and heat generation, in industry, as well as for hydrocarbon-fueled vehicles make a key contribution to atmospheric air pollution and the impact on climate change.

The main CO_2 emitters in the Fund’s group are Samruk-Energy JSC *(70%),* and JSC NC KazMunayGas *(17%)*, whose activities are focused on fossil fuels. The share of JSC NC QazaqGaz and JSC NC Kazakhstan Temir Zholy accounts for 5% and 4%, respectively *(Annex No. 2 – Table 2).* The source of CO_2 emissions for the remaining PCs *(4%)* is also the use of hydrocarbon fuels to support their production and operational activities. The main sources of emissions of pollutants and greenhouse gases are fuel power plants, marker pollutants, which are nitrogen oxides, sulfur oxides, carbon monoxide, dust *(ash).*

Over the period 2019-2021, there was an increase in the level of CO_2 emissions, primarily due to an increase in electricity production at JSC Samruk-Energy power plants. The structure of direct emissions *(Scope 1)* is dominated by the following production processes: stationary combustion of fossil fuels *(coal, gas, fuel oil)* to generate electricity- and heat energy *(boilers, furnaces, gas compressors, generators)*, fuel combustion on technological equipment *(furnaces, heaters, gas compressors, gas treatment plants, drilling rigs, mining equipment, etc.)*, emissions from transport *(air transport engines, internal combustion engines, traction engines of locomotives, etc.)*, volatile emissions *(equipment leaks, losses from evaporation, ventilation, etc.)*, flaring of gas, and emissions in the processes of grinding coal and associated formations during coal mining, emissions as a result of low-temperature carbon oxidation reactions during storage of internal stripping on external rock dumps.

Production of electric and thermal energy

The production of electric and thermal energy accounts for more than 71% of carbon dioxide emissions.

The total installed capacity of the Fund's power plants is 6,624 MW, which is about 30% of the total installed capacity of Kazakhstan's power plants. The Fund owns such major power plants in Kazakhstan as coal-fired Ekibastuz GRES-1 and GRES-2.

Electricity generation by the Fund's power plants is more than 37.9 billion kWh, which is more than 33% of the total electricity generation in the country. In the context of the Fund's companies, according to data for 2021, 86% of electricity was generated at coal-fired power plants, 6% was generated at "clean" energy sources *(SPP, WPP and small/large HPP)* and almost 7% at gas facilities.

In 2020-2021, despite the decline in economic output due to the COVID-19 pandemic, there was a significant increase in electricity consumption. In 2021, Ekibastuz GRES-1 and GRES-2 generated the maximum amount of electricity during the operation of the stations. In 2021, the gas station of the Karabatan PSU *(Samruk-Kazyna Ondeu LLP)* was also brought to its design capacity.

The production of thermal energy is carried out at Almaty thermal power plants and boilers of the Western thermal complex, whose share in the production of thermal energy of the country is about 6%. In the cogeneration cycle, heat production is an additional process to the production of electricity *(emissions are common, fuel costs are divided according to special methods)*.

The largest consumption of primary energy resources *(64%)* falls on JSC "Samruk-Energo" – about 12.6 million tons of c. eq. per year. The main energy resource consumed is coal from the Bogatyr mine, used for the production of electric and thermal energy in the amount of more than 12.3 million tons of c. eq.

It is the development and transformation of the electric power industry that should make the main contribution to achieving carbon neutrality.

Transport Sector

The share of the transport sector in greenhouse gas emissions in Kazakhstan in 2021 amounted to about 7%, of which 11% of greenhouse gas emissions are accounted for by the Fund's transport sector *(road transport, railway, water transport)*. Of the total direct greenhouse gas emissions of the Fund, emissions from transport account for 6%, or 2.9 million tons of CO_2. In the structure of direct greenhouse gas emissions of the Fund for 2021, the share of JSC NC Kazakhstan Temir Zholy accounts for about 4%, and the share of JSC Air Astana is about 1.3%.

The consumption of the main types of motor fuel *(gasoline, diesel fuel, gas and jet fuel)* in the transport sector of the Fund in Air Astana JSC and JSC NC Kazakhstan Temir Zholy *(KTZh)* amounted to about 1.2 million tons of c. eq., which is more than 6% of the total consumption of energy resources in the group of companies of the Fund. Emissions from the consumption of diesel fuel used for transport account for 71% of the total emissions from the Fund Group's transport, aviation kerosene consumption – 21%, gas consumption, including natural gas and liquefied petroleum gas – 3%. The share of 5% is accounted for by the consumption of gasoline and fuel oil *(marine fuel).*

In the structure of diesel fuel consumption of JSC NC "Kazakhstan Temir Zholy" 98% falls on rail transport *(traction needs),* up to 1% – on motor transport and ensuring the operation of diesel generators, boilers and furnaces. The total consumption of the company's primary energy resources is about 0.9 million tons of c. eq.

The only consumer of aviation kerosene in the Fund's group of companies is JSC Air Astana. The annual consumption of the company's energy resources is 0.3 million tons of c. eq., while gasoline consumption accounts for an insignificant share of 0.2% in the consumption structure.

There are more than 16.4 thousand vehicles at the Fund's facilities, of which about 45% of vehicles use gasoline, 42% diesel fuel, and about 9% of vehicles use liquefied petroleum gases *(LPG) (Annex No. 2 - Table 5)*.

Oil and gas transportation

Kazakhstan has one of the longest oil and gas transportation systems in the world. Export and transit routes of oil and gas transportation to Europe and China pass through the territory of the country.

The length of the main oil pipelines is 5378 km. The Fund participates in the largest oil pipeline CPC *(Caspian Pipeline Consortium)* with a design capacity of up to 67 million tons of oil per year through JSC NC KazMunayGas *(19% of shares).* The export of Kazakh oil to the east to China is provided by the KCP oil pipeline *(Kazakh-Chinese Pipeline)* with a design

capacity of up to 20 million tons of oil per year, where the Fund's share in this project is 50%.

The oil of a part of the Mangystau fields requires heating to be transported in a liquid state through an oil pipeline, therefore, the world's only heated *("hot")* oil pipeline "Uzen-Atyrau-Samara" is operated. The consumption of natural gas for heating oil is about 130 - 140 million m^3 per year

Gas transportation is accompanied by gas consumption for own needs and losses, including direct emissions of methane into the atmosphere during gas pipeline repairs and gas losses during transportation through the main and distribution gas pipelines.

The share of JSC NC KazMunayGas in the consumption of primary energy resources of the Fund is 18%, the total consumption of primary energy resources is 3.2 million tons of c. eq. per year. The basis of consumption is natural gas, which accounts for about 28% *(915 thousand tons of c. eq.),* which is used mainly at refineries and for heating oil. Associated petroleum gas accounts for 28% of total consumption *(900 thousand tons of c. eq.).*

The consumption of energy resources by JSC "NC "QazaqGaz" is about 1.5 million tons of c. eq., natural gas accounts for 98.6% of consumption. At the same time, when transporting gas through main gas pipelines, gas consumption for own needs and losses is 0.7-1.5%, through distribution gas networks – up to 4%. The main consumers of gas are gas pumping units with a gas turbine drive.

Mining and processing of minerals

The main areas of the Fund's production are energy resources: uranium, oil and coal.

In the extraction of energy resources, the largest volume in energy equivalent is the extraction of uranium. Uranium mining is carried out by the method of underground borehole leaching with a solution of sulfuric acid, which is accompanied by the operation of injection and pumping wells. In addition to uranium mining, the uranium industry is represented by production facilities for the production of fuel pellets at the Ulba Metallurgical Plant *(UMZ).* In 2021, a line for the production of fuel assemblies for French-designed reactors by the Chinese General Nuclear Power Corporation *(CGNPC*) was launched at the UMZ.

Oil production by wholly owned subsidiaries of the Fund in 2021 decreased by 9.8% compared to 2019 to 18.3 million tons , which is about 21.3% of total oil production in Kazakhstan.[1]

The share of Bogatyr Komir LLP reaches about 40% of coal production in the country. Coal mining is accompanied by greenhouse gas emissions,

[1] considering the entire volume of production of JSC NC KazMunayGas, including shares in the projects of the "big three" fields and in joint ventures

where the main volume of emissions is methane and carbon dioxide generated during self-oxidation of dumps.

At the Bogatyr coal mine, work continues on the transition to a cyclic-flow production technology with an increase in the design production capacity to 50 million tons. Against the background of growing demand for electricity in Kazakhstan, there is a need to increase coal production to supply the country's coal-fired power plants.

Regarding the extraction and processing of metals, it should be noted that the output to the design capacity of ShalkiyaZinc Ltd. will be achieved only by 2025, therefore, it is recommended to choose 2025 as the base year for JSC NMC Tau-Ken Samruk.

Industrial processes

Emissions from industrial processes are represented by the use of coke, acetylene and electrode mass. Coke is used in refineries and metallurgy enterprises. Coke accounts for about 40% of CO_2 emissions from industrial processes.

1.2. Indirect emissions

According to the Fund's group of companies, in 2021, the consumption of electric energy from external sources amounted to 12.6 billion kWh, and the consumption of thermal energy is 1.2 million Gcal. Part of the electricity consumed is produced at the enterprises' own power plants, but it is not taken into account in indirect emissions due to their inclusion in direct emissions during production.

Indirect greenhouse gas emissions from the consumption of electrical and thermal energy from third-party sources amount to 10.8 million tons of CO_2. In the structure of indirect greenhouse gas emissions, electricity accounts for 95%, while the basis *(80%)* is electricity consumption from coal generation.

In the context of portfolio companies, more than 90% of indirect greenhouse gas emissions are accounted for by JSC NC KazMunayGas *(31%),* JSC NC Kazakhstan Temir Zholy *(30%)* and JSC KEGOC *(29%).* Indirect emissions for the Fund's group of companies for 2021 are shown in Appendix 2, Table 6.

The consumption of electric and thermal energy of JSC "NC "KazMunayGas" is about 3.8 billion kWh and 0.8 million Gcal per year, respectively. At the same time, within the framework of purchased electric energy, gas generation accounts for 61% *(2.3 billion kWh),* and for coal generation - 39% *(1.5 billion kWh).* The consumed thermal energy is mainly accounted for by coal-fired generation *(0.8 million tons). Gcal).* Electrical energy is consumed for the operation of industrial equipment *(rocking machines, pumps, compressors and oil pumping units)*.

Electricity consumption in JSC "NC "Kazakhstan Temir Zholy" is 3.2 billion kWh, mainly due to coal generation. The consumption of thermal energy is also provided by coal generation sources and amounts to 67.7 thousand tons Gcal. The consumed electric energy is spent on ensuring the operation of electric locomotives *(91% of total consumption)* and on ensuring the operation of electric heaters, lighting and pumping equipment.

The electric energy consumption of KEGOC is about 3.3 billion kWh per year. At the same time, in the structure of purchased electricity consumed, 94% are coal-fired generation sources, 4% are gas generation sources and 2% are renewable energy sources. The main energy consumption accounts for the compensation of electricity losses during transmission through electric networks, which account for 6.4% of the volume of electricity transmission. The total length of power transmission lines on the company's balance sheet is 27 thousand km, and there are 81 substations with a voltage of 35-1150 kV.

The electric energy consumption of JSC "NAC "Kazatomprom" is about 0.8 billion kWh, heat energy consumption - 226 Gcal for 2021. Coal generation accounts for the predominant share in the structure of electricity consumption - 84%, gas generation accounts for 9%. Electricity consumption from renewable sources is 2%. The basis of consumption is the consumption of electricity for the extraction of uranium by underground-borehole leaching *(pumping equipment).*

The total consumption of electric energy from third-party sources for the portfolio companies of JSC "Samruk-Energo", JSC "NC "QazaqGaz", LLP "Samruk-Kazyna Ondeu", JSC "Air Astana", JSC "Kazpost", JSC "Kazakhtelecom" and JSC "NGC "Tau-Ken Samruk" is less than 0.5 billion kWh.

2. Challenges of low-carbon development

When achieving the target indicators for carbon neutrality, there are a number of challenges that can have a multiplicative effect on the main activities of the Fund's companies.

Socio-economic

1. The need for structural changes in the country's economy.

Today, about 70% of the electricity produced in the country is generated using coal as fuel. Kazakhstan's economy is the 12th in the world in terms of energy intensity and the 5th in the world in terms of carbon intensity, which is due to one of the lowest tariffs for gas, coal and, as a result, electricity.

Population growth, trends in digitalization and automation can lead to an increase in energy consumption in the country up to 3 times.

In 2021, the growth in electricity consumption amounted to 6.1%. Ekibastuz GRES-1 and GRES-2 stations generated the maximum amount of electricity in their history, which led, among other things, to an increase in accidents *(the increase in accidents in 2021 was 30% compared to the previous year)*.

Global pressure on coal companies and the gradual abandonment of coal power is an important factor for the Fund's group of companies, since coal mining, generation and use of electricity generated through coal combustion takes a significant share in the production processes in the Fund's group.

2. The need to ensure a balance between socio-economic development and environmental impact.

For countries in which coal-fired generation continues to be the basic source of energy, a rapid transition to renewable energy sources can lead to systemic problems of energy security. In this regard, as part of the transition to low-carbon development, the key task is to ensure energy security, which affects both the development of the economy and the social sphere, including food security and access to water resources.

The growing demand for energy resources due to the rapid population growth, digitalization, automation and electrification of various industries, as well as new environmental restrictions lead to a failure of electricity supplies worldwide. In Germany, which is one of the "flagships" of the green economy, an unforeseen increase in electricity demand due to a decrease in temperature has led to the need to deconservate coal generation. The plans of the new Japanese energy strategy provide for the expansion of nuclear generation.

Currently, there is a shortage of basic capacities of about 1.3 GW in the energy system of Kazakhstan. According to expert estimates, this trend will continue and intensify until the introduction of new sources of electricity generation.

3. Negative social impact as a result of the refusal to use coal

Decisions to reduce the volume of coal production and the share of coal generation should also take into account social aspects, such as ensuring the further development of regions and single-industry towns associated with coal mining and electricity production using coal, as well as preventing an increase in unemployment due to the closure of such industries *(5 single-industry towns and about 40 thousand workers depend on the coal industry)*.

Today, the coal industry of Kazakhstan has about 40 thousand employees, of which more than 12 thousand belong to the Fund's group of companies. Coal transportation accounts for 16% of the total domestic freight turnover of the railway industry. At the same time, it is necessary to note the presence of the Fund Group companies in single-industry towns, where the life of single-industry towns is directly connected with the coal industry.

4. Dependence of heat supply on sources using fossil fuels.

For Kazakhstan, as one of the continental countries, it is critically important to provide the population with heat. The specific consumption of thermal energy in Kazakhstan for space heating is more than 2 times higher than in other countries. The consumption of thermal energy per 1 person in Kazakhstan, in turn, is also 2 times higher compared to other countries.

In the production of heat for the population and industrial consumers in Kazakhstan, cogeneration-type power plants that also run on fossil fuels *(coal and gas)* are integral. There are 41 thermal power plants in operation in the country, as well as 63 large and 2,200 small boiler houses that provide thermal energy to the population and industrial consumers. At the same time, heat production technologies using renewable energy sources are not developed.

The issue of developing the use of renewable energy for the purpose of heat supply requires determining the economic feasibility and conducting appropriate studies to determine the applicable technologies, taking into account climatic conditions and the seasonality of their operation.

Moreover, today in Kazakhstan, the production and sale of heat at cogeneration type stations is subsidized due to the marginality of electricity production and sale.

In this regard, it is necessary to take into account the issues of heat supply when making decisions on the further operation of existing sources using fossil fuels.

Technological

1. Instability of electricity supply from renewable energy sources.

The key technologically constraining factor of renewable energy sources today is the problem of integrating renewable energy sources into the energy system due to the instability of their operation. The most common sources of renewable energy – the sun and wind – directly depend on weather conditions, which it is not possible to predict with high accuracy. One of the solutions to this issue is the use of energy storage systems.

2. The need to develop both basic and maneuverable power.

A feature of the functioning of any power system is the uneven consumption of electricity during the day - a decline at night, an increase by the beginning of the working day and peaks in consumption in the evening. At the same time, for stable and reliable operation of the electric power network, the supply must coincide with consumption, otherwise its imbalance occurs and as a possible result – a blackout.

Currently, the available volume of regulating capacities in the NES of Kazakhstan is insufficient. Conditional maneuvering capacities in Kazakhstan account for about 18% of generation. The standard for a stable operating system is 20% of the entered capacity of all types of power plants.

The need to balance the variable output of wind and solar power plants increases the need for maneuverable power plants and energy storage systems. As a result, the cost of renewable energy, taking into account the cost of balancing, may increase by 1.5 - 2 times. The operation of the power system with a significant share *(more than 15%)* of wind and solar power plants requires additional reserves of basic and maneuverable generation, as well as changes in the basic principles of regulating power systems.

The key role in this issue is played by JSC KEGOC, which is the operator of the national electric grid and the System Operator, as well as JSC Samruk-Energo, which occupies a dominant position in the electricity generation market *(about 29% in 2020).* At the same time, the development of Smart Grid and digital technologies can become one of the tools for the development of maneuverable capacities.

In order to increase the share of maneuverable capacity, auctions for maneuverable capacity are being introduced at the country level this year.

3. Limited gas resources.

One of the transitional fuels for the energy transition is considered to be gas. At the same time, in Kazakhstan, despite significant gas reserves, commercial gas resources are limited in the volumes necessary for the large-scale development of gas generation. It is necessary to increase the gas resource base due to geological exploration and new projects.

Moreover, the price of gas for the domestic market is much lower than for export, which makes domestic supplies economically less attractive.

At the same time, the development of gas generation is both a challenge and a growth point, which will entail investments in field exploration and gas infrastructure. In addition, the main gas infrastructure requires large capital investments to maintain safe operation.

4. The need for a significant upgrade of the network infrastructure.

At present, the degradation of the electric power grid infrastructure is about 70%. It is important to increase the stability of the electricity supply chain by investing in the reconstruction and modernization of the network infrastructure, as well as the construction of new high-voltage power lines.

The national electric grid should be strengthened and be ready in a timely manner to connect new large energy sources necessary to cover the growing demand and the observed shortage of electricity.

Moreover, the introduction of renewable energy sources also requires infrastructure modernization, including in order to integrate energy storage systems. It is necessary to develop Smart Grid technologies together with energy storage and storage systems.

5. Not all portfolio companies can reduce their emissions in absolute terms. The key solution for such companies is the use of offset mechanisms.

In portfolio companies, there is a direct correlation between the expansion of productivity and the volume of greenhouse gas emissions. In a number of portfolio companies, despite a significant reduction in specific greenhouse gas emissions, the planned significant expansion of activities as a result will lead to an increase in total greenhouse gas emissions in absolute value. In such cases, the key tool for reducing the carbon footprint is the use of the offset mechanism.

Financial

1. The need for significant financial investments.

The transition to low-carbon development, of course, has a global scale and will require significant investments. At the same time, the development of "green" technologies is quite an expensive initiative today.

In order to attract private investment effectively, it is necessary to ensure profitability, for which it is advisable to revise the tariff policy and introduce additional economic incentives.

In order to make an effective and timely transition to low-carbon development, it is necessary to attract a significant amount of investment, which previously mainly focused on the development of the oil and gas sector. The implementation of new gas generation construction projects alone will require more than 3.4 billion US dollars of investments by 2027, and the investment needs for the construction of 2,400 MW of renewable energy facilities will amount to about 2.3 billion US dollars. Transparent and competitive conditions for the selection of investment projects and ensuring

a high level of stability for investors are required to attract investment in the low-carbon development sector.

2. The risk of lost profits due to the start of a new commodity supercycle.

According to the expert community, today the world is witnessing the beginning of a new commodity supercycle, accompanied by an active increase in demand and prices for raw materials, including hydrocarbons.

For Kazakhstan and countries with a similar economic structure, there is a unique chance to provide income that can be directed, among other things, to the diversification of the economy and the energy basket.

Over the past hundred years, there have been four commodity supercycles, the last one started in 1996, peaked in 2008 *(after 12 years of expansion)*, and its lower limit fell in 2020 *(after a 12-year recession).* According to experts, the rise in oil prices, in turn, will lead to an increase in demand for coal. In the long term, according to forecasts, natural gas, not coal, will still be in great demand, including against the background of plans by major economies to reduce greenhouse gas emissions. The total value of commodities according to the Bloomberg Commodity Index increased by 33% in 2021, which was the sharpest increase since 1979. These are precisely the groups of raw materials for which Kazakhstan has competitive country advantages, as well as the necessary materials and supply chains. Objectively, for countries with a similar economic structure, as in Kazakhstan, this is a chance to implement comprehensive diversification and transition to low–carbon development.

In this regard, it is fundamental to ensure a planned and reasonable energy transfer based on a reasonable balance between the pace of development of human civilization and ensuring ecological balance.

Regulatory

1. The need to liberalize tariff regulation

In order to make an effective and timely transition to low–carbon development, significant investments are needed - public or private. At the same time, in order to stimulate private investment, it is necessary to ensure the commercial attractiveness and payback of projects, which is currently limited by the tariff policy aimed at curbing growth.

Modernization and low-carbon development of the energy system will be accompanied by an increase in tariffs and prices for energy resources. In order to offset the negative impact on socially vulnerable segments of the population, it is necessary to organize a system of compensation for part of the costs of paying for electricity and heat for socially vulnerable segments of the population.

Moreover, tariff liberalization will not only provide economic factors for development, but will also create incentives for the introduction and application of more energy-efficient and energy-saving technologies.

In addition, further development of tariff regulation is necessary. In terms of electricity storage, there are currently no special tariffs for such systems in Kazakhstan. In particular, there is no tariff regulation in the implementation of renewable energy projects with energy *storage (outside the auction mechanism)*, which creates difficulties for implementation.

To date, the mechanism of return on investment for RES is auction auctions for the selection of projects for the construction of new renewable energy facilities. The auction results for 2015-2021 show the dynamics of the auction price decline. The tariff continues to decrease from year to year as a consequence of the trend of cheaper cost of construction of renewable energy facilities. Taking into account devaluation and inflation, the marginal auction price for hydroelectric power plants in Kazakhstan has almost lost its investment attractiveness. For example, in 2018, auctions were held for the selection of hydroelectric power projects with a total capacity of 20 MW. According to the results of electronic bidding, 4 winners were determined, but currently, none of the four projects are being implemented.

2. Imperfection of the quota allocation mechanism

The entry into force of the new Environmental Code from July 1, 2021, as well as the updating of the Code of Administrative Offenses on Environmental Issues entails the risks of paying significant fines for "brown" productions. At the same time, there are a number of problematic issues in the allocation of quotas.

1. The mechanism for determining quotas is based on past periods, does not take into account the growth of production indicators. Thus, the quota is issued not for the planned volume of production, taking into account the growth of the country's economy, but for the volume of production for the specified historical period *(base period),* while it is shifted for each new quota period;

2. When determining the quota, the country-averaged specific GHG emissions coefficient per unit of production is used to create fair competition and an incentive for lagging industries to catch up to the advanced ones in the country.

3. The imbalance of the needs of the economy and quotas. Additional quotas for the difference in production volume *(increase in capacity)* are limited by the volume of quotas in the reserve, while the formation of the reserve does not take into account economic growth. According to the results of the 2018-2020 period, all operators who applied for additional quotas received only 74% of the volume of additional quotas required by law.

All of the above creates a situation when operators of quota installations "enter" the quota period with a quota deficit of about 50% *(especially in the electric power industry),* creating a risk of a crisis situation in the quota market at the end of the quota period, when the demand for quotas will not be provided with supply. Thus, the quota mechanism and quota trading for installations with GHG emissions of more than 20 thousand tons

of CO_2 per year incur unjustified financial risks for operators of quota installations due to the unfair distribution of quotas and the lack of additional quotas in the reserve of the National Quota Distribution Plan, taking into account the development of the country's economy.

3. The need to build an effective system of carbon regulation and trade in offset units

Despite the strengthening of legislative requirements for the monitoring, reporting and verification system regarding greenhouse gas emissions and their absorption, greenhouse gas accounting in companies is conducted mainly on CO_2, and methane and nitrous oxide emissions are not fully taken into account, which, although they belong to greenhouse gases, are regulated as pollutants in accordance with the legislation of the Republic of Kazakhstan.

In addition, there is no practice of implementing offset projects. Today, investors do not take into account the profit from the sale of offset CO_2 units in the financial models of green projects.

Taking into account the above, it is necessary to ensure a planned and "reasonable" transition, which will include not only the reorientation of the company's business development directions, the use and implementation of low-carbon technologies, but also the improvement of regulatory, financial and socio-economic aspects.

3. Goals of low-carbon development

The Fund shares the global public's concern about climate change and supports global efforts to reduce greenhouse gas emissions, improve energy efficiency, transit to renewable energy sources and phase out the burning of carbon fuels.

The strategic goal of the Fund is to reduce the carbon footprint *(Scope 1 and Scope 2)* of the Fund by 10% by 2032 as compared to the 2021. The Fund will aim to achieve carbon neutrality by 2060.

In general, carbon neutrality does not mean the complete exclusion of greenhouse gas emissions – the emissions that cannot be reduced must be compensated. At the same time, based on the forecast shortage of electricity and significant coal reserves in the country, it is planned to develop coal generation and introduce new coal blocks in the Ekibastuz region.

Within the framework of this Concept, 3 key development scenarios for which year 2021 is defined as basic one are considered:

1. "Business as usual *(BAU)* is the implementation of the current business model;
2. "Decarbonization" *(D)*, which assumes by 2032, despite the growth of coal capacity and the growth of electricity generation, the retention of greenhouse gas emissions at the level of 2021;
3. "Deep Decarbonization" *(DD)* is the implementation of a business model that assumes a more accelerated energy transition and diversification of the energy portfolio with the achievement of carbon neutrality by 2060.

The key indicators of the three scenarios up to 2032 are given below. Indicators of the three scenarios up to 2060 are given in Annex No. 2 – Tables 7-9.

Table 1 - Forecast of the Fund target indicators until 2032 according to three scenarios:

No.	Parameters	BAU *(Business as usual)* 2032	D *(Decarbonization)* 2032	DD *(Deep decarbonization)* 2032
1	**Coal stations –** commissioning	GRES-1 Block 1 - 2024 GRES-2 Block 3 - 2026 Block 4 - 2028 Block 5 - 2030	GRES-1 Block 1 - 2024 GRES-2 Block 3 - 2026 Block 4 - 2028 Block 5 - 2030	GRES-1 Block 1 - 2024 GRES-2 Block 3 - 2026 Block 4 - 2028 Block 5 - 2032
2	**Coal stations –** conservation	not commissioned	not commissioned until the NPP is commissioned in 2035	GRES-1 one unit - from 2031
3	**Switch of Almaty CHP to gas**	2024	2024	2024
4	**NPP commissioning**	-	1 unit in 2035 *(1200 MW)*	1 unit in 2032 *(1200 MW)*

5	**Share of RES** and **HPP** *(new projects)*	26%	26%	30%
6	**Carbon Capture, Utilization and Storage - CCUS**	-	13%	-
7	**Electrification of cars**	-	15%	19%
8	**Energy saving and energy efficiency** *(thousand ton of coal equivalent)*	-	624	624
9	**Purchase of energy from RES**	26%	45%	45%
10	**Offsets** *(million tons of CO_2)*	-	-1	-1
11	**Carbon footprint** *(Scope 1 + Scope 2)* million ton of CO_2/ % changes from 2021	**68.5** **+19%**	**57.9** **0%**	**52** **-10%**
12	**Carbon footprint** *(Scope 1 + Scope 2 + Methane)* million ton of CO2 eq/ % changes from 2021	**84** **+12%**	**73.1** **-3%**	**66** **-12%**

3.1. Business as usual scenario (BAU)

The scenario assumes continuation of the current trends in the activities of the Fund group without a focus on low-carbon development. Based on economic feasibility, energy efficiency and energy saving measures will be implemented.

In the electricity generation sector, which is a key source of emissions, high utilization of coal generation is expected. There are no plans to put a nuclear power plant into operation under the current scenario. Current projects for the construction of renewable energy and hydroelectric power plants will be implemented, the share of which in electricity generation will reach about 26%.

In this and other scenarios *(D and DD),* the following projects will be implemented:

- switch of Almaty CHP-2 and CHP-3 from coal to natural gas;
- construction of HPP *(111 MW)* and commissioning WPP *(240 MW)*;
- increase in the share of electrification of transport, including the Dostyk-Moiynty railway section *(833 km);*
- implementation of infrastructure modernization projects (electric and gas networks);

As a result, this scenario assumes an increase in direct greenhouse gas emissions by 25% *(or 11.7 million tons of CO_2)* from 47 million tons of CO_2 in 2021 to 58.7 million tons of CO_2 by 2032.

Based on the country-wide plans to increase the share of electricity generation from renewable energy sources, the projected share of electricity consumption by the Fund group from renewable energy sources and hydroelectric power plants by 2032 will be about 26%. This will reduce indirect greenhouse gas emissions by 9% – from 10.8 million tons of CO_2 in 2021 to 9.8 million tons of CO_2 in 2032.

In general, under this scenario, the carbon footprint *(direct and indirect emissions)* of the Fund group will increase by 19% by 2032 – from 57.8 million tons of CO_2 to 68.5 million tons of CO_2. To mitigate environmental penalties, it will be necessary to purchase carbon quotas and offset units.

3.2. Decarbonisation scenario (D)

The scenario assumes the implementation of a set of measures for the transition to low-carbon development.

The construction of nuclear power plants will be carried out in the generation sector. At the same time, taking into account the need to ensure energy security and the projected timing of commissioning of nuclear power plants by 2035, coal-fired generation will remain the basis of electricity production until 2032. The projected share of renewable energy and hydroelectric power generation by 2032 is 26%.

In this regard, despite the switch of Almaty CHP-2 and CHP-3 to natural gas and energy saving projects, this scenario also plans a significant increase in direct greenhouse gas emissions by 22% or by 10.4 million tons of CO_2 – from 47 million tons of CO_2 in 2021 to 57.4 million tons of CO_2 million tons of CO_2. The projected level of electrification of motor transport by 2032 is about 15%.

The scenario assumes a 33% reduction in indirect emissions by 2032 *(from 10.8 million tons of CO_2 to 7.2 million tons of CO_2)* through the purchase of about 45% of electricity from alternative sources.

Taking into account the growth of direct emissions, in order to reduce the carbon footprint, there is a critical need to compensate for emissions through carbon capture, utilization and storage *(CCUS),* as well as the implementation of projects and the purchase of carbon offsets.

In order to at least keep the growth of the carbon footprint at the level of the value of 2021, it is necessary to apply CCUS technologies to 13% of emissions by 2032. CCUS technologies today are largely expensive. In this regard, achieving this task is economically difficult.

3.3. Deep decarbonization scenario (DD)

This scenario is based on the activities of the deep decarbonization scenario, but assumes a faster energy transition through accelerated commissioning of nuclear power plants *(the first unit in 2032).* The introduction of an environmentally friendly source of base power will reduce the workload

of coal-fired power plants and carry out the conservation of one of the blocks of Ekibastuz GRES-1 with high wear. The projected share of renewable energy and hydroelectric power generation by 2032 is about 30%. The level of electrification of motor transport by 2032 is 19%. The reduction of indirect emissions is similar to scenario D, by 33% through the purchase of up to 45% of electricity from alternative sources.

Reducing coal generation and implementing energy efficiency measures will reduce direct emissions by 3% or 1.2 million tons of CO_2 – from 47 million tons of CO_2 in 2021 to 45.8 million tons of CO_2 by 2032. In this regard, the implementation of this scenario does not require significant volumes of carbon capture and storage *(CCUS)* by 2032. At the same time, part of the carbon footprint will be compensated through offset mechanisms. This will make it possible to reduce the carbon footprint of the Fund group by 10% or 5.8 million tons of CO_2 by 2032, from 57.8 million tons of CO_2 in 2021 to 52 million tons of CO_2 by 2032.

A significant increase in nuclear power plant capacity will become the basis for replacing coal generation (*the key emitter of greenhouse gases in the Fund group)* and achieving carbon neutrality by 2060.

The main directions of achieving the indicators of the DD scenario, in addition to changing the structure of generation, are:

- electrification of railway transport (*construction of power lines/ traction substations and electric locomotives on batteries);*

- replacement of gasoline vehicles with vehicles with "zero" emissions. Gas engine fuel can be used as a transition fuel;

- switching transport *(diesel locomotives, quarry and other transport)* to the use electricity and biodiesel;
- partial use of sustainable aviation fuel *(SAF)* when refueling aircraft.

Taking into account the results of these scenarios, it is proposed to focus on the deep decarbonization *(DD)* scenario.

4. Key directions of low-carbon development

Achieving the stated carbon neutrality goals is an ambitious task for the Fund, which includes the largest assets in the country, accounting for about 13% of the country's direct greenhouse gas emissions.

The Fund is convinced that achieving carbon neutrality by 2060 should be based on a reasonable balance between energy and environmental security. Taking into account the current challenges in the field of energy security and stability, a pragmatic approach will be applied within the framework of energy transition, which identifies four key areas:

1. Alternative energy and low-carbon technologies.
2. Resource efficiency and GHG emission management technologies.
3. Infrastructure and regulation.
4. Efficient carbon footprint management.

4.1 Alternative energy and low-carbon technologies

Low-carbon energy means energy produced without burning fossil hydrocarbon fuels, such as renewable energy sources *(solar, wind, water, biomass)*, nuclear and hydrogen energy, etc.

The list of technologies and solutions considered below is not exhaustive and can be adjusted and supplemented based on the results of R&D and technology development.

Renewable energy sources

The most common renewable energy sources today are wind, solar, water, and biogas plants. According to the International Agency for RES, over the past 6 years, solar power plants construction costs have decreased by more than 50%, and wind – by almost 10%. By 2030, a further 30% reduction in the cost of RES construction is projected, which makes the cost of electricity from wind and solar power plants more competitive compared to modern coal generation.

Over the past seven years, the Fund has gained experience in implementing RES projects and their further production operation. The Fund plans to implement a number of new RES projects in the medium and long term. It is estimated that in order to achieve the Company's goal, it will be necessary to implement new WPP projects with a total capacity of about 1,455 MW. The annual volume of electricity production after the operation of all planned capacities will amount to more than 4.5 billion kWh. At the same time, the Fund is currently implementing 3 *(three)* WPP projects in Yereimentau and the Shelek corridor, which is unique in its wind potential, two of them are at the construction stage and one project is at the initiation stage.

There are also hydroelectric power plants in the structure of assets: Moinak HPP, Shardara HPP, Kapchagai HPP, and cascade HPP with a total

total capacity of 834 MW. In the future, new HPP projects with a total capacity of 1,092 MW are also planned to be implemented by 2030, including two counter-regulatory HPPs.

Nuclear power

The forecasts of the International Energy Agency show that in the near future nuclear power will play one of the key roles in the global structure of low-carbon energy production. At the meeting of the European Parliament in July 2022, the proposal of the European Commission on the recognition of nuclear energy as a sustainable energy source was approved. Many nuclear power projects will be awarded the status of “green” with inclusion in the list of facilities in which investments do not harm the climate, but bring large revenues in the form of taxes.

Currently, the total NPP capacity in the world is 394 GW, while 58 GW is under construction, and 102 GW is planned for construction. Given the high share of coal-fired generation in the structure of electricity production in Kazakhstan, as well as the modern *(post-Fukushima)* high level of NPP safety requirements, nuclear power can become the basis for the phased replacement of coal-fired power plants and the transition to carbon neutrality. A unique fast neutron desalination reactor was in operation in Kazakhstan until 1999.

There are all prerequisites for the construction of NPP in Kazakhstan: the country is a leader in the production and export of uranium *(23% of world production)* and a plant *(Ulba FA LLP)* for the production of nuclear fuel - fuel assemblies *(FA)* and their fuel elements components was launched in 2021. Kazakhstan has a rather unique scientific and technical base represented by the National Nuclear Center *(NNC).* The NNC research complex has three research reactors *(including the Tokamak thermonuclear power reactor)* and three unique experimental stands for testing a wide range of structural materials and reactor components under various reactor technologies and operating conditions. The construction of NPP in Kazakhstan will make it possible to use the scientific and technical potential and an extensive personnel base of scientists. The capabilities of the country’s industry allow, with the participation of Kazakhstan scientists, to increase the share of Kazakh products in the construction of NPP.

In the future, given the structure of the energy system of Kazakhstan, it is advisable to consider the construction of three NPPs – in the southern zone, in the eastern region, as well as in the west of the country. This will provide the regions with a basic source of electricity, reduce the need for interregional flows, and in general will strengthen the energy security of the country.

Hydrogen energy

According to the International Energy Agency, in 2021 there were 14 operating plants for the production of low–carbon hydrogen from

hydrocarbons around the world and 40 similar projects are planned, of which four are under construction *(in China and the USA)*. 35 of them plan to use natural gas for hydrogen production.

At this stage, “hydrogen energy” in the Fund is at the stage of intensive scientific and technological research, the potential of which is considered in the long term.

In the companies of the Fund group, hydrogen is already produced on an industrial scale from methane, the most cost-effective method of production, and is used exclusively in oil refining.

In the long term, the Fund sees the role of low-carbon hydrogen in decarbonizing certain sectors of the economy, for example, the transport sector *(fuel cell cars),* as well as a system for accumulating electricity. The use of RES-generated electricity or methane pyrolysis is considered for hydrogen production. The chemical and metallurgical industries are considered as the main consumers of hydrogen.

The creation of hydrogen production from associated gas by pyrolysis *(without carbon dioxide emissions)* will permit the use of hydrogen directly in places of consumption, for example, for metallurgical plants using direct iron reduction technology. This expands the opportunity for economically profitable gas consumption within the country.

It is planned to study and introduce projects for the production of “green” hydrogen for use in its own production processes for creating “green” products, as well as possible further export of products to international markets. In addition, it is planned to study the use and introduction of “blue” and “orange” hydrogen, in which the production procedure will be accompanied by a carbon capture procedure *(for example, autothermal reforming allows you to capture up to 95% of emissions).*

According to experts, in the energy sector, at certain levels of specific investments, the NPP hybrid power plant with hydrogen is already one of the most reliable and cheap ways of carbon–free energy supply.

Today, the Fund is studying the experience of world leaders in hydrogen energy for pilot projects on the production and use of hydrogen.

Switching from coal to gas

The international community accepts gas as a transit fuel to achieve carbon neutrality. It was the substitution of natural gas for coal-fired power plants that allowed the USA to achieve a significant reduction in the growth rate of GHG emissions over the past decade.

The switch of coal plants to gas will also increase the maneuvering capacity needed to cover peak loads. Due to the lack of gas, it is advisable to focus on the switch of coal-fired thermal power plants to high-efficiency gas generation *(CCGT)* of the cogeneration type, including for the heat supply of Almaty. Heat production at cogeneration plants is directly related to low-carbon projects.

To date, in order to reduce the negative impact on the environment, JSC Samruk-Energy initiates the switch of Almaty CHP to gas. In November 2021, in the presence of the President of the Republic of Kazakhstan, the project for switching of the Almaty CHP-2 was launched. In the future, it is planned to switch Almaty CHP-3 and expand the capacity of Almaty CHP-1, which has already been converted to gas in 2017. At the same time, it is also necessary to provide for measures to modernize and repair the gas transportation infrastructure.

The implementation of the above-mentioned gasification projects will ensure the reduction of emissions of harmful substances *(dust, oxides of sulfur and nitrogen)* into the atmosphere in Almaty region, increase the capacity and reliability of heat and electricity supply. The conversion of Almaty CHP-2 to gas will reduce greenhouse gas emissions at the plant by almost 32% – from 3.7 million tons in 2020 to 2.5 million tons per year by 2026.

Other low-carbon generation

Various new technologies will be considered within the framework of alternative sources of low-carbon generation. The development of geothermal energy is also a new promising direction for the Fund.

The main impact of geothermal plants *(GeoTPP)* on atmospheric air is the release of hydrogen sulfide contained in geothermal steam. The advantages of geothermal energy are complete safety for the environment, minimal CO_2 emissions into the atmosphere, inexhaustibility of resources, independence from external conditions and time of day.

Today GeoTPP is widely developed and used for the needs of consumers in the USA, Japan, Iceland, China and other countries. The undisputed leaders in this direction are the USA with electricity production of more than 18 billion kWh from GeoTPP per year.

Studies conducted in Kazakhstan have shown that the country has significant geothermal water resources with medium and low temperatures *(from 80°C to 170°C).* The main geothermal reservoirs are found in the south and south-west of Kazakhstan. In these areas, the average temperature is above 120℃.

The Fund is considering in the long term the implementation of a pilot project and the construction of GeoTPP.

4.2. Resource efficiency and emission management technologies

Clean coal technologies

Along with the development of low-carbon energy sources, the Fund's work will focus on improving technologies, introducing breakthrough solutions that contribute to improving the environmental friendliness of existing traditional fuel-energy complex (FES) facilities.

From the point of view of energy security, the Fund will continue to implement projects for the construction of coal-fired generation facilities in

the coming years, which is a necessary measure until the launch of new basic capacities based on alternative energy sources. Subsequently, with full and reliable provision of energy security based on “clean” energy sources, coal-fired generation can be gradually “mothballed”.

Taking into account the vast coal resources available, as well as the need to apply pragmatic approaches due to the current structure of the economy and electricity generation, it is proposed to consider clean coal technologies based on coal enrichment and gasification - the use of coal gasification systems to produce combustible synthesis gas for production needs and to replace coal, fuel oil and diesel fuel. Gasification of coal will allow its use during the transition period of decarbonization and reduce emissions into the atmosphere.

At the moment, the Fund is considering underground coal gasification technologies, which have a number of advantages over both the coal mining method and traditional coal burning. Underground coal gasification opens up new opportunities for the use and mining of coal seams with a high ash content *(more than 60%)* with complex mining and geological conditions of occurrence without coal extraction from the formation.

Resource saving and energy saving

Kazakhstan refers to the countries with a high energy intensity of GDP, which is associated not only with a high share of energy-intensive industry in the GDP structure, that indicates the significant energy saving potential. Minimizing energy and resource consumption by increasing energy efficiency and switching to efficient, resource-saving and environmentally friendly technologies is an effective tool in achieving carbon neutrality goals. The implementation of energy saving measures will reduce the consumption of fuel and energy resources and prevent emissions associated with their combustion.

The Fund is constantly working to improve energy efficiency and reduce the energy intensity of its productions. Thus, from 2014 to 2020, a comprehensive Energy Efficiency Improvement Program was implemented, realization of which has already made it possible to reduce the energy intensity index of the gross volume of marketable products by 27% as compared to 2014 *(up to 3.57 ton of c. eq./KZT million).* As part of the modernization and energy saving, old *(less efficient)* gas processing equipment is being replaced with new one, the transition from fuel oil to natural gas *(as fuel at production facilities)* and the use of new generation additives to increase the flow rate. In the coal mining segment, it is necessary to note the modernization projects carried out at the Bogatyr section with the transition to a cyclic-flow technology of mining, transportation, averaging and loading of coal, which will allow replacing worn-out equipment with modern crushers, conveyors, and improving the energy efficiency of coal mining and averaging. In the oil refining segment, it is necessary to note the completion of the modernization stage of the three major refineries owned by the Fund.

As a result of modernization, the depth of oil refining has increased, the volume of flaring of refinery gas has significantly decreased, and energy efficiency has increased.

One of the main directions for reducing direct greenhouse gas emissions in the oil and gas industry should be the abandonment of flaring gas *(except technologically unavoidable)* by 2030 and the reduction of volatile emissions *(leaks)* associated with the operation of any production facilities and ongoing production processes. The volume of associated petroleum gas *(APG)* utilization in the Fund's companies in 2020 amounted to 98%, and the volume of emissions from flaring was only about 2.2 tons of CO_2-eq. per thousand tons of hydrocarbon production *(this is 24% lower than in 2019, and 79% lower than the global average for the industry according to the International Association of Oil and Gas Producers)*. The Fund subsidiaries managed to significantly reduce flaring due to the implementation of various projects. In particular, after the introduction of the hydrogen sulfide removal system at JSC EmbaMunaiGas, the volume of utilization is 93%, and MangistauMunaiGas recycles 99% of the gas at the Kalamkas field as fuel for its own needs, including at the Kalamkas GTPP.

In terms of efficient use of resources, the key direction is to reduce methane emissions. Kazakhstan's share in global methane emissions is 0.9% *(according to IEA data for 2021)*, while 75% of methane emissions are contributed to this indicator by the oil and gas sector and coal mining. Reducing methane emissions from oil and gas production is particularly promising, since more than 70% of emissions can be reduced using existing technologies. The issue of timely detection of methane leaks at oil production facilities is one of the main challenges in the oil and gas industry today. The Fund plans to implement Leak Detection and Remediation *(LDAR)* programs to identify, quantify and minimize uncontrolled emissions. The tool most commonly used for LDAR programs is the OGI *(Optical Gas Imaging)* camera, a highly specialized version of an infrared camera that can detect a gaseous compound based on its wavelength.

JSC NC KazMunayGas has already implemented a pilot campaign on detection and quantification of emissions of methane and volatile non-methane organic compounds on the territory of several production facilities. Based on the results of the pilot projects, measures for the wide-scale implementation of the Program and the installation of a vapor capture system for collecting dry gas and volatile emissions in the long term will be considered.

The most significant source of methane emissions is the coal mining segment. Taking into account the global warming coefficient, emissions into the atmosphere of 346 thousand tons of methane at the Bogatyr section (*by the end of 2021)* are equivalent to 8.65 million tons of CO_2-eq, which is commensurate with the total carbon dioxide emissions in the oil and gas segment (*8.6 million tons of CO_2-eq. in total, JSC NC KazMunayGas and JSC NC QazaqGaz)*. The gradual replacement of coal generation will lead to a

decrease in coal consumption in the domestic market and, as a result, a decrease in methane emissions.

Carbon dioxide capture and storage

The transition to carbon neutrality is possible due to renewable energy sources, as well as due to the modernization of industrial facilities. However, the focus is not only on the broad reorientation of industry, but also on the indicator of greenhouse gas absorption, as well as climate projects as an intermediate stage tool.

Carbon Capture Utilization and Storage Technology *(CCUS)* provides for the capture of up to 90% of CO_2 that would otherwise be released into the atmosphere as a result of burning fossil fuels in electricity generation and industrial processes. The technology is one of the few that allows decarbonization of sectors that do not use renewable energy sources.

The use of carbon dioxide is the use of captured CO_2 to produce products suitable for commercial use. The key areas are 3 main areas: mineralization, chemical and biological use.

The most well-established form of CO_2 recovery is enhanced oil recovery *(EOR),* when CO_2 is pumped into oil or gas tanks to increase their recovery. Other forms of CO_2 utilization being studied include using CO_2 in the production of concrete or plastic materials, or converting it into biomass by feeding CO_2 to algae, which is then collected and processed into biofuels for transportation. CO_2 can also be used to stimulate plant growth and can be captured in the soil using biochar to improve soil quality.

Portfolio Companies of the Fund are considering the possibilities of using CCS technologies. At the moment, a site for a pilot project on CO_2 capture is being determined.

A number of CCUS technologies by the world's leading companies are being considered. A project is being considered as R&D, the development of which will solve the problem of increasing oil recovery by using composite foams during CO_2 flooding. The technology is the most effective way to reduce CO_2 emissions into the atmosphere *(34% of the world's captured CO_2 is captured by this technology).*

Due to the limited *(demand and technology*) chemical use of CO_2, an injection option is analyzed to increase reservoir pressure during oil or gas production. Thus, injection of CO_2 can increase oil production by more than 10%. In 2021, JSC NC KazMunayGas signed a memorandum of cooperation with Shell in the field of development of carbon capture, utilization and storage technologies.

The Fund is also analyzing the possibility of building an experimental clean coal-fired power plant with technology for capturing and storing *(geological)* carbon dioxide.

Compensation (carbon farms and offsets)

Biological sequestration of carbon is the process of absorbing carbon dioxide from the atmosphere and converting it into biomass by planting forests, or increasing the carbon layer of the soil *(humus)* agricultural methods.

One of the measures is the creation of so-called ‘carbon farms” in order to absorb carbon emissions. However, climate projects require justification and appropriate calculations. That is, the calculation of how much a particular territory, a particular object absorbs carbon and how much greenhouse gas it produces should be calculated in accordance with international practices.

Absorption of carbon dioxide by planting forests, or increasing the carbon layer of the soil *(humus)* agricultural methods, as well as carbon capture and disposal projects with long-term storage are the most common offset projects currently.

Restoration and creation of new plantations is a work that is currently carried out all over the world, including in Kazakhstan. In his next Message on September 1, 2021, the President of the Republic of Kazakhstan instructed to plant more than 2 *(two)* billion trees in the forest fund and 15 million in settlements within 5 *(five)* years.

The Fund’s initiatives in this direction include projects aimed at absorbing greenhouse gases through afforestation, reforestation, and landscaping.

Taking into account the presence of the mining industry in Kazakhstan and significant reserves of silicate rocks *(especially diatomite)*, it seems promising to study the possibility of using ERW *(Enhanced silicate rock weathering)* technology for the absorption of carbon dioxide. When cultivating arable land with silicate rocks, long-term removal of CO_2 from the atmosphere is observed through the formation of calcium carbonate (chalk). The advantage of the ERW approach is the final disposal of carbon dioxide, whereas with CCUS there is a significant risk of leakage and return of carbon dioxide to the atmosphere.

4.3 Infrastructure and regulation

NES modernization and Smart Grid introduction

The development of low-carbon energy with the corresponding development of the electric grid infrastructure and energy storage and storage systems *(for RES)* is an important factor necessary to achieve the goals of transition to carbon neutrality.

The increased involvement of the RES share in the energy system, modernization, decentralization and digitalization of the energy infrastructure significantly increase the need for smart measuring systems. Smart Grid is a basic technological element, the Fund of a “smart” or digital network – an

intelligent electricity metering system designed for the operational formation of a reliable volume of services, multi-tariff accounting, monitoring of electricity quality and other functions.

The Fund has already started implementing some elements of Smart Grid technology, so KEGOC JSC is implementing a monitoring and control system based on WAMS/WACS synchrophasor technologies, which will maximize the use of network bandwidth through real-time management.

The Fund is planning to implement a comprehensive plan for development of intelligent networks, which includes the development of an integrated energy accounting system, through the development and introduction of the concept of Smart Metering *(smart meter)*, which will allow real-time monitoring and remote control over energy consumption, development of analytics and big data management and research on the possibility of using systems energy storage for renewable energy integration.

In the future, taking into account the development of digital solutions, it is possible to develop Smart Grid to the level of data exchange between devices and appliances connected to the network in order to regulate peak loads and use maneuverable potential. Currently, the Ministry of Energy of the Republic of Kazakhstan, together with the Asian Development Bank, is developing a draft Concept for digitalization of the electric power system of the Republic of Kazakhstan *(Smart Grid)*.

Energy accumulation and storage systems

Given the instability of RES, energy storage systems play an important role in their development. They reduce the level of imbalances in the system, serve for system regulation of the network and, in general, are a maneuverable source of the network with a very short time required for response. There are various types of batteries for energy storage: lead, lithium-ion, sodium-sulfur, flow, etc. The most common are lithium-ion batteries.

In general, there are two key options for the use of storage systems – at the level of RES objects or at the level of network infrastructure. In the case of the implementation of accumulation systems at the network level of KEGOC JSC, it is necessary to determine the optimal locations for the installation of systems. The key limiting factor for today is the cost of technology.

KEGOC JSC, with the assistance of the USAID Regional Program “Power the Future”, has completed the development of a preliminary feasibility study *(PFS)* on the introduction of battery-based energy storage systems *(BESS)* in Kazakhstan. As a result of the study, the type, parameters, function and economic feasibility of BESS technologies for Kazakhstan were determined.

Based on the results of the work carried out, it is planned to establish a center for advanced technologies in Kazakhstan for the pilot

implementation of BESS. Currently, the Fund's group is already considering the possibility of building RES facilities using energy storage technologies.

Maneuverable generation

The problem of peak loads and the need for maneuverable capacities to cover them is related to the peculiarities of the functioning of the electric power system. In any networks, including in the unified energy system *(UES)* of Kazakhstan, consumption during the day is uneven: it falls at night, increases by the beginning of the working day and reaches a peak in the evening. In the energy sector, unlike many other manufacturing industries, it is impossible to remove excess products to a conditional warehouse and take it from there at the time of a shortage. The supply must match the consumption, then the electric power network works stably. Otherwise, it is unbalanced and as a result – a blackout. Certain types of electricity generation, which are commonly called maneuverable capacities, solve the problem of peak loads.

It is planned to implement a number of projects for the development of maneuvering capacities in the UES of the Republic of Kazakhstan. One of the key areas will be the construction of hydroelectric power plants.

For example, Samruk-Energy JSC is currently implementing projects for the construction of a counter-regulating Kerbulak HPP with a capacity of 36 MW, reconstruction and modernization of the HPP Cascade of Almaty Electric Power Plants JSC. The possible construction of the HPP can provide the power system with about 500 MW of maneuverable capacity.

"Green" transport

The Fund has identified the following areas for development in the field of low-carbon technologies in the transport sector: electrification of railway lines, introduction of cars, locomotives and diesel locomotives powered by batteries and liquefied natural gas *(LNG),* research and analysis of hydrogen technologies for use on the railways of Kazakhstan.

Sustainable alternative fuels - biofuels and hydrogen have potential in aviation, shipping and heavy-duty road transport, where electrification is currently impossible.

In order to reduce the total consumption of jet fuel in recent years, Air Astana has added new, more fuel-efficient aircraft to its fleet, including Airbus A320neo, AirbusA321neo and Airbus A321LR *(with a new engine variant)*. In addition, some of the Company's pilot training programs include training in fuel efficiency skills. The introduction of Sustainable Aviation Fuel (SAF) in the EU, UK and USA countries makes it possible to introduce this practice gradually in Kazakhstan. JSC Air Astana is considering the possibility of studying the use of sustainable aviation fuel *(SAF*) as part of pilot projects.

The Fund is considering such measures to reduce greenhouse gas emissions from motor transport as the switch of transport to LPG and in the

long term the gradual replacement of gasoline transport with electric, and the replacement of diesel fuel with biodiesel.

For example, JSC NC KazMunayGas is switching vehicles to gas engine fuel, including compressed natural gas. At Kazakhtelecom JSC, the number of vehicles converted to gas today is more than 30% of the fleet.

The reduction in diesel fuel consumption can be achieved primarily through the electrification of railways and the introduction of electric locomotives with rechargeable batteries, projects of which are already being implemented in the USA. In order to reduce the environmental impact, JSC NC Kazakhstan Temir Zholy plans to implement two pilot projects: “Introduction of locomotives powered by liquefied natural gas *(LNG)”* and “Introduction of shunting locomotives powered by batteries”. Moreover, JSC NC Kazakhstan Temir Zholy plans to create a system for calculating the carbon footprint for shippers.

4.4. Efficient carbon footprint management

Carbon footprint accounting and reporting

Reliable and effective measurement of greenhouse gas emissions and carbon dioxide uptake is a key requirement for integration into internationally recognized systems of emissions trading and carbon units. Calculating the carbon footprint is the first and necessary step that companies are taking on the way to solving problems related to climate change. In addition, only on the basis of the analysis of reliable and qualitative data will it be possible to further define targets for reducing the carbon footprint.

Currently, only one of the Fund’s portfolio companies discloses information on the Carbon Disclosure Project CDP Climate Program. Only 2 companies verify their indicators. The remaining companies carry out reporting and verification of direct emissions within the framework of the National Emissions Trading System *(ETS)* in accordance with the requirements of legislation.

The availability of CDP reporting directly affects the ESG rating of the Fund’s companies. This allows investors and shareholders to assess all types of risks, as well as opportunities and long-term prospects for investments in companies.

In this regard, to conduct a comprehensive analysis and assessment of the current situation on direct *(Scope 1)* and indirect greenhouse gas emissions *(Scope 2)* at the enterprises of the Fund Group, using a unified methodological approach to the calculation of greenhouse gas emissions. The Fund will develop the practice of verified reporting on the CDP climate program in the next few years.

In the longer term, the task is to expand reporting under the CDP climate program and to ensure that indirect greenhouse gas emissions of Scope 3 are taken into account *(accounting for indirect greenhouse gas emissions in purchased goods and services).*

This will make it possible not only to compare data between companies, but also to prepare for reporting in accordance with national and international norms and standards, as well as to verify data by third-party organizations, for example, to calculate the carbon footprint of products under the EU carbon border adjustment mechanism *(CBAM).*

Starting from 2021, UK companies with a premium listing are required to disclose information related to climate change in accordance with the TCFD recommendations, and from 2023 this requirement will become mandatory for disclosure for all economic entities. TCFD recommendations form a target model for managing the climate agenda at the organization level. The key elements of the TCFD recommendations are already integrated into the existing widespread standards and practices of non-financial reporting.

The Fund will work on implementation of TCFD recommendations in the practices of corporate governance, strategic planning, risk assessment, control, as well as disclosure of information in reporting. The implementation of TCFD recommendations contributes to the strengthening and development of corporate risk management practices that will prepare the Fund for the expected tightening of regulation in financial markets. Early adaptation will allow the Fund and portfolio companies to organically implement management processes, reducing the costs of the new administrative burden.

The Fund also intends to introduce actively such a tool as ESG ratings into the practice of portfolio companies in practice. In 2020, JSC NC KazMunayGas was evaluated by the ESG rating of the international rating agency “Sustainalytics” *(Amsterdam, Netherlands),* and received the ESG risk rating of Sustainalytics. From 2023, the remaining portfolio companies will be evaluated by ESG rating agencies.

Digitalization

For the purpose of international recognition of information about the Fund’s greenhouse gas emissions and predict their impact on the environment, a high-quality verification system based on digital solutions is needed. The acceptance of information by international climate trading systems affecting pricing in the market of quotas for greenhouse gas emissions and carbon units in Kazakhstan depends on the quality and reliability of the data.

The Fund plans include creation of a single digital system that will meet the requirements of world standards for accounting for CO_2 emissions, which will enable integration into the mechanisms of cross-border carbon regulation. The Fund plans to develop uniform corporate requirements for verification procedures for direct and indirect emissions, as well as to verify and validate data according to an internationally recognized methodology.

The introduction of innovative, including digital technologies in production plays a crucial role in ensuring the efficiency of resource

development. Technologies from the world's leading leaders, including in the field of digital technologies, are used in the petrochemical projects implemented by the Fund.

ESG in relations with partners and suppliers

Suppliers and contractors are an integral link in the desire to reduce the carbon footprint of their products throughout the supply chain — from the extraction of raw materials to the disposal of goods at the end of its life cycle. The Fund plans to introduce ESG criteria into procurement processes to evaluate suppliers and contractors.

In international practice, special attention is paid to environmental criteria and the provision of incentives for environmentally friendly goods, such as domestic producers. In the field of energy efficiency development, it is advisable to consider the application of certification requirements *(for example, Energy Star)* by setting energy consumption standards for equipment and machinery. Additionally, by analogy with conditional discounts for domestic producers, it is possible to consider such a tool for suppliers who meet the criteria for sustainable procurement. Among the environmental aspects, the sustainability criteria can include issues of the production of goods from recycled materials, with a smaller carbon footprint, with low emissions and discharges of pollutants, etc.

The practice of ESG factor analysis will be integrated into the Fund's investment decision-making process: analysis of significant ESG factors and ESG risk assessment to identify investment risks and opportunities that are highly likely to affect the Fund's performance and investment efficiency.

"Green" financing

The Fund intends to adhere to the principles of sustainable financing and actively support the development of clean energy, environmental care and social orientation of business.

Most international financial institutions have declared the priority of their strategy to invest mainly in "green" projects. The advantage of using "green" financing is subsidizing the loan rate, if the project complies with the "green" taxonomy.

One of the most common instruments of "green" financing is the issue of "green" bonds. Green bonds are any type of bonds whose proceeds will be used exclusively to finance or refinance projects aimed at reducing the carbon footprint.

Today, "green" bonds are gaining great popularity as both a reputational product and a cheaper source of financing for climate and environmental projects. A key aspect of green bonds is the reduction of the coupon rate when the issuer achieves its goals to reduce the impact on the environment.

Sustainable development bonds are one of the new ways to finance future projects and solve the problems of economical use of fossil resources,

as well as urban pollution. Sustainable development bonds are bonds whose proceeds will be used exclusively to finance or refinance a combination of “green” and social projects in accordance with certain principles established by the International Capital Markets Association *(ICMA)*. By issuing sustainable development bonds, the Fund can get a number of significant advantages: improving its image, attracting new investors and attracting resources for eco-projects on favorable terms.

On November 25, 20211, JSC Samruk-Energy made its debut offering of green bonds by public subscription on the stock exchange of the Astana International Financial Center - Astana International Exchange in the amount of KZT18.4 billion with a coupon rate of 11.4% per annum and a circulation period of 6.5 years.

One of the additional financing mechanisms for low-carbon development planned for implementation by the Fund is the creation of a Carbon Fund of the Fund group.

The activities of the Carbon Fund are planned to be provided by financing from the Fund's companies with the involvement of development institutions and financial institutions. The implementation of the Carbon Fund will provide access to targeted sources of financing for low-carbon projects, will ensure the necessary competencies, stable implementation of both offset projects and enterprise modernization projects in terms of reducing emissions.

Environmental culture of the company

In order to implement the Concept of Low-carbon Development, it is not enough to introduce only technical decarbonization measures. According to IEA estimates, less than 40% of the emissions reduction will result from the introduction of low-carbon technologies that require massive political support and investment. Another 55% of emissions reductions require a combination of deployment of low-carbon technologies and active involvement of consumers. The remaining 5% of emissions reductions will be associated with changes in behavior and activities that will lead to a reduction in energy consumption.

Therefore, the fundamental importance in the implementation of the concept is occupied by the employees of the Fund group. Only a change in the paradigm of thinking of each employee and an understanding of the importance of their own contribution to decarbonization can lead to the successful achievement of carbon neutrality goals.

The environmental responsibility of each employee of the Fund is to implement their own conscious consumption of resources on a daily basis and to take into account environmental aspects when taking decisions. Each employee of a company should contribute to the formation of the company's image as a responsible player in the international market, whose work is based on the principles of sustainable development. It is necessary to introduce and promote the principles of "green" mindset at all levels.

In order to implement the concept, corporate governance practices will be improved with the introduction of ESG principles, the introduction of corporate programs, and the launch of the Green Office project. Employees will be involved in risk reduction activities, improvement of the environmental management system, which will help Portfolio Companies not only to improve their non-financial indicators, but also to support environmental education, as well as employee awareness. The Fund is planning to create a corporate motivation system for encouraging employees and to make efforts for the development of a socially and environmentally oriented business.

Increasing the competence and awareness of the company's employees' role in managing environmental issues and reducing the carbon footprint of the entire Fund group will be carried out, inter alia, within the framework of the Sustainable Development Committee under the executive body of the Fund to manage development in the field of ESG for the implementation of the above initiatives in all portfolio companies of the Fund.

5. The necessary resources for the implementation of the directions of the Concept

In order to implement measures aimed at reducing the carbon footprint by 2032 and achieving carbon neutrality by 2060 in the long term, the Plan for the transition of Samruk-Kazyna JSC to a low-carbon business model has been developed for the above-mentioned key areas *(Appendix 1).*

More than 50 activities have been identified in four key areas with an estimated implementation cost of about 20-25 billion US dollars. Of these, about 85% of the funds will be directed to the implementation of more than 20 major investment projects for the transition to alternative energy *(construction and expansion of renewable energy facilities, construction of nuclear power plants, switch of thermal power plants from coal to gas)* and increase maneuverable generation *(construction of hydroelectric power plants and CCGT)*.

According to these projects, it is planned to attract own and loan funds, as well as investors' funds with the prospect of repayment through electricity tariffs.

The sources of funding for R&D projects will be funds within the deduction of funds from the subsoil users of the Fund group.

In order to effectively and timely implement the Concept, government support is important in terms of improving the regulatory framework. Moreover, given the importance of commissioning nuclear power plants for the purposes of low-carbon development, it is necessary to make timely decisions on the implementation of this project.

6. Conclusion

The Concept defines a unified framework for low-carbon development as an integral component of the Fund's long-term development and is the Fund's strategic document for achieving carbon neutrality. Given the significant share of the Fund's group of companies in the country's economy, the implementation of the Concept's activities is extremely important in order to achieve carbon neutrality by the Republic of Kazakhstan by 2060.

This Concept provides for the main three scenarios of the Fund's development in the medium term *(until 2032)* and long term *(until 2060)*: “business as usual" *(BAU)*, retention decarbonization scenario *(D)* and deep decarbonization scenario *(DD).*

At the same time, in order to reduce the carbon footprint, it is necessary to follow the deep decarbonization *(DD)* scenario. This scenario implies significant changes in the structure of electricity generation due to accelerated commissioning of nuclear power plants and earlier conservation of coal-fired power plant units, as well as an increase in the capacity of RES and HPPs, the purchase of electricity from RES and energy saving measures.

The key areas of low-carbon development are activities in the field of alternative energy, increasing resource and energy efficiency, improving infrastructure, as well as effective management of the carbon footprint and business processes.

The implementation of the directions of the Concept will ensure the long-term sustainability and investment attractiveness of the Fund's group of companies.

For the effective implementation of the Concept that meets Kazakhstan's sustainable development goals, it is necessary:

- regular revisions and updates of the Concept and accompanying Plan for the Fund's transition to a low-carbon business model, taking into account new technological advances, as well as socio-economic development;
- active participation of stakeholders at all stages of development, implementation, monitoring and updating of the Concept;
- constant monitoring and transparent implementation of the developed measures.

7. Glossary

Terms and definitions

Carbon footprint: The sum of greenhouse gas emissions and removals in the production system, expressed as equivalents and based on an assessment of the product life cycle using one impact category - climate change. The equivalent of a specific amount of greenhouse gas is calculated as the mass of a given greenhouse gas multiplied by its global warming potential. For the purposes of this Concept, the carbon footprint includes direct *(carbon dioxide, CO_2)* and methane *(CH_4)* and energy indirect greenhouse gas emissions.

Carbon neutrality: zero greenhouse gas emissions achieved by balancing carbon dioxide emissions and uptake.

Quota-based installation: an installation whose quota-based greenhouse gas emissions exceed twenty thousand tons of carbon dioxide per year in regulated sectors of the economy.

Direct greenhouse gas emissions (Scope 1): Greenhouse gas emissions from greenhouse gas sources owned or controlled by an organization.

Indirect greenhouse gas emissions (Scope 2): Greenhouse gas emissions from the production of imported electrical energy, heat or steam consumed by an organization.

Other indirect greenhouse gas emissions (Scope 3): Greenhouse gas emissions that differ from energy indirect greenhouse gas emissions that are the result of an organization’s activities, but arise from greenhouse gas sources owned or controlled by other organizations.

Acronyms and Abbreviations

AIX	Astana International Exchange
APG	Associated petroleum gas
BAU	Business as usual
CBAM	Carbon Border Adjustment Mechanism
CCGT	Combined-cycle gas plant
CCUS	Carbon capture, use and storage
CHP	Central heating and power plant
CO_2	Carbon dioxide
c. eq.	Coal equivalent

D	Decarbonization
DD	Deep Decarbonization
EOR	Enhanced oil recovery
ESG	Environmental, Social, and Corporate Governance
ETL	Energy transmission line
EU	European Union
FA	Fuel assembly
FEC	Fuel and energy complex
FER	Fuel and energy resources
GBP	Green Bond Principles
GeoTPP	Geothermal power plant
GHG	Greenhouse gases
GRES	Hydraulic circulation station
GTTP	Gas turbine power plant
HPP	Hydroelectric power plant
ICMA	The International Capital Market Association
IEA	International Energy Agency (IEA)
ISO	International Organization for Standardization
KASE	Kazakhstan Stock Exchange
LDAR	Leak detection and repair program
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
MGP	Main gas pipelines
NPP	Nuclear power plant
NDC	Nationally determined contributions
OECD	Organization for Economic Cooperation and Development
R&D	Research, Development and Engineering works
Refineries	Oil processing plant
RES	Renewable energy sources

SAF	Sustainable aviation fuel
SPP	Solar power plant
TCFD	Task Force on Climate-Related Financial Disclosures
TPP	Thermal power plant (CHP, GRES, GTPP, etc.)
USA	United States of America
WPP	Wind Power Plants

Annex No.1

Plan for the transition of Samruk-Kazyna JSC to a low-carbon business model*

s/i No.	Directions	Portfolio companies	Measure	Effect	Unit of measure	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Direction 1. Alternative energy and low-carbon technologies																
1	Renewable energy sources	Samruk-Energy JSC	Construction of a WPP near Shelek village (Energiya Semirechiya LLP)	Substitution of carbon generation	MW	60	60	60	60	60	60	60	60	60	60	60
2	Renewable energy sources	Samruk-Energy JSC	Construction of a WPP near Yereimentau (EWP LLP)		MW		50	50	50	50	50	50	50	50	50	50
3	Renewable energy sources	Samruk-Energy JSC	Expansion of the Yereimentau WPP (FWPS LLP)		MW		5	5	5	5	5	5	5	5	5	5
4	Renewable energy sources	Samruk-Energy JSC	Expansion of the WPPP near Shelek village up to 300 MW		MW								240	240	240	240
5	Renewable energy sources	Samruk-Energy JSC	Expansion of the Yereimentau WPP (FWPS LLP) up to 300 MW		MW										200	200
6	Renewable energy sources	JSC NC KazMunayGas	Construction of a WPP in Nur-Sultan with Eni		MW				50	50	50	50	50	50	50	50
7	Renewable energy sources	Fund, JSC NC KazMunayGas	Construction of the Mirny WPP with Total Eren		MW						1000	1000	1000	1000	1000	1000
8	Renewable energy sources	JSC NC KazMunayGas, JSC NAC Kazatomprom, JSC NMC Tau-Ken Samruk, Kazakhtelecom JSC	Construction of low-power RES at Subsidiaries	Carbon generation substitution, Prevention of indirect CO_2 emissions	MW			0.5	1	1.5	2	2	2	2	2	2
9	Renewable energy sources	JSC NC KazMunayGas	Construction of WPP and SPP in Mangystau region with Eni	Substitution of carbon generation	MW				180	180	180	180	180	180	180	180

s/i No.	Directions	Portfolio companies	Measure	Effect	Unit of measure	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
			(WPP/SPP and GTPP for balancing)													
10	Renewable energy sources	JSC NC KazMunayGas	Construction of a WPP in Atyrau region		MW			135	135	135	135	135	135	135	135	135
11	Renewable energy sources	All PCs	Increasing the share of low-carbon generation in the purchase of electricity	Reduction of indirect CO_2 emissions	Share of purchased energy from low-carbon sources, %	4	6	9	13	17	21	25	30	35	40	45
12	Renewable energy sources	JSC NC Kazakhstan Temir Zholy (KTZh), JSC NAC Kazatomprom (KAP)	Replacement of diesel boilers with a combined system with heat pumps (13 boiler caps, 25 boilers in KTZh)	Reduction of diesel fuel consumption, reduction of direct CO_2 emissions	% of replacement			20	40	60	80	100	100	100	100	100
13	Renewable energy sources	JSC NC Kazakhstan Temir Zholy	Addition of electric heaters (976 units) with heat pumps		% of addition			20	40	60	80	100	100	100	100	100
14	Nuclear power	Kazakhstan Nuclear Power Plants JSC	NPP construction	Substitution of carbon generation			Preparation and approval of FS, DED and other documentation				Construction					Commissioning of unit 1
15	Conversion from coal to gas	Samruk-Energy JSC	Expansion of the gas generation capacity of CHP-1 of Almaty Electric Stations JSC to 240 MW (CCGT)	Expansion of gas generation capacity, MW	MW									95	95	95
16	Conversion from coal to gas	Samruk-Energy JSC	Switch of CHP-2 of Almaty Electric Power Stations JSC from coal (430 MW) to gas (CCGT and 557 MW cogeneration plant)		MW			200	200	379	557	557	557	557	557	557
17	Conversion from coal to gas	Samruk-Energy JSC	Switch of Almaty CHP-3 JSC "Almaty Electric Stations" from coal (173 MW) to gas (450 MW CCGT)		MW				450	450	450	450	450	450	450	450

s/i No.	Directions	Portfolio companies	Measure	Effect	Unit of measure	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
18	Other low-carbon generation	Samruk-Energy JSC	Conservation of one block of EGRES-1 LLP	Reduction of the share of coal generation												Conservation
Direction 2. Resource efficiency and emission management technologies																
19	Clean coal technologies	Samruk-Energy JSC	Coal enrichment and gasification	R&D			R&D									
20	Resource saving and energy saving	Fund and all PCs	Development and implementation of the Energy Saving and Energy Efficiency Improvement Program			development	Implementation									
20.1	Resource saving and energy saving	All PCs	Implementation of measures aimed at reducing the consumption of fuel resources	FER saving, direct CO_2 emissions reducing	thousand ton of coal equivalent		210	305	357	385	407	440	472	504	525	525
20.2	Resource saving and energy saving	All PCs	Implementation of measures aimed at reducing the consumption of electric and thermal energy	Reduction of indirect CO_2 emissions	thousand ton of coal equivalent		32	49	63	77	82	88	92	95	98	98
21	Resource saving and energy saving	JSC NC QazaqGaz	Overhaul of the GPU at compressor stations	Reduction of natural gas consumption, reduction of direct CO_2 emissions	thousand tons of CO_2			38	38	38	38	38	38	38	38	38
22	Resource saving and energy saving	JSC NC QazaqGaz	Use of mobile compressor stations (MCS) in the repair of main gas pipelines	Reduction of direct emissions	thousand tons of CO_2-eqv			71	71	71	71	71	71	71	71	71
23	Carbon dioxide capture and storage	Fund	Analysis of the possibility of implementing carbon capture utilization and storage (CCUS) technologies (the potential of carbon storage tanks)	R&D	amount	R&D										

s/i No.	Directions	Portfolio companies	Measure	Effect	Unit of measure	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
24	Carbon dioxide capture and storage	Fund	Investigation of the possibility of using enhanced rock weathering technology to absorb carbon dioxide	R&D			R&D									
25	Carbon dioxide capture and storage	JSC NC KazMunayGas	CCUS pilot project according to the assessment of the potential of CO_2 injection to increase the oil recovery of the developed oil reservoirs.	Pilot project	amount	Stage 1 Screening of CO2-eq. emission sources and injection tanks at KMG assets		Stage 2 Design as part of the first phase of the CCS/CCUS pilot project at KMG assets		Stage 3 Implementation of a pilot project on the use of CCS/CCUS technology						
26	Compensation (carbon farms and offsets)	All PCs	Formation of a portfolio of offset projects	Carbon footprint growth compensation	thousand tons of CO_2-eqv		334	499	866	1397	1398	4420	4480	5215	5215	5815
26.1	Compensation (carbon farms and offsets)	Samruk-Energy JSC	Implementation of an offset project for the existing Yereimentau WPP 45 MW		thousand tons of CO_2-eqv		150	150	150	150	150	150	150	150	150	150
26.2	Compensation (carbon farms and offsets)	Samruk-Energy JSC	Implementation of an offset project for the existing Kapchagai SPP 2.4 MW		thousand tons of CO_2-eqv		4	4	4	4	4	4	4	4	4	4
26.3	Compensation (carbon farms and offsets)	Samruk-Energy JSC	Implementation of an offset project for a WPP near Shelek village 60 MW (Energiya Semirechiya LLP)		thousand tons of CO_2-eqv		180	180	180	180	180	180	180	180	180	180
26.4	Compensation (carbon farms and offsets)	Samruk-Energy JSC	Implementation of an offset project for WPP near Yereimentau village (EWP LLP)		thousand tons of CO_2-eqv			150	150	150	150	150	150	150	150	150

s/i No.	Directions	Portfolio companies	Measure	Effect	Unit of measure	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
26.5	Compensation (carbon farms and offsets)	Samruk-Energy JSC	Implementation of an offset project for the expansion of the Yereimentau WPP (FWPS LLP)		thousand tons of CO_2-eqv			15	15	15	15	15	15	15	15	15
26.6	Compensation (carbon farms and offsets)	Samruk-Energy JSC	Implementation of an offset project for the expansion of theWPP near Shelek village up to 300 MW		thousand tons of CO_2-eqv									735	735	735
26.7	Compensation (carbon farms and offsets)	Samruk-Energy JSC	Implementation of an offset project for the expansion of the Yereimentau WPP (FWPS LLP) to 300 MW		thousand tons of CO_2-eqv											600
26.8	Compensation (carbon farms and offsets)	JSC NC KazMunayGas	Implementation of an offset project from the Mirny WPP (1000 MW) together with Total Eren		thousand tons of CO_2-eqv							3020	3020	3020	3020	3020
26.9	Compensation (carbon farms and offsets)	JSC NC KazMunayGas	Implementation of an offset project from the WPP in Nur-Sultan (50 MW) together with Eni (50/50 participation)		thousand tons of CO_2-eqv					150	150	150	150	150	150	150
26.10	Compensation (carbon farms and offsets)	JSC NC KazMunayGas	Implementation of offset project from WPP and SPP in Mangystau region together with Eni		thousand tons of CO_2-eqv					380	380	380	380	380	380	380
26.11	Compensation (carbon farms and offsets)	JSC NC KazMunayGas	Implementation of the offset project from a WPP in Atyrau region (134.6 MW) together with Renovatio		thousand tons of CO_2-eqv				365	365	365	365	365	365	365	365
26.12	Compensation (carbon farms and offsets)	JSC NC KazMunayGas	Implementation of an offset project for the production of biofuels (for consumption within Kazakhstan). Together with Eni		thousand tons of CO_2-eqv								60	60	60	60
26.13	Compensation (carbon farms and offsets)	JSC NC KazMunayGas	Implementation of the offset project from the project of construction of low-power RES for Subsidiaries		thousand tons of CO_2-eqv				1.5	3	4.5	6	6	6	6	6

s/i No.	Directions	Portfolio companies	Measure	Effect	Unit of measure	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
27	Compensation (carbon farms and offsets)	All PCs	Absorption of carbon dioxide from the atmosphere and the transition to biomass by planting forests or increasing the carbon layer of the soil (humus) On 2000 hectares	Reducing the net carbon footprint	thousand tons of CO_2				10	11	12	13	14	15	16	16
Direction 3. Infrastructure and regulation																
28	Maneuverable generation	Turkestan CCP LLP	Construction of a maneuverable combined-cycle gas plant (CCGT) in Turkestan	Construction of maneuverable capacities for RES integration	MW					Up to 1000 MW	Up to 1000 MW	Up to 1000 MW	Up to 1000 MW	Up to 1000 MW	Up to 1000 MW	Up to 1000 MW
29	Maneuverable generation	Samruk-Energy JSC	Construction of HPP-29		MW								71	71	71	71
30	Maneuverable generation	Samruk-Energy JSC	Construction of a HPP cascade on Ugam river		MW						100	100	100	100	100	100
31	Maneuverable generation	Samruk-Energy JSC	Construction of a HPP cascade on Tentek river		MW								500	500	500	500
32	Maneuverable generation	Samruk-Energy JSC	Construction of a HPP cascade on Koksu river		MW							376	376	376	376	376
33	Maneuverable generation	Samruk-Energy JSC	Construction of the Kerbulak HPP	Commissioning of a 40.6 MW HPP and increase in distributing KapHPP (by 100 MW)	MW				140.6	140.6	140.6	140.6	140.6	140.6	140.6	140.6
34	Maneuverable generation	Samruk-Energy JSC	Construction of the Bulak HPP	Commissioning of a 80 MW HPP and increase in distributing ShHPP (by 450 MW)	MW									530	530	530

s/i No.	Directions	Portfolio companies	Measure	Effect	Unit of measure	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
35	Maneuverable generation	JSC NC QazaqGaz	Construction of the gas infrastructure for projects of Almaty CHPP-2 and CHPP-3	Increase in gas generation	Commissioning		Input									
36	NEPS modernization and Smart Grid introduction	KEGOC JSC	Strengthening of the electric network of the Western zone of the UES of Kazakhstan. Reconstruction of 5,220 kV overhead lines and 220 kV Uralskaya, "Pravoberezhnaya, Inder, Kulsary, Tengiz, Karabatan substations	Improving the reliability of NEPS and opportunities for integrating RES	Commissioning			Input								
37	NEPS modernization and Smart Grid introduction	KEGOC JSC	Recontruction of the electric network of the Southern zone of the UES of Kazakhstan								Input					
38	NEPS modernization and Smart Grid introduction	KEGOC JSC	Unification of the energy system of Western Kazakhstan with the UES of Kazakhstan. Construction of electric grid facilities									Input				
39	Energy accumulation and storage systems	KEGOC JSC	Implementation of a pilot project of a 5 MW ESS with a capacity of 4 hours in Kyzylorda region	Pilot project	Amount		Launch									
40	"Green" transport	Air Astana JSC	Investigation of the possibility of implementing the project "Biofuels, including sustainable aviation fuel"	R&D				R&D								
41	"Green" transport	JSC NC Kazakhstan Temir Zholy	Investigation of the possibility of introducing LNG as a fuel for a traction train	Pilot project				Pilot project								

s/i No.	Directions	Portfolio companies	Measure	Effect	Unit of measure	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
42	"Green" transport	JSC NC Kazakhstan Temir Zholy	Increase in the share of railway electrification (the current level of electrification is 40%)	Reduction of CO_2 emissions from diesel fuel combustion	% share of electrification	40	40	40	40	44	44	44	44	44	45	45
43	"Green" transport	All PCs	Partial conversion of motor vehicles (gasoline engine) to electricity or alternative fuel	Reduction of gasoline consumption, reduction of direct CO_2 emissions	Share of vehicles on alternative fuel, %	0	0	0	5	6	7	8	9	15	17	19
Direction 4. Efficient carbon footprint management																
44	Carbon footprint accounting and reporting	All PCs	Getting ESG rating	Improvement of the ESG management system, improvement of the ESG rating	Number of PCs (total) rated	1	4	7	8	8	8	8	8	8	8	8
45	Carbon footprint accounting and reporting	All PCs, except for JSC NC KazMunayGas	Getting a CDP climate rating			1	4	7	8	8	8	8	8	8	8	8
46	Carbon footprint accounting and reporting	All PCs	Introduction recommendations of the Task Force on Climate-related Financial Disclosures (TCFD)		Number of PCs that have introduced recommendations		2	5	8	9	9	9	9	9	9	9
47	Carbon footprint accounting and reporting, digitalization	All PCs	Introduction of digital solutions for collecting data on sustainable development, including carbon footprint		Commissioning			ntroduction								
48	Carbon footprint accounting and reporting	JSC NC Kazakhstan Temir Zholy	Introduction of a carbon footprint calculation system for rail freight transportation		Improving the ESG rating				Introduction							
49	Environmental culture of the company	All PCs	Launch of the Green Office project		Amount PC		4	7	9	11	11	11	11	11	11	11

s/i No.	Directions	Portfolio companies	Measure	Effect	Unit of measure	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
50	ESG in relations with partners and suppliers	Fund and all PCs	Developing ESG criteria for partners and suppliers		Amending internal regulations		Introduction									
51	"Green" financing	Fund	Development of proposals for the creation of a mechanism for green certificates acquisition		Pilot project			Development								
52	"Green" financing	Fund	Issue of "green bonds (if necessary)		Bond issue											
53	"Green" financing	Fund	Creation of the carbon fund of the Fund Group		Creation of the Fund											
Total			Energy Saving and Energy Efficiency Improvement Program, including the potential		thousand ton of coal equivalent		**242**	**354**	**419**	**462**	**490**	**527**	**563**	**599**	**624**	**624**
			Potential for reducing direct GHG emissions by reducing fuel consumption (Scope 1)		thousand tons of CO_2		**400**	**600**	**680**	**720**	**750**	**800**	**860**	**900**	**940**	**940**
			Potential for reducing indirect GHG emissions by reducing energy and heat consumption (Scope 2)		thousand tons of CO_2-eqv.		**181**	**1067**	**1070**	**1448**	**470**	**510**	**540**	**560**	**580**	**580**
			Offset projects		thousand tons of CO_2-eqv.		**181**	**1396**	**1406**	**1407**	**1408**	**4429**	**4490**	**5226**	**5231**	**5831**
			Carbon generation substitution (RES) to prevent indirect CO_2 emissions		MW	**60**	**115**	**250**	**481**	**482**	**1482**	**1482**	**1722**	**1722**	**1722**	**1922**
			Construction of maneuverable capacities (CCGT and HPP)		MW				**41**	**1041**	**1141**	**1517**	**2088**	**2168**	**2168**	**2168**
			Expansion of gas generation capacity, MW		MW			**200**	**650**	**829**	**1007**	**1007**	**1007**	**1102**	**1102**	**1102**

*The plan is subject to adjustment in the case of:

- Instructions of the President of the Republic of Kazakhstan within the framework of the annual Messages of the Head of State to the people of Kazakhstan on the situation in the country and the main directions of domestic and foreign policy of the Republic

- Amendments to provisions of international agreements in the field of climate change and nationally determined contributions of the Republic of Kazakhstan to the achievement of the temperature target of the Paris Agreement
- changes in strategic directions;
- changes in methods of calculation and/or verification of emissions;
- changes in the necessary investments, including as a result of the introduction of new techniques;
- the results of new scientific research.

Annex No.2

Table 1. Fuel-energy resources consumption by types of energy resources in the Fund's Group of Companies in 2021 (thousand tons of coal equivalent)

PC	Coal	Gas	APG	Boiler fuel	Liquid fuel	Primary (total)	Secondary (electricity and heat)	Total
JSC Samruk-Energy	12 381	136	0	0	66	12 583	7	**12 590**
JSC NC KazMunayGas	0	915	900	697	715	3 230	593	**3 821**
JSC NC QazaqGaz	0	1 519	0	0	11	1 530	10	**1 540**
JSC NC Kazakhstan Temir Zholy	19	54	0	0	876	950	409	**1 359**
Samruk-Kazyna Ondeu LLP	0	517	0	0	0.6	517	2.7	**520**
JSC KEGOC	0	0	0	0	5	5	407	**412**
JSC Air Astana	0	0	0	0	305	305	0.4	**306**
JSC Kazatomprom	0.3	0	0	5	41	46	100	**146**
JSC Kazakhtelecom	0.5	5	0	0	8	14	35	**49**
JSC Kazpost	2	1	0	0	11	14	6	**20**
JSC NMC TKS	0	0	0	0	0.7	1	3	**4**
Share by resource (%)	**59,7%**	**15,2%**	**4,3%**	**3,4%**	**9,8%**	**92,4%**	**7,6%**	**100%**
Total by the Fund group	**12 403**	**3 149**	**900**	**702**	**2 039**	**19 194**	**1 574**	**20 769**

Table 2. Direct emissions of CO_2 by the Fund group for 2021

PC	CO2 emissions (thous. ton)	Share, %
JSC Samruk-Energy	33 032	70,29%
JSC NC KazMunayGas	7 904	16,82%
JSC NC QazaqGaz	2 514	5,35%
JSC NC Kazakhstan Temir Zholy	1 919	4,08%
Samruk-Kazyna Ondeu LLP	848	1,81%
JSC Air Astana	611	1,30%
JSC NAC Kazatomprom	94	0,20%
JSC Kazpost	31	0,07%
JSC Kazakhtelecom	28	0,06%
JSC KEGOC	11	0,02%
JSC NMC Tau-Ken Samruk	1	0%
Total	**46 992**	**100%**

Table 3. CO_2 emissions of the Fund's group on technological processes

Technological processes	CO_2 emissions (thous. ton)	Share, %
Fuel combustion, total	**44 824**	**96%**
Production of electric and thermal energy	**33 296**	**71%**
Transport, including	**2 898**	**6%**
Air	609	1%
Railway	2 203	5%
Motor transport	84	0%
Oil and gas transportation	**2 690**	**6%**
Mining and processing of minerals	**5 915**	**13%**
Other	**17**	**0%**
Industrial processes	**1 694**	**4%**
Total	**46 992**	**100%**

Table 4. Total fuel-energy resources (FER) consumption by the Fund's group of companies in 2021

PC	FER consumption (tons of coal equivalent)	Share (%)
JSC Samruk-Energy	12 590 768	61%
JSC NC KazMunayGas	3 821 301	18%
JSC NC QazaqGaz	1 540 399	7%
JSC NC Kazakhstan Temir Zholy	1 358 664	6%
Samruk-Kazyna Ondeu LLP	520 205	3%
JSC KEGOC	412 140	2%
JSC Air Astana	306 092	1%
JSC NAC Kazatomprom	145 741	1%
JSC Kazakhtelecom	48 860	1%
JSC Kazpost	20 588	
JSC NMC Tau-Ken Samruk	4 140	
Total by the Fund group	**20 768 898**	**100%**

Table 5. Number of vehicles by fuel type and CO_2 emissions

Fuel type	Type of transport		Total number	CO_2 emissions (thousand tons)
	Passenger	Special		
Gasoline	6 489	961	7 450	74
Diesel	3 873	3 541	7 414	2 061
Gas (GHG, LPG)	679	815	1 494	100
Jet fuel	-	41	41	609
Coal	-	34	34	52
Fuel oil	-	19	19	2
Total	**11 041**	**5 411**	**16 452**	**2 898**

Table 6. Indirect emissions of CO_2 by the Fund group for 2021

PC	CO_2 emissions thousand tons	Share (%)
JSC NC KazMunayGas	3 329	31,1%
JSC NC Kazakhstan Temir Zholy	3 230	30,1%
JSC KEGOC	3 101	28,9%
JSC NAC Kazatomprom	694	6,5%
JSC Kazakhtelecom	224	2,1%
JSC NC QazaqGaz	79	0,7%
JSC Kazpost	32	0,3%
JSC NMC Tau-Ken Samruk	27	0,3%
JSC Samruk-Energy	24	0,2%
Samruk-Kazyna Ondeu LLP	22	0,2%
JSC Air Astana	3	0,0%
Total	**10 764**	**100%**

Table 7. Key indicators for the "Business as usual" scenario (BAU).

1. Business as usual (BAU)					
	2021	**2032**	**2040**	**2050**	**2060**
Installed capacity, MW					
Total installed capacity	**6 624**	**13 558**	**14 558**	**15 058**	**16 078**
WPP and SPP	53	409	909	1409	2409
HPP	834	3768	4268	4268	4268
NPP	0	0	0	0	0
CPP coal	4500	6681	6681	6681	6681
CPP gas	530	2677	2677	2677	2677
Key production indicators					
Energy production, billion kWh	**38**	**76**	**80**	**82**	**92**
RES and HPP share	6%	26%	29%	30%	30%
NPP share	0%	0%	0%	0%	0%
Share of coal generation	87%	55%	52%	52%	53%
TPP with CCUS share	0%	0%	0%	0%	0%
Energy consumption					
Share of clean electricity *(purchase)*	2%	26%	40%	57%	78%
Banning the purchase of electricity from coal-fired generation	**absent**				
Level of electrification of the PBX *(gasoline)*	0%	0%	0%	0%	0%
Replacement of diesel fuel with biodiesel	0%	0%	0%	0%	0%
Share of sustainable aviation fuel consumption *(SAF)*	0%	0%	0%	0%	0%
Electrification of railway transport *(diesel locomotives)*	current level	0%	0%	0%	0%
Energy saving and energy efficiency improvement *(from basic),* tons of coal equivalent	0	0	0	0	0
Reduction of the carbon footprint, million tons of CO2					
The dynamics of the carbon footprint from the level of 2021 (+ growth) (- decrease)		**+19%**	**+15%**	**+13%**	**+16%**
Carbon footprint, million tons of CO_2 *(SCOPE1 and SCOPE2)*	57.8	68.5	66	65	67
Carbon footprint, million tons of CO_2 - equivalent *(SCOPE1 and SCOPE2 + CH4)*	75.0	84	80	78	79
CCUS from coal and gas generation	0.0	0	0	0	0
Offsets and ERW	0.0	0	0	0	0
Total emissions including intakes	57.8	68	66	65	67

Table 8. Key indicators for the Decarbonization (D) scenario

Decarbonization scenario (D - decarbonization)					
	2021	**2032**	**2040**	**2050**	**2060**
Installed capacity, MW					
Total installed capacity	6 624	**13 558**	**14 758**	**15 958**	**16 978**
WPP and SPP	53	409	909	1409	2409
HPP	834	3768	4268	4268	4268
NPP	0	0	1200	2400	2400
CPP coal	4500	6681	5681	5181	5181
CPP gas	530	2677	2677	2677	2677
Key production indicators					
Energy production, billion kWh	38	**76**	**80**	**82**	**92**
RES and HPP share	6%	26%	29%	30%	30%
NPP share	0%	0%	11%	22%	19%
Share of coal generation	87%	55%	41%	31%	34%
TPP with CCUS share	0	13%	13%	-18%	-46%
Energy consumption					
Share of clean electricity *(purchase)*	2%	45%	59%	79%	100%
Banning the purchase of electricity from coal-fired generation		**since 2040**			
Level of electrification of the PBX *(gasoline)*	0%	15%	25%	63%	100%
Replacement of diesel fuel with biodiesel	0%	0%	10%	55%	100%
Share of sustainable aviation fuel consumption *(SAF)*	0%	0%	5%	15%	25%
Electrification of railway transport *(diesel locomotives)*	current level	0%	15%	38%	75%
Energy saving and energy efficiency improvement *(from basic),* tons of coal equivalent	0	624	624	624	624
Reduction of the carbon footprint, million tons of CO2					
The dynamics of the carbon footprint from the level of 2021 (+ growth) (- decrease)		**0%**	**-22%**	**-45%**	**-66%**
Carbon footprint, million tons of CO_2 *(SCOPE1 and SCOPE2)*	**57.8**	64.6	53	42	44
Carbon footprint, million tons of CO_2 -equivalent *(SCOPE1 and SCOPE2 + CH4)*	75.0	79.8	67	55	56
CCUS from coal and gas generation	**0**	-5.7	-6	-7	-20
Offsets and ERW	**0**	-1	-2	-3	-4
Total emissions including intakes, CO_2 million tons	**57.8**	**58**	**45**	**32**	**20**
Total emissions including intakes, CO_2-eq million tons	75.0	73.3	59	45	32

Table 9. Key indicators for the Deep Decarbonization (DD) scenario

3. Deep decarbonization scenario (DD - deep decarbonization)	2021	2032	2040	2050	2060
Installed capacity, MW					
Total installed capacity	**6 624**	**15 467**	**15 508**	**16 708**	**17 898**
WPP and SPP	**53**	1618	2459	3459	3959
HPP	**834**	3768	4268	4268	4268
NPP	**0**	1200	2400	3600	4800
CPP coal	**4500**	6181	3681	3181	2151
CPP gas	**530**	2677	2677	2677	2677
Key production indicators					
Energy production, billion kWh	**38**	**76**	**80**	**82**	**92**
RES and HPP share	**0**	30%	34%	35%	35%
NPP share	**0**	12%	22%	32%	39%
Share of coal generation	**1**	39%	25%	15%	10%
TPP with CCUS share	**0**	0%	7%	23%	90%
Energy consumption					
Share of clean electricity *(purchase)*	**0**	45%	59%	79%	100%
Banning the purchase of electricity from coal-fired generation		**since 2040**			
Level of electrification of the PBX (*gasoline)*	**0**	19%	25%	63%	66%
Replacement of diesel fuel with biodiesel	**0**	0%	10%	55%	100%
Share of sustainable aviation fuel consumption (SAF)	**0**	0%	5%	15%	25%
Electrification of railway transport *(diesel locomotives)*	**current level**	0%	19%	38%	75%
Energy saving and energy efficiency improvement *(from basic*), tons of coal equivalent	0	624	624	624	624
Reduction of the carbon footprint, million tons of CO2					
The dynamics of the carbon footprint from the level of 2021 (+ growth) (- decrease)		**-10%**	**-38%**	**-65%**	**-100%**
Carbon footprint, million tons of CO_2 *(SCOPE1 and SCOPE2)*	**57.8**	53.0	40	30	25
Carbon footprint, million tons of CO_2 -equivalent *(SCOPE1 and SCOPE2 + CH4)*	75.0	67	52	38	32
CCUS from coal and gas generation	**0**	0	-2	-7	-20
Offsets and ERW	**0**	-1	-2	-3	-4
Total emissions including intakes, CO_2 million tons	57.8	52.3	36	20	0
Total emissions including intakes, CO_2-eq million tons	75.0	66	48	28	8

Annex No.3

Kazakhstan's key partners are developing internal carbon regulation systems:

The European Union *(41.8% of total exports)*, one of Kazakhstan's key trading partners, has been working on a fundamental revision of climate legislation since 2020, under which it plans to become the world's first climate-neutral part of the world by 2050. To meet the climate ambitions of the European Green Deal, the European Commission has set an interim target to reduce emissions by 55% by 2030. In July 2021, the EU submitted 15 new and revised legislative proposals *(the "Fit for 55" package).* The measures include additional support for environmentally friendly transport, renewable energy sources, expansion of regulatory coverage *(construction, roads, inland maritime transport, agriculture, waste and small industrial enterprises)*, the mechanism of equitable Transition *(Social Climate Fund),* as well as the mechanism of cross-border carbon regulation (*Carbon Border Adjustment Mechanism, CBAM).*

The CBAM implies the application of a cross-border indirect tax at the EU border for importers of high-carbon products from countries that do not have a greenhouse gas emissions control system commensurate with the EU. This tax will be paid by the buyer of imported goods in the EU, based on the provided and confirmed data on the carbon intensity of the goods. The transition period is defined as the period from 2023 to 2025, when only reporting on the carbon intensity of products will have to be submitted, in 2026 it is planned to commission into effect with the direct payment of tax.

The Russian Federation *(23.9% of the trade turnover)* has announced its intention to achieve carbon neutrality by 2060. Changes in the regulatory framework include the adoption of the Law "On Limiting Greenhouse Gas Emissions" dated 02.07.2021 and the Strategy of Socio-Economic Development of the Russian Federation with Low Greenhouse Gas Emissions until 2050 dated October 29, 2021. The main direction of Russia's low-carbon development is to establish a balance between greenhouse gas emissions and their absorption, which contributes to the expansion of projects for the absorption of greenhouse gas emissions.

China *(17.9% of the trade turnover*), as the largest developing country, has also included the achievement of climate goals in the state agenda.
China intends to reduce the carbon intensity of the economy by more than 65% by 2030 *(from 2005 level).* China expects peak emissions by 2030 and plans to achieve carbon neutrality by 2060. The share of alternative fuels in primary energy consumption will increase to 25% by 2030. It is also planned to increase the forest fund by 6 billion m3 by 2030 *(from 2005 level)*.

Turkey *(4% of the trade turnover)* has set a goal to reduce greenhouse gas emissions by 21% by 2030 compared to the usual scenario of economic development. There is a voluntary carbon market in the country.

Companies and organizations adhere to voluntary decarbonization strategies to achieve the goals of the Paris Agreement.

As a result, the climate policy of Kazakhstan's key trading partners can have a significant impact on the economy of Kazakhstan and development of the Fund.