Unofficial translation

Approval of the Strategy of the Republic of Kazakhstan on Achieving Carbon Neutrality by 2060

Decree of the President of the Republic of Kazakhstan of 2 February 2023 No. 121

To be published in
Compilation of Acts of the President and
Government of the Republic of Kazakhstan

HEREBY I RESOLVE TO:

1. Approve the attached Strategy of the Republic of Kazakhstan on Achieving Carbon Neutrality by 2060.

2. To the Government of the Republic of Kazakhstan to take action arising from this Decree.

3. Oversight over execution of this Decree shall be entrusted on the Administration of the President of the Republic of Kazakhstan.

4. This Decree shall become effective on the date of signing.

President of the Republic of Kazakhstan *K Tokayev*

APPROVED BY
Decree of the President of the Republic of Kazakhstan
of 2 February 2023 No. 121

STRATEGY of the Republic of Kazakhstan on Achieving Carbon Neutrality by 2060

Content

1. Introduction

Low carbon development is an enabler of sustainable development, and its main intent is to prevent the destructive impact of global climate change.

According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), the anthropogenic emissions of greenhouse gases (GHGs) achieved the highest end in human history with a devastating impact on the Earth's climate system. This involves direct physical risks and threats to ecosystems, infrastructure, and human life and health. In response to these challenges and to mitigate these risks, the countries around the world are keen to join international commitments.

Resolution *Transforming our world: the 2030 Agenda for Sustainable Development* was adopted by the General Assembly of the United Nations (UN) on 25 September 2015 whereby 193 Member States of the UN committed to ensure sustainable, comprehensive and progressive growth, inclusiveness and environmental protection in partnership and peace.

In December 2015, the Paris Agreement was adopted to promote environmental integrity, green economy, transfer of high-performance technology and climate change adaptation. The key aims of this Agreement include holding the increase in the global average temperature to well below 2°C above pre-industrial levels (years 1850-1900), and pursuing efforts to limit the temperature increase to 1.5°C.

According to the IPCC' assessment in 2021, climate change will intensify in the coming decades in all regions and if no action is taken to immediately and on a large scale reduce GHG emissions, limiting warming to 2°C will not be reached.

Pursuant to the Paris Agreement, all parties present their climate action plans – Nationally Determined Contributions (NDCs) every five years. Also, countries develop

low carbon development strategies as a long-term perspective for NDCs. The main purpose of such strategies is to ensure that anthropogenic emissions from different sources and GHG sinks are balanced.

52 countries approved their low carbon development strategies by September 2022; in addition, the European Union (EU) and the United States (US) set targets to achieve carbon neutrality by 2050, and China by 2060.

13 countries with a contribution to global gross domestic product (GDP) equal to 25% legally committed to achieve zero-emission targets (Canada, Spain, Portugal, Germany, the UK, Norway, Japan and others).

33 countries with a contribution to global GDP equal to 50% incorporated their zero-emission targets into programs /declarations (the US, Australia, Türkiye, Chili, Italy, the Netherlands, India, Saudi Arabia, Brazil, Argentine and others).

Municipalities and large companies are developing climate strategies (sustainable development strategies) too. Given that cities account for 65% of global energy and 70% of GHG emissions, over 120 cities declared that they intended to achieve carbon neutrality by 2050 (100 of them by 2030).

According to the Carbon Disclosure Project, 13 000 companies (or 64% of global market capitalization) disclosed some information about climate change in 2021; roughly 200 of them had specific data on their carbon footprint and carbon neutrality strategy. These companies regularly report on how they pursue green agenda.

Different low carbon development initiatives are implemented such as 200 countries declared phasing out unabated coal-fired generation and complete withdrawal from inefficient fuel subsidies which artificially lower coal, oil and natural gas prices.

29 countries, including Canada, Denmark, the US, Italy, Switzerland, and the UK committed to refrain from financing the energy sector (particularly, fossil fuel projects) by the end of 2022 in favor of more environmentally-friendly projects. Denmark, France, Greenland, Ireland, Quebec, Sweden and Wales announced termination of licensing oil and gas exploration and production.

100 countries signed the Global Methane Pledge initiated by the US and EU to reduce methane emissions by 30% by 2030.

120 countries accounting for roughly 90% of the world's forests committed to stop deforestation by 2030. These countries include Canada, Brazil, China, Indonesia, the US, the UK, Russia.

Over 100 governments, municipalities, states and large enterprises joined the declaration to move toward zero-emission vehicles and end the sale of internal combustion engine vehicles worldwide by 2040.

Countries are implementing some forms of regulation such as GHG allowances, carbon taxes and charges for entities not covered by quotas; they are developing carbon regulation frameworks and are implementing safeguards such as labelling of carbon products and cross-border mechanisms.

EU pursues the strongest climate policy by enforcing transition to zero-carbon economy by 2050.

The European Green Deal includes initiatives to expand the coverage of sectors in the emission trading system (ETS) and implement a carbon tax for the majority of other GHG emissions outside of the ETS.

As part of its Green Deal (policies varying from ambitious reduction of emissions to investments in advanced research and innovation), the European Commission developed the Carbon Border Adjustment Mechanism (CBAM) which is designed to levy a surcharge on goods for imports of carbon-intensive products depending on the amount of specific GHG emissions from their production.

Implementation of CBAM is a trigger for large export companies to give up environmentally dirty materials and semi-finished products used to produce finished products. This applies to goods with an unknown carbon footprint too.

In addition, in the framework of the Action Plan on Financing Sustainable Growth, the EU Commission proposed a clear and detailed EU taxonomy – a classification system for sustainable activities – with the objective to invest in sustainable projects and activities and reduce investments into carbon-intensive assets.

A new green trade strategy of the EU is under preparation, and it will reflect economic and climate priorities as per the Green Deal.

Given the international significance of the climate agenda, there has been a substantial increase in sustainable and ESG-based investments which have tripled in the past 8 years and doubled in the past 5 years to US$ 46 trillion at the end of 2021.

The financial sector is putting more emphasis on ESG investments and climate change risks including risks of non-performing assets. Investments are revaluated against conformity with climate goals. Large investors, including international development banks, plan to withdraw their investments to fossil fuel sectors. Companies face growing pressure to disclose climate information and risks, including information on the carbon footprint of products and decarbonization of supply chains. All these trends remain in the years and decades to come and will make a significant impact on the global and regional economy.

By 2025, ESG funds will manage more assets than any other funds, and the market share of ESG funds in 2025 will increase to 57% compared to the current 15%. Moreover, the financial alliance of 450 companies from 45 countries (equity, insurance and pension funds, banks, stock exchanges, etc.), whose members manage 40% of the world's financial assets, have declared a goal to fully reduce GHG emissions by 2050.

Kazakhstan signed the Paris Agreement on 2 August 2016 and ratified it on 6 December 2016. Prior to signing, in September 2015 Kazakhstan demonstrated its commitment to the goal by presenting its NDC in the framework of the UN Framework Convention on Climate Change with the commitment to achieve:

- unconditional reduction of GHG emissions by 15% by December 2030 relative to 1990 levels;
- conditional reduction of GHG emissions by 25% by December 2030 relative to 1990 levels, subject to additional international investments, access to low-carbon technology transfer mechanism, financing from the Green Climate Fund and flexible mechanisms for countries with a transitional economy.

In December 2020, at the Climate Ambition Summit (organized by the UN, UK and France in partnership with Chile and Italy) President of Kazakhstan K.K. Tokayev declared a new goal – to achieve carbon neutrality by 2060 reaffirming commitments made by Kazakhstan under the Paris Agreement.

Now, this Strategy of the Republic of Kazakhstan on Achieving Carbon Neutrality by 2060 (the "Strategy") is developed in response to global climate trends and related international commitments. The Strategy defines national approaches, strategic course of public policy focused on the progressive economic transformation to ensure well-being, sustainable economic growth and fair social progress and is adopted to ensure coherence and coordination of public policies.

The Strategy considers the need to adapt the economy of Kazakhstan in line with global climate trends, such as implementation of CBAM, advancement of ESG principles, promotion and attraction of green investments, energy efficient manufacturing, electrification, etc.

2. Situation analysis

Since the middle of the 20th century, Kazakhstan has been facing the negative consequences of climate change.

Average annual temperature has been increasing by 0.28°C each decade in the country, especially in the autumn season (0.31°C) while average annual precipitation has been significantly decreasing by 0.2 mm for 10 years.

The economic situation in the last decade of the 20th century led to lower consumption of fuel and energy resources and, as a result, lower GHG emissions.

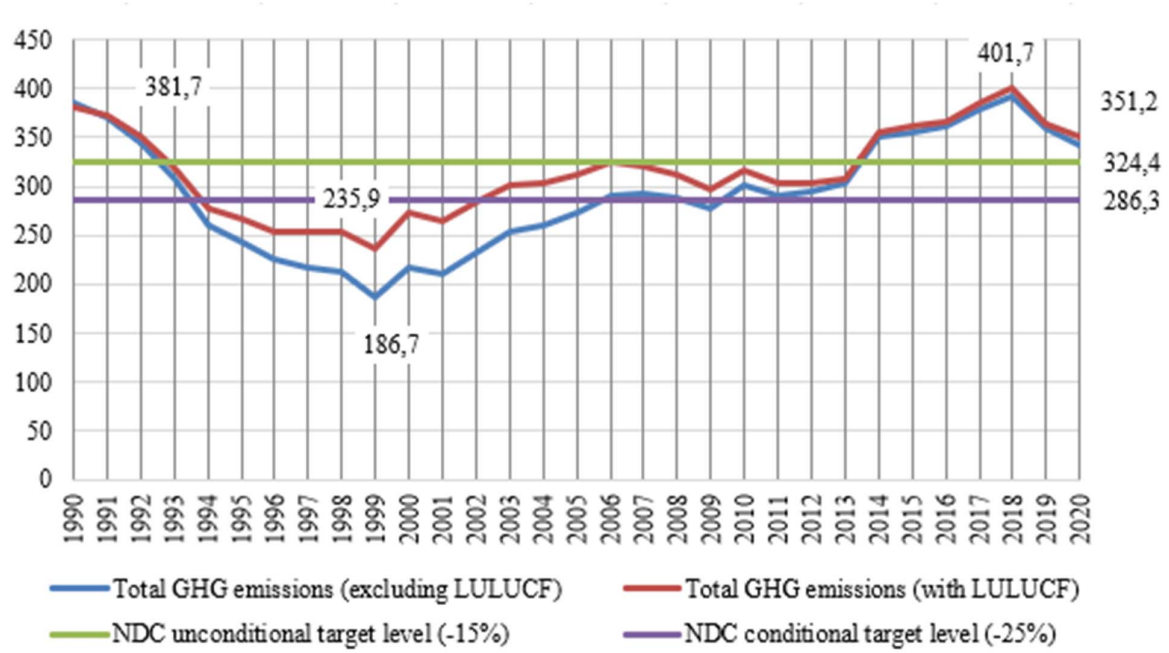
From the early 2000s, as the economic recovery gathered pace, GHG emissions increased until the global financial and food crisis in 2008.

In 2018, net emissions totaled 401.7 million tons of CO_2-eq, exceeding 1990 emissions by 5.2%.

In 2019, GHG emissions dropped to 364.7 million tons of CO_2-eq which was 9.2% lower, relative to 2018 levels and 4.5% lower relative to 1990 levels. The decrease in emissions was because of lower fuel consumption.

In 2020, national net emissions of 351.2 million tons of CO_2-eq were 12.6% below 2018 emissions and 8% below 1990 emissions due to COVID-19 pandemic (Figure 1).

Figure 1. GHG emissions over time



Note: based on national inventory 2022

Three greenhouse gases dominate in national total emissions accounting for 99.5%:

- 81.6% of national GHG emissions are carbon dioxide (CO_2) originating mostly from the combustion of organic fuel and arable farming;
- 12.4% are methane (CH4) which is emitted mostly from fuel production, transportation and shipment/ storage, biodegradation of organic waste and livestock farming to produce meat, milk, wool and hides; and
- 5.6% are nitrogen oxide (N_2O).

Other GHGs are emitted from industrial processes.

The majority of GHG emissions in Kazakhstan are attributed to the energy sector (77.6% of national net emissions) followed by agriculture – 11.6%; industrial processes and product use (IPPU) – 6.3 %; land use, land use change and forestry (LULUCF) – 2.4%; and waste – 2.1 % (Table 1).

Table 1. Changes in GHG emissions in Kazakhstan by IPCC sectors in 1990 and 2020, million tons of CO_2-eq.

Sectors of GHG sources and sinks	1990	2020	Change in 2020 relative to 1990, %
Energy	316.92	272.50	-14.02
IPPU	19.29	22.29	+ 15.54
Agriculture	44.74	40.72	-8.98
LULUCF	-3.91	8.38	+314.30
Wastes	4.65	7.35	+58.17
TOTAL net emissions of GHGs	**381.69**	**351.24**	**-7.98**

Energy

According to the IPCC, energy emissions (or emissions of energy sector or energy system) originate from fuel combustion and fugitive emissions.

The energy sector includes production of primary energy (oil, coal, peat, shale, natural gas, wastes, hydropower, biomass, wind, solar and geothermal energy), transportation, processing into secondary energy (electricity, fuel, gasoline, diesel fuel, hydrogen, biofuel), transmission and distribution, final demand for energy services in transport, buildings and industry, and fugitive emissions from primary energy production, transportation and distribution.

Kazakhstan possesses the world's largest coal reserves located near the surface, and the cost of coal extraction is the cheapest in the world.

The country has abundant underground reserves of coking coal with high methane levels from the coal seams.

Along with substantial reserves and extensive use of fossil fuel resources, Kazakhstan has significant potential for renewable and alternative energy including wind, solar, geothermal, nuclear, hydrogen and bio-energy.

The energy sector is the largest emitter of GHGs in Kazakhstan. In 2020, 77.6% (272.5 million tons of CO_2-eq) of total GHG emissions in Kazakhstan were attributed to the energy sector due to extensive use of fossil fuel.

Emissions from the production of primary energy (extraction) account for 16.6% of all GHG emissions (58.3 million tons of CO_2-eq). 8.1 percentage points are fugitive emissions, where 6.7 percentage points are fugitive emissions from coal production (23.7 million tons of CO_2-eq in 2020).

Final energy demand consists of direct fuel combustion in industry, transport, agriculture, residential and non-residential buildings, and use of electric and thermal energy. For overall fuel and energy resources used in the country (150.7 million tons of CO_2-eq), 41% is oil and petroleum products; 29.4% is coal and coal processing products; 7.6% is natural gas, including compressed natural gas (motor fuel); 16.2% is electric power; and 5.8% is heat. The share of renewables in domestic energy consumption is 2%; while in 2020 the share of renewable energy sources (RES) in power generation was 3.0% and in 2021 – 3.6%.

Though coal and processed coal products account for 29.4% in energy mix (in comparable energy units of measurement), the contribution of coal in the national net emissions is higher than 55.7%. Therefore, decrease the reliance of Kazakhstan's economy on coal is essential for low carbon development and achievement of carbon neutrality by 2060.

Electricity and heat generation

Electricity and heat are generated by public-service utilities whose major activity is supply of municipal services such as electricity and heat generation, combined generation of heat and electricity.

This sector is relatively small from an economic perspective – 1.6% of total value added and 1.7% of employment in Kazakhstan; however, it is critical for the smooth operation of Kazakhstan's economy and society. In 2020, power plants and thermal power plants (boilers) generated 108.1 billion kWh and 91.2 million Gcal. Contribution of this sector into national net GHG emissions is 31.6% or 110.9 million tons of CO_2-eq.

68.9% of electric power and 99% of thermal power was generated from coal combustion in 2020; 20% of electric power from natural gas; and 0.05% from residual fuel. Hydropower plants (HPP) generated 8.8% of electric power; while wind power plants (WPP), solar power plants (SPP) and biogas plants generated 2.2% of electric power (or 3.0% including small HPPs).

Many power plants use outdated technologies and exceed their economic life. In 2020, in Kazakhstan there were 179 power plants: 68 thermal power plants (TPP) (28 coal-fired, 38 gas-fired, and 2 residual oil-fired), of them 41 were combined heat and power

plant (CHP); 51 HPP (45 of them were small HPPs with the capacity up to 35 MW), 28 WPP, 31 SPP and 1 biogas plant. The average age of coal-fired power plants was 55 years, gas-fired power plants –40 years, HPPs – 56 years. Almost 39% of installed generating capacities are older than 40 years and 64% are older than 30 years.

Electricity and heat distribution systems are worn-out resulting in high distribution losses (up to 35% of total power losses in some regions) and causing higher GHG emissions in this sector.

The worn-out assets drive the need for modernization and upgrade of electric power and heat generation technologies and afford an opportunity to replace existing outdated carbon-intensive equipment and infrastructure with low- and zero-carbon technologies such as gas-fired TPPs at the initial stage, and to accelerate the uptake of alternative and renewable energy capacity.

Kazakhstan has created an enabling environment for the promotion of RES:

1) a designated single electricity purchaser for the electricity market – Settlement and Financial Center for Support of Renewable Energy Sources, LLC;

2) a model form of renewable power purchase contract – a Power Purchasing Agreement;

3) terms of prioritized investment contract specified for RES;

4) tariffs set through RES auctions;

5) prioritized dispatching of RES and unimpeded access to the national grid of the Republic of Kazakhstan.

Currently, 142 RES plants with installed capacity of 2332 MW are operating in Kazakhstan:

- 43 WPPs with the capacity of 894 MW;
- 54 SPPs with the capacity of 1150 MW;
- 40 HPPs with the capacity of 280 MW;
- 5 bio electric power plants with the capacity of 8 MW.

This enabling environment is intended to support large-scale generation of electric power from renewable energy sources. But, the existing support measures for small-scale RES generation are not fully functional yet.

In Kazakhstan, thermal power is generated from 37 CHPs and roughly 2500 boiler facilities of varying capacity. The total available electric power capacity is 6,517 MW (33.8% of total available capacity of power plants), heating power – 20,135 Gcal/h. At present, 38% of steam boilers and 17% of hot water boilers, 24% of steam turbines and 60% of gas turbines are operating beyond fleet life recommended by manufacturers and necessitate gradual modernization. 76% of CHPs have served over 50 years, the average wear is 66%.

The total length of heat supply networks is 11,400 km, the average wear is 57% (6,500 km), including 3,200 km that need to be fully replaced.

Transport

According to IPCC, the energy sector reporting covers fuel combustion in *Transport* which includes all types of transport operations (except for military transport). Fuel emissions from any air or maritime transport involved in international operations must be excluded and reported separately.

At present, the transport sector accounts for 6.6% of value added and roughly 6.9% of employment in the economy. Economic development over the past decades has vitalized the transport sector too and led to increased number of vehicles and related GHG emissions. In the past 15 years, car ownership by households and businesses, as well as passenger traffic in automobile transport has tripled.

The transport sector is operating almost exclusively on fossil fuels and is one of the main sources of GHG emissions.

Also, most automobile transport in Kazakhstan are private cars. This is reflected in the mix of GHG emissions from this sector.

A large proportion of road transport GHG emissions from fuel combustion reflects a relatively high motorization rate in the country, while the car fleet largely consists of old and outdated vehicles.

Buildings (housing maintenance and municipal infrastructure)

According to IPCC, the energy sector report covers fuel combustion in *Residential sector* and *Commercial sector* groups which jointly are referred to as Buildings sector. It includes fuel consumption in residential, commercial and public buildings.

Climate conditions in Kazakhstan are very cold winter and hot summer that underpin a high energy demand for heating and cooling of buildings. The average energy

consumption in the buildings sector is roughly 270 kW*h/m2 and is two times higher than in Europe (100-120 kW*h/m2), and higher than Russia (210 kW*h/m2).

Apart from severe climate conditions, the main reason for such energy inefficiency of buildings is substantial energy losses due to inadequate insulation. Heat losses in buildings are from defective ventilation designs (56% of all losses), leaks through poorly insulated walls (22%), windows (14%) and floors (8%). In 2020, residential and non-residential buildings accounted for 43.3% of total end energy use in Kazakhstan.

Many buildings fail to meet modern energy efficiency standards. In general, out of 2.4 million buildings in the country 31.5% are older than 50 years and 32.9% are older than 25 years.

Investments in energy efficiency of buildings are constrained by cheap heat and electricity tariffs and the return of such investments from energy savings will take a long time.

Considering the climatic conditions and inadequate thermal insulation, heat generation is the most significant source of emissions from buildings. Most of the heat is generated from combustion of fossil fuel in smaller boiler plants. In rural areas, most of the heat is generated from combustion of coal and petroleum.

District heating in large cities covers roughly 50% of consumption. However, scarce investment into worn-out distribution networks results in distribution losses of up to 30% of energy supply.

Industry

In Kazakhstan, manufacturing accounts for roughly 12.9% of total domestic production and 6.6% of employment.

In the past 20 years, manufacturing in Kazakhstan has increased significantly leading to an increase in related GHG emissions. By 2020, emissions from fuel combustion in industry reached 144.2% relative to 1990 levels. Industry is also the largest consumer of final energy (31.1%, or 12.5 million tons of oil equivalent in 2020).

Industry produces more than 21.6% of all GHG emissions in Kazakhstan. GHG emissions from ferrous and non-ferrous metallurgy accounted for 70.4% of industrial GHG emissions in 2020.

GHG emissions from IPPU in total net emissions account for 22.3 million tons of CO_2-eq, or 6.3%. IPPU emissions have been increasing since 1996 mainly from mineral

industry where emission has increased 2.1 times since 1990. In general, by 2020 the IPPU emissions were 15.5% higher relative to 1990 levels.

The majority of GHG emissions from industrial processes occurs in the production of basic materials – cement, aluminum, cast iron and steel. In Kazakhstan, these industrial sectors produce 91% of all emissions from industrial processes (54.0% in metallurgy and 37.1% in mineral industry).

Agriculture and forestry

This subsection covers two sectors in IPCC reporting framework.

Sub-sector on energy "Agriculture, forestry, fishery, fish farming" including fuel combustion in agriculture, forestry, fisheries.

Sector on "Agriculture and forestry, other types of land use" covers GHGs from agriculture, net CO_2 emissions from soils used in agriculture and net CO_2 emissions from deforestation and other types of land use.

Agriculture and forestry accounts for roughly 6.2% of GDP and 13.5% jobs in Kazakhstan. 41.1% of the population live in rural areas.

Agricultural operations are adversely impacted by climate change and in turn they affect climate, availability of water, land degradation, deforestation and other processes.

In 2020, agriculture and forestry (including land use) along with fuel combustion emitted 52.1 million tons of CO_2-eq, or 14.8% of national net GHG emissions. Fuel combustion account for 3.0 million tons of CO_2-eq, or 0.8% of national GHG net emissions.

The majority of GHG emissions unrelated to fuel combustion in agriculture occur in animal farming (62.5%). After reaching the minimum level in 1998 the GHG emissions from manure management have been growing on average by 3.5% per year. This growth of GHG emissions reflects an increase in livestock, dairy and other cattle productivity over time.

Emissions in this sector are cushioned by GHG sinks (which sequester carbon in soil and biomass) in forests, arable land, wetlands, human settlements and other lands across the country. In LULUCF, forests are the largest carbon sink in Kazakhstan (10 million tons of CO_2-eq in 2020). The forest area of Kazakhstan covers 30.1 million ha; forest plantations (public and private) and sustainable forest restoration are necessary steps for

forest expansion. At the end of 2020, an ambitious plan to plant over two billion trees by 2025 was declared.

Sub-standard soil management in farming (absence of crop rotation, insufficient and untimely fertilization, etc.) has led to a humus depletion in soils which continues to decline each year affecting the ability of soils to capture and store carbon dioxide.

This sector is affected by climate change. Climate change is affecting precipitation patterns and biomes in Kazakhstan; extreme weather events become more frequent and intense; average temperature is increasing, and availability of water for irrigation is decreasing. Currently, agriculture accounts for two-thirds of national water consumption. Climate change may affect crop yield of in almost all regions.

Agricultural development is perceived as one of top priorities because of its important role in providing employment, especially in rural areas, and for social and food security reasons, and its importance for climate change mitigation is increasingly recognized. However, limited access to financing prevents many farmers from developing a more productive and sustainable agricultural sector. Over 80% of agricultural infrastructure is outdated. Currently, only 1% of agricultural land in Kazakhstan is used for organic farming.

Waste management

Landfill and incineration of waste prevails in the waste management system. At present, the waste management sector contributes 0.3% of total value added and 0.9% of total employment in economy, while GHG emissions from the waste accounts for 2.1% of total emissions.

The waste sector produces methane (CH4) and carbon dioxide (CO_2) emissions from anaerobic degradation of organic wastes and sludge at municipal waste management (MWM) landfills or anaerobic treatment of wastewater.

GHG emissions from wastes have been steadily increasing since 1994. 52.2% of GHG emissions in this sector come from MWM; 47.4 % - wastewater treatment; and 0.4% - incineration.

Waste generation has been increasing due to the growing population and volume of waste per capita. In 2020, 54.7% of solid waste was disposed at landfills; 24.4 % was sorted for recovery. Despite a high rate of wastewater treatment, the residual sediment (approximately 20% of dry sludge) was moved to sludge beds and dumpsites.

Segregation of solid waste streams (e.g. paper, glass, organic waste) and sorting prior to recycling is almost non-existent which increases waste to landfill. It is estimated that roughly 37% of municipal waste (approximately 2 million tons per year) may be used for biogas production.

Many landfills are in poor condition, have exhausted their capacity and require reclamation. Low waste collection and sorting tariffs make investments into waste management projects economically unviable and hinder the fulfillment of regulatory requirements.

The situation with wastewater is similar due to inadequate availability of wastewater treatment facilities in the cities and towns. The existing wastewater treatment facilities are in a poor state, equipment is at the end of life, and often outdated technologies and treatment methods are used.

Sludge treatment and disposal infrastructure is not available. Currently, sludge is not treated; instead, it is collected and dumped into sledge beds or landfill though it contains organic matters.

Risks and opportunities

The current situation is compounded by internal and external risks.

Over the past few decades, Kazakhstan has rapidly increased production and consumption of fossil fuels creating an economic model based on the country's abundant natural resources and reliance on the export of fossil fuel and minerals. This strategy has spurred fast economic growth, which has almost tripled since 1998.

Recent global developments have led to more stringent environmental requirements for manufactured products as a message to businesses with low energy efficiency and high carbon intensity. These include plans by financial institutions and investors to divest from carbon-intensive assets in favor of green investments; growing demand for disclosure of GHG emissions and mitigation, including in the supply chain; there are plans to introduce cross-border carbon adjustment.

Decarbonization in the main export markets may sharply decrease future global demand for high-carbon goods, which in turn increases the risk of non-performing assets associated with the extraction, processing and utilization of fossil fuel (particularly in energy, construction and industry).

This risk is especially relevant for Kazakhstan because its economic model relies on export of fossil fuel. Historically, this approach resulted in peak investment in extractive industries and underinvestment in other sectors. As a result, fixed assets are largely worn-out and outdated technologies are used in such underinvested sectors, and the economy as a whole and its sectors become very energy intensive. Large-scale modernization is needed.

The imperfect tariff system is a key barrier to future modernization. The current system is weak to encourage investment into distribution networks and electricity and heat generation technologies.

At the same time the country may untap new opportunities by attracting green finance, transferring zero-carbon technologies, integrating into the global carbon market, implementing carbon and climate projects under auspices of the Paris Agreement, and entering the new international markets of green energy, products and innovative technologies.

The tangible threats of global climate change, economical and political international ambitions, and the untapped opportunities make it imperative for Kazakhstan to accelerate decarbonization of its national economy. Successful decarbonization will depend on succeeding in the development of gas potential.

3. Basic framework: goal and principles, economic effect, approaches and vision

3.1. Goal and principles

The key goal of the Strategy is to make Kazakhstan’s economy resilient to climate change and achieve carbon neutrality by 2060.

The mid-term aim of the Strategy (according to the country’s NDC) is to reduce GHG emissions by 2030 by 15% relative to 1990 emissions (unconditional aim) and achieve reduction by 25% subject to international support to decarbonization of the economy (conditional aim).

The progress of the Strategy will be measured against the following targets (Table 2).

Table 2. Targets on GHG emissions, capture and sequestration

	1990	2020	2030	2040	2050	2060
	The achieved emissions		*Unconditional target NDC**	*Indicative emissions ***		*Strategic goal*
National GHG net emissions, million tons of CO_2-eq.	**381.7**	**351.2**	**324.4**	**209.9**	**95.4**	**0.0**
GHG sinks (-)/ GHG net emissions (+) in LULUCF, million tons of CO_2-eq	-3.9	8.4	-20.3	-28.3	-40.3	-45.2
GHG emissions, million tons of CO_2-eq *net of LULUCF*	**385.6**	**342.9**	**344.7**	**238.3**	**135.8**	**45.2**

Note:

** Conditional target for NDC – reduce by 25% relative to 1990 baseline (286.3 million tons of CO_2-eq);*

*** Indicative level will be revised in future updates of the Strategy.*

Implementation of the Strategy relies on the following principles:

1) focus, unity and coherence: all planned initiatives are goal-oriented and coherent;

2) technical and economic feasibility: technologically feasible but least-cost pathway for low-carbon development and carbon neutrality;

3) just transition: create new opportunities in the regions affected by decarbonization policy with a targeted support for the population;

4) circular economy: economy based on the use of recovered resources and reduced consumption;

5) phasing: implementation of strategic initiatives through short- and mid-term plans coupled with ongoing review of the previous phases and overall strategic cycle;

6) transparency and interaction with the society: broad engagement of all stakeholders at all levels of monitoring and decision-making, including central and local authorities, quasi-public sector, science, business (associations and companies), non-governmental organizations and local communities;

7) efficiency (balance): maintain balance between achievement of the goal and security (economic, energy, social) and stability.

3.2. Investment needs

Economic development driven by investments in the new reality will increasingly require market conditions which are attractive for capital and financial markets, and for investments from national and international businesses and households.

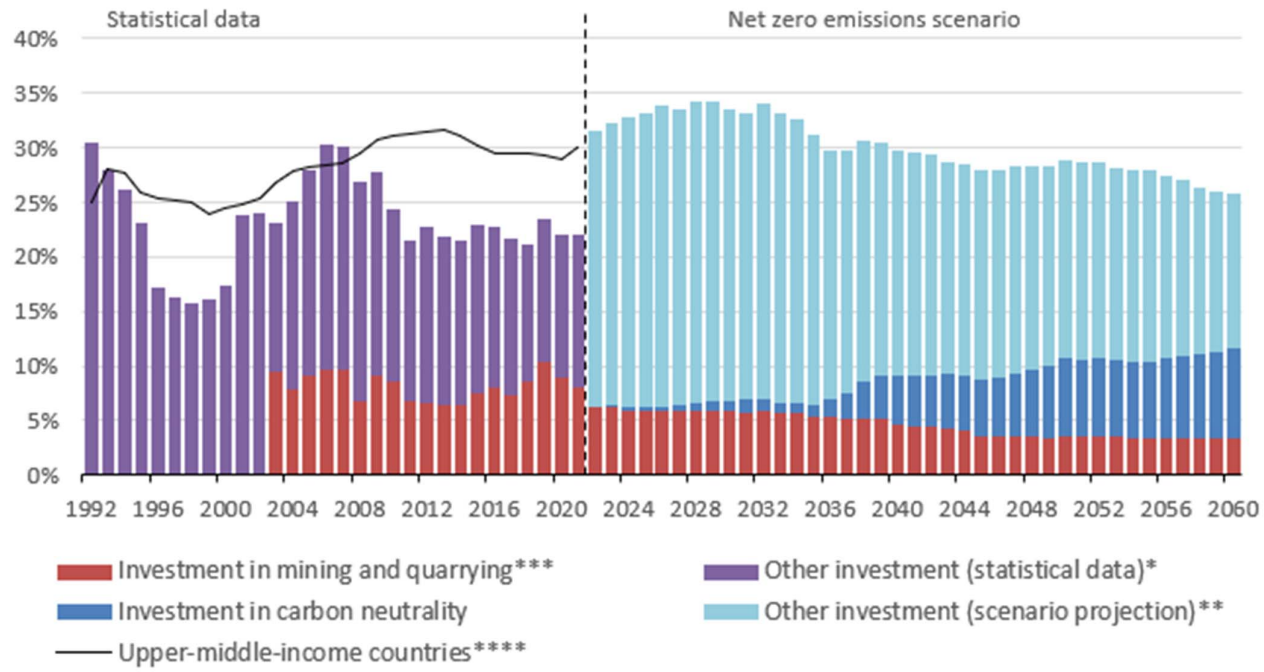
It is important to emphasize that many low- and zero-carbon investments will replace high-carbon projects. This effect is illustrated in Fig. 2 which compares historical investments relative to GPD and projection under carbon neutral scenario.

In the past decades, the share of investments in GDP of Kazakhstan with the rare exception was consistently lower than the average in upper-middle income countries (the World Bank classifies countries by income per capita ranging from US$ 4096 to US$ 12,695 as an upper-middle income country).

Carbon-intensive investments are increasingly declining, and investments are redeployed to low- and zero-carbon operations. Relative to GDP, green investments need to be as much in total investments as currently accounted for the mining sector.

Given the extremely high depreciation of fixed assets, the investment will have to increase significantly by 2030. However, if green technologies are chosen to replace obsolete equipment, these investments will contribute to significant GHG emission reductions without the need to mobilize additional investments in decarbonization.

Figure 2. Total investments in economy to GDP (statistical data and projected carbon neutral scenario), %



* Until 2003, total investment including mining and quarrying
** NZE scenario data can slightly differ from World Bank data due to different accounting of reinvested profits
*** Statistical data until 2019, scenario projection from 2020
**** Countries with GIP per capita between USD 4096 and USD 12695

Source: World Bank, Bureau of National Statistics (1992-2019).

The size of the investment required relative to GDP is not much higher than it has been in the past. During the extensive investment phase until 2030, the share of investments in GDP reaches 34% which is slightly above the average for the upper-middle income countries and in Kazakhstan in 2006-2007. After 2030, the share of investments in GDP declines and by 2060 it reaches the current level.

Net investment in low-carbon technologies for low-carbon development and carbon neutrality is estimated to require US$ 610 billion, or 19.6% of gross fixed capital formation. Direct public investments in achieving carbon neutrality will only account for a small share of 3.8% of total investment.

More than half of the required investments, or US$ 386.3 billion, are existing and circulating investments in the economy which will be reoriented from resource sectors to greener ones, while the remaining part, or US$ 223.7 billion, are new investments.

At the same time, the investment needs until 2030 is US$ 10 billion; and the remaining US$ 600 billion will be invested by the end of 2060.

Given that the expected total GHG emission savings over the same period are 9.335 billion tons of CO_2-eq in the carbon neutrality scenario, the price of decarbonization is relatively low at US$ 65.4 per ton of CO_2-eq.

Most investments will be made by private and public businesses and households, as well as by the designated carbon fund which consolidates all environmental payments, international grants and investments for greening and decarbonizing the economy.

Overall, low-carbon development and the achievement of carbon neutrality will bring to Kazakhstan's economy:

- sustainable economic growth;
- increased investment attractiveness;
- advanced technological development and competitiveness;
- new highly-productive jobs while maintaining a high level of employment;
- growth of Kazakhstan's non-resource export;
- improved environmental quality and ecological well-being of the population.

3.3. Approaches and vision

The Strategy's goal will be achieved through integrated implementation of low-carbon policies and sectoral (energy, industry, agriculture and forestry, waste management) and cross-cutting approaches (just transition, green finance, research and development (R&D) and education, public awareness, international cooperation, climate change adaptation, carbon regulation system).

The low-carbon policy will be supported by improvements in the investment climate.

This will involve enabling legislative and institutional frameworks and support to the establishment and development of financial and physical infrastructure needed for a green economy. Particular attention will turn to continuous attraction and support of private investment (including international) in the decarbonization process.

The government will encourage accelerated modernization of existing industries and infrastructure and provide support to vulnerable populations.

Important elements of transition to carbon neutrality include development of regulation through the introduction of information technologies and transition to digital platforms for processing, control and monitoring of fairness and transparency.

To this end, monitoring of GHG mix and volumes will be digitized which includes the development of a dedicated program for monitoring satellite data for emissions control at the national, sectoral and regional levels.

Satellite monitoring of emissions by remote sensing will ensure transparency, objectivity and comparability of data for participation in international economic mechanisms in accordance with the Paris Agreement.

The digitalization of business processes in the mining and metallurgy, oil and gas, fuel and energy and agribusiness sectors will scale up development and implementation of low- and zero-carbon technologies in line with international standards. All processes in energy generation, transportation and consumption, including public utility sector and households will be gradually digitized.

In addition to energy transition, the advanced international approaches and standards will be introduced in all economic sectors to enable transition to alternative and renewable energy sources. These include standards for environmentally friendly modes of transport, reduction of fuel and energy consumption, waste treatment, and energy efficiency.

A GHG validation infrastructure will be established to ensure that the verified GHG emission reports of domestic companies are recognized in other countries.

3.3.1. Sector-wide approaches and vision for low-carbon development

Carbon neutrality is an ambitious goal for Kazakhstan, and it can be achieved through initiatives in three key dimensions:

1) decarbonization of industries and processes related to fossil fuel;

2) decarbonization of industries and processes unrelated to fossil fuel;

3) enhancement of natural sinks for emission sequestration and implementation of industrial solutions for carbon capture, utilization, long-term storage, and sequestration.

Fossil fuel-related GHG emissions will be reduced by:

1) shifting from fossil fuel and derivative products to alternative and renewable energy sources;

2) improving energy efficiency and energy savings;

3) electrification – replacement of fuel combustion facilities by power-driven technologies.

GHG emissions unrelated to energy use will be reduced by improving energy efficiency – the use of processes and technologies with low and zero emissions. Energy efficiency will be improved by using best available techniques in industrial processes and zero-carbon products, development of sustainable farming and waste management.

GHG emissions can be reduced by increasing the capture capacity of ecosystems, and carbon capture, utilization and storage technologies. This will involve the ability to store carbon in forests, soils, wood products or industrial processes. Carbon capture, utilization and storage technologies will be used to capture and sequester carbon and methane.

3.3.1.1. Energy

Low-carbon development and achievement of carbon neutrality in Kazakhstan by 2060 will require a deep transformation of the energy system and will consist of three key elements:

1) decarbonization of primary energy supply;

2) decarbonization of electric and thermal power generation;

3) decarbonization and high-performance of final energy use in buildings, transport, and industry.

The largest reduction of GHG emissions in the energy sector will be reached by shifting towards more sustainable energy sources: gradually reducing fossil fuels and switching to the use of electricity instead of direct combustion of fossil fuels. Natural gas should be used as an intermediate fuel to decarbonize the energy sector and to this end geological exploration will be carried out to identify new gas fields. Alternative and renewable energy sources will be promoted in the decarbonization process.

Better energy efficiency and the transition to low-carbon technologies in all economy sectors will drive significant changes in primary energy supply.

Decarbonization of the fossil fuel energy sector has some specificities. The oil and gas sector whose emissions account for 2.7% of national emissions will continue to cut emissions by reducing methane leakage, using more energy efficient technologies and improving plant processes.

Coal mining will reduce GHG emissions as a result of lower coal use in other economic sectors. At the same time, due to the country's ample coal reserves, a long-term vision for alternative uses of coal will be developed.

Final demand will shift towards the use of low carbon fuels (biofuels and hydrogen) in areas where switching to electricity remains difficult. Therefore, a long-term vision for hydrogen energy will be developed.

Reduction of final energy demand will require substantial transformations in such sectors as transport, public utilities, agriculture (in terms of fuel combustion) and industry.

Energy efficiency improvements in low-carbon development and achieving carbon neutrality will be in all sectors. Such improvements include, inter alia, better insulation and the use of advanced energy efficient appliances in buildings, switch to modern fuel-saving vehicles and gradual replacement of industrial equipment at the end of its useful life with newer and energy efficient technologies. At the same time, a vision for tariff regulation will be developed to accelerate the roll-out of low-carbon projects.

Decarbonization will require a widespread phase-out of fossil fuels and inefficient fuel subsidies. Thus, there will be the largest possible shift of final energy consumption to electricity and heat, as well as low- and zero-carbon fuels.

Considering the objectives of this Strategy, it is necessary to accelerate the process of refocusing generation capacities from coal to natural gas.

Other approaches to decarbonizing the energy sector will be developed along with the research and technological progress in low-carbon technologies and processes.

The Strategy should result in a shift in energy system priorities across the electricity, transport, public utilities (buildings) and industry sectors (Table 3).

Table 3. Priorities of current and decarbonized energy system by sectors

Sector	Current system (2022)	Carbon neutral system (2060)
Power	Prevalence of coal	Alternative and renewable energy sources, carbon capture and storage
Transport	Prevalence of petroleum products	Electric power, hydrogen, biofuels
Buildings	Prevalence of coal and gas in heating systems	Electrification, energy efficiency, heat generated from alternative and renewable energy sources
Industry	High demand for fossil fuel	Electrification, energy efficiency, hydrogen, carbon capture and storage

It appears from the table that low-carbon development and carbon-neutral system in 2060 suggest the following transformations:

1) gradual replacement of coal with alternative and renewable energy sources;

2) phase-out of fossil fuel in end use to the minimal level through electrification of energy use in all sectors of the economy;

3) transition to the use of hydrogen, biofuels and synthetic low-carbon fuels in the processes which are difficult or impossible to electrify;

4) use of carbon capture and storage technologies.

Electricity and heat generation

The transformation of the power and heat sectors will be driven by changes in the technological structure of power and heat generation on one side and by the growing electricity demand of other decarbonized sectors on the other side. And reduction of losses in the generation and transmission of electricity and heat will be of paramount importance during decarbonization.

To achieve low-carbon development and carbon neutrality by 2060, the share of coal-fired generation will be gradually and consistently reduced, the share of renewables and alternative energy will increase, while natural gas will be used as an intermediate fuel. Nuclear power plants will be considered as a stable source of energy, so a long-term vision for the development of nuclear power will be developed.

Due to the growing share of renewable and alternative sources of electricity generation, additional flexible generation should be commissioned. In this regard, a long-term vision for the development of solar and wind generation will be elaborated.

In the medium- and long-term, sufficiency of water resources will remain uncertain; therefore, a long-term vision for hydropower development will be developed.

In the medium to long-term, carbon capture and storage (CCS) technology will be utilized to capture GHGs. In this regard, a vision will be developed to decommission coal-fired capacities which are older than 30 years and to introduce CCS technology for those capacities that will continue to operate after 2035. At the same time, decommissioned coal-fired capacities will be prioritized for green energy projects.

Gasification of existing coal-fired facilities can also contribute to emission reduction.

District heating will be decarbonized by switching from coal to natural gas, using renewable energy in the form of geothermal energy (heat pumps) and biofuels. Decentralized (individual) independent heat supply will be at the center of technological change. In the medium and long term, geothermal energy and solar hot water supply will be promoted; therefore, a vision for their development will be elaborated.

To decarbonize electricity and heat generation, a new tariff system that stimulates the introduction of energy-saving technologies and changes in consumer behavior will be implemented.

An important point is the development of the wholesale and retail market for electricity and heat, as well as the network infrastructure of the National Electric Grid and network stations for energy storage.

In addition, the development of small-scale RES and smart power will be promoted, and other approaches to decarbonize the electricity and heat generation will be used.

Transport

Low-carbon development of transport sector must be aligned with the concept “Avoid-Shift-Improve”. Decarbonization will be conducted in three key areas:

1) avoided or reduced need for travel (Avoid);

2) shift to more environmentally-friendly modes of transport (Shift);

3) higher efficiency in energy use and reduction of emissions from vehicles (Improve).

Avoid is understood as falling demand for energy by passenger cars, efficient management of passenger and freight traffic, development of public transport system, and efficient urban planning to reduce the need in vehicle trips.

Shift is understood as extensive use of alternative fuels and large-scale electrification of transport.

Improve is understood as renovation of vehicle fleet and modernization of the existing vehicles. This step will complement Avoid and Shift.

Urban planning and transport infrastructure will be improved to achieve decarbonization in the transport sector. Sustainable urban mobility and public transport will be promoted through optimization of passenger operations, extensive electrification and gasification.

Electrification of railways and optimization of freight traffic will continue.

Shift to transport which uses alternative and renewable energy sources will be encouraged through creation of the respective infrastructure and other incentives.

Development of local manufacturing of vehicles using alternative and renewable energy sources will play an important role in decarbonization of transport.

Other approaches from international practice of transport decarbonization will be used as well.

Buildings (housing and public utilities sector)

Buildings are the largest source of GHG emissions and play a key role in emission reduction. Decarbonization in the buildings sector will be achieved by shifting from heating based on fossil fuel to heating based on renewables and more efficient technological equipment.

Significant investments will be made to gasify and electrify heating to reduce GHG emissions from buildings, and to use RES (e.g. PVs, thermal, solar, geothermal energy).

Efforts will be made to implement monitoring, reporting and verification of energy efficiency of buildings and adopt stringent requirements for energy efficiency of new residential, public and industrial buildings at the level at least Class C.

Thermal modernization of buildings and new heating technologies are necessary to significantly reduce energy demand for heating; therefore, automated systems for heat control and metering will be implemented.

Improved energy efficiency resulting from thermal modernization of buildings and introduction of new energy efficient technologies will lead to lower energy consumption and associated negative social costs from burning fossil fuel in buildings.

The use of RES and efficient technologies for heating and hot water supply will be promoted too.

In addition, other approaches to decarbonization of housing and utilities sector from international practice will be used.

3.3.1.2. Industry

Decarbonization of industrial processes calls for significant changes which include the following key elements:

1) use of alternative construction materials instead of cement, steel, aluminum that use lower or zero GHG emissions;

2) increased volumes of waste treatment (including scrap) to reduce the need in processing of raw materials as the main source of emissions in this sector;

3) implementation of new manufacturing technologies with zero GHG emissions coupled with carbon capture and storage.

Many options for decarbonization of industrial processes suggest equipment upgrade and restructuring of processes in such a way as to separate manufacturing processes or enable smooth modernization of equipment from low-carbon to zero-carbon processes (shift from natural gas to hydrogen in DRI).

Even though some technologies remain costly for some producers (hydrogen-based DRI or CCF in cement plants), transitional technologies (natural gas-based DRI) and process improvement (injection of CO_2 into concrete which subsequently will be supported by in-house CCS) lay the ground for full elimination of process-related GHG emissions in these sectors.

Innovative low-carbon developments in mechanical engineering will also be widely adopted and other approaches to decarbonize the industrial sector available in international practice will be used.

In general, to decarbonize industry, steps will be taken towards reduction of heat losses in industrial processes and the use of low-temperature heat.

Specialization and cooperation for the use of the most modern energy efficient technologies and materials will be developed.

3.3.1.3. Agriculture and forestry

Energy use in this sector will shift from fossil fuel resources to alternative and renewable energy such as biofuels and geothermal energy.

\To decarbonize, it is important to exploit bioenergy potential of agricultural waste. The application of controlled decomposition technologies in anaerobic digestion plants to produce biogas for heating and power generation will reduce waste and GHG emissions. Solid residues from anaerobic digestion can be used as organic fertilizer and to some extent replace chemical fertilizers.

In general, although the growth of agricultural production increases GHG emissions, the decarbonization efforts will slow down this trend.

Key decarbonization activities include:

1) sustainable farming and improved irrigation;

2) sustainable forest use and reforestation.

Sustainable farming practices need to be scaled up, this is especially important for better livestock management and expanded irrigation systems, including but not limited to changes in crop rotation and crop diversification. Sustainable livestock management practices such as sustainable use, development and conservation of livestock genetic resources, application of technological solutions to reduce methane emissions from livestock and sustainable pasture management will be mainstreamed.

Shelter crops and synergies resulting from integration of livestock and crop production are important.

It is planned to scale up climate-smart agriculture, in particular carbon farming, precision farming, new crops resistant to climate change, and organic farming.

Actions will be taken to halt deforestation, conserve forests and rehabilitate degraded lands to achieve sustainable forest use and reforestation. A vision will be developed for public and private afforestation, sustainable land management and improved water supply and irrigation.

To further ensure food security, agroforestry and organic farming practices will be scaled up, and producer-consumer chains will be streamlined. Development of food

systems based on circular economy and regenerative agricultural practices will be of great importance.

Integration of biodiversity into agriculture is important too.

As a result of land use changes, the sector could become a net CO_2 sink that will make it possible to offset GHG emissions from agricultural production and partially from other sectors by 2060.

Investments in sustainable agriculture and climate resilience bring several benefits – they reduce GHG emissions from agriculture, contribute to climate change mitigation, and increase productivity.

3.3.1.4. Waste management

The key steps towards decarbonization of waste management will include:

1) reduced waste generation;

2) accelerated coverage with municipal solid waste collection and sorting;

3) increased waste recycling and composting.

Reduction of total GHG emissions from municipal solid wastes will be driven by gradual phase-out of open dumping and significant reduction in landfilling. These reductions will more than offset the small increase in emissions resulting from the increased use of organic waste for composting and energy generation. A ramp-up in full coverage of waste collection, sorting and recycling will be incentivized.

It is important to ensure a shift towards more efficient water-saving appliances and equipment to reduce wastewater. Additional incentives will be offered to minimize waste and wastewater generation. Changing the technology of sludge treatment will increase the use of sewage sludge for biogas and fertilizer production. This will not only reduce GHG emissions from wastewater but will also help increase RE generation reducing the use of fossil fuels and further contributing to the reduction of GHG emissions associated with energy use.

Overall, a vision for the circular economy model and waste gasification (with energy generation and/or chemicals production) will be developed to decarbonize the waste management sector.

3.3.1.5. Cross-sectoral vision for low-carbon development

In the process of energy transition, GHG emission reduction approaches that are applicable to the above sectors will be implemented. These will include the introduction of financial and tax policies that incentivize the reduction of anthropogenic GHG emissions in carbon-intensive sectors of the economy.

The government will support the implementation, dissemination and scaling of zero-carbon technologies and technologies with low GHG emissions.

Tax, customs and budgetary policies will be modified to consider the challenges of low-GHG development and implications for GHG rebalancing in budgetary expenditures and investments.

It is important to work on sectoral and regional emission reduction plans and set sectoral targets for transition to low-emission development and improvement of energy and environmental efficiency in economic sectors.

The use of secondary energy resources in the production of goods, will be encouraged to support disseminating technology to capture, dispose or further utilize GHGs.

Mechanisms will be developed to incentivize energy saving and the introduction of low- and zero-carbon technologies.

National research and engineering capacity will be built and developed for the successful energy transition.

White and green certificates, public non-financial reporting systems for companies and a regulatory framework will be developed to catalyze energy transition.

3.3.2. Cross-cutting approaches to low-carbon development

Efforts of government authorities will be closely coordinated to make implementation of the Strategy efficient and well-timed.

Low-carbon development and transition to carbon neutrality will go hand in hand with broad stakeholder engagement at all decision-making levels, including central and local authorities, quasi-public sector, science, business (associations and enterprises), non-governmental organizations and local communities. This will facilitate better understanding and support to the successful implementation in the mid- and long-term, joint initiatives on low-carbon development and transition to carbon neutrality.

Businesses may on a voluntary basis initiate development of corporate strategies on low-carbon development and carbon neutrality. These initiatives will give additional momentum to low carbon development.

In turn, the government will support development and implementation of corporate strategies by connecting to green taxonomy, best available technologies and special economic zones.

3.3.2.1. Just transition and new job

Low-carbon development leads to transformation of the country's economic structure, particularly in industrial sectors. By this, employees in these economic sectors related to fossil fuel will be fully covered with social protection.

In addition, these employees will have access to job retraining and green jobs in sectors with low emissions and will be supported in setting up small green businesses.

Low carbon development will raise employment in agriculture, bioenergy production and waste management sectors. More jobs can be offered in implementation of renewable energy sources, modernization of buildings and development of infrastructure.

Large-scale modernization of fixed assets in the energy sector and dynamic development of renewable energy sources is not conceivable without systemic tariff reforms.

The associated potential negative effect on households will be considerably mitigated by full-scale improvement of energy efficiency, targeted financial support to vulnerable households and lower prices of other types of energy.

To raise awareness to people, timely planning and communication about tariff reforms will be conducted along with the communication campaign on benefits of energy efficiency.

Social risk mitigation mechanisms will be developed to enable a just and effective transition (including targeted support to households).

During the decarbonization process in Kazakhstan and elsewhere, further studies will be conducted in relation to the labor market in new sectors which will lay the ground for the deployment of programs and support measures, including job retraining programs for employees in declining industries.

Support to employees who lack skills in newer industries (including low and zero-carbon technologies) training and job retraining especially labor forces from basic industries will be at the core of government efforts for workforce development.

3.3.2.2. Financing and green investments

The attraction of additional private investments from domestic and international sources for the transition to a green and carbon-neutral economy will become a priority for the country.

Investments in transition to a green and carbon-neutral economy promote GDP growth and bring huge benefits for the economy. Environmentally sustainable farming practices reduce GHG emissions and conserve water resources, reduce soil erosion, increase yields, generate additional revenues, increase the output and reduce risks of damage from negative weather and climate conditions.

Investments in energy efficiency of buildings will save energy and reduce costs for households and businesses, decrease air pollution with hazardous and dangerous substances, and raise people's income.

Recycling (circular economy) provides synergies in other sectors by reducing the costs of raw materials. Investments in zero-carbon vehicles decrease noise and air pollution and provide tangible benefits to households, such as fuel cost savings.

According to the World Bank, the right investments now can provide short-term benefits such as jobs and economic growth, and long-term benefits which include decarbonization and sustainability. Programs incentivizing low carbon development can create new jobs which will be sustainable, inclusive and bridging inequality, better sustainability of infrastructure – these are clear benefits for the economy.

Kazakhstan is well positioned for international climate finance and can attract investments through various channels in addition to corporate projects, including through ETS, green finance frameworks, public finance and international financial institutions. However, investments needed for low carbon development and carbon neutrality require more finance. For this reason, a vision for financing the transition to carbon neutrality with detailed design of financing by sources, tariff policy, phased involvement of funding elements will be developed.

Close collaboration of public and private sectors, active participation in international project finance schemes, including sustainable development mechanism under the Paris

Agreement, and use of innovative digital technologies will accelerate green transformation and actions on reduction of GHG emissions and climate adaptation.

To attract additional resources for low carbon development and transition to carbon neutrality, the regulatory and institutional frameworks will be improved with an enabling environment for the development of innovative instruments and standards of green finance; the taxonomy of green projects will be updated considering international experience in similar taxonomies and investor expectations.

To encourage private investments in low- and zero-carbon technologies, pricing should be revised in some sectors, particularly in heat and power, waste collection and sorting.

Economically appropriate policies will allow markets to set prices that cover all capital, operational and environmental expenditures, incentivize rational and careful use of resources and encourage private investment into energy efficiency and switch to alternative fuels. In addition, GHG pricing internalizes the environmental costs of carbon-intensive products and promotes investments into renewables and low-carbon manufacturing technologies. At the same time, a meaningful price of GHG emissions will generate public revenue that can be earmarked to support decarbonization and green projects.

Therefore, of great importance is the creation of a ‘carbon’ fund that would accumulate funds from the sale of carbon units and carbon tax, which would further finance projects to reduce emissions and increase GHG sequestration.

Improved framework conditions and clear signals about future policies will reduce the uncertainty and risks perceived by domestic and international investors and thus reduce the investment costs associated with decarbonization. This can be enhanced by active engagement with the international community (e.g. development banks, governments and international organizations) to ensure support for green investments.

International standards will be introduced to enhance investment attractiveness, including standards related to green building, green transport, energy efficiency of buildings and dwellings and environmental management.

Fiscal incentives should be available to domestic businesses to encourage the uptake of low- and zero-carbon technologies.

Policies promoting green investments should be complemented by improvement of the overall business environment and investment climate in Kazakhstan with transparent criteria for green investments – ESG criteria. The taxonomy of green projects should

clearly define, with reference to international approaches, the relevant indicators of "environmental friendliness" of businesses, such as energy efficiency and energy saving, reduction of GHG emissions, and climate change adaptation.

Pilot projects will be implemented to determine the potential of new decarbonization technologies in the context of Kazakhstan.

In this regard, the decarbonization opportunities in various sectors will be tested in the pilot project to decide on the scaling of such technology and develop amendments to legislation on state support in the form of fiscal incentives, financial and non-financial support.

Technologies that are currently not yet widespread in Kazakhstan will be tested considering various aspects – climate specificities, architecture of Kazakhstan's energy system, consumption patterns of fuel and energy resources, households' behavior, etc.

3.3.2.3. R&D and education

Research and development, innovations and education are important for low carbon development and transition to carbon neutrality and climate adaptation.

Transformation of the economic setup in Kazakhstan as part of low carbon development and transition to carbon neutrality will need research, technology and professional skills.

Even now, progress in decarbonization and energy transition requires proactive support from research fundamental and applied studies in different sectors of the economy and a review of labor markets for creation of new jobs.

Training of domestic specialists, including through public-private partnerships, will be provided to build and develop low-carbon infrastructure in the manufacturing sector and reduce dependence on foreign technologies and best available techniques.

Spending on science will increase consistent with the current processes of technological modernization based on decarbonization principles with a focus on the research in low-carbon development, circular economy, and alternative energy.

Support will be provided to research in areas prioritized for the transition to low-carbon development (RES, biogas, nuclear and hydrogen power, energy efficiency, energy saving, etc.) where Kazakhstan can achieve a relative advantage in international markets.

Research programs will naturally complement development of new industries, encourage low-carbon projects and support collaboration of researchers and business stakeholders.

Grants for entrepreneurs and startups will be provided to better integrate domestic scientists with the foreign research community in strategic innovative areas and facilitate the development of high-quality, Kazakhstan-relevant research and commercialization of new technologies.

Human resources and training in such areas as climate policy, green energy, environmental economics, sustainable design, digitalization and others will be supported. Innovative methods, solutions and tools will be introduced into the domestic education system. Technological changes will enhance the requirements for professional skills in sectors where new technologies are introduced. Digital skills will become integral to all occupational standards.

As one of the priorities, access to up-to-date knowledge and data on climate change and low-carbon development for all stakeholders (decision-makers, expert community, business and others) will be expanded through increased investment and scientific and technical capacity building.

Engagement of citizens, NGOs and other social groups in decarbonization processes through education, research and innovation programs is an important step towards low-carbon development in Kazakhstan.

3.3.2.4. Behavioral change

Transition to a low-carbon economy will require the public to change their attitude considerably to the challenges of green development, behavior and consumption in the mid- and long-term. These changes should rely on sustainable development values which will be consistently promoted – from large-scale education and communication programmes to raise interest, awareness and engagement, and will involve civil society to implement the Strategy.

The policy will focus on the promotion of a low carbon culture and behavior change.

Thus, sustainable development especially in relation to climate change, energy transition and reduction of GHG emissions will be incorporated into curricula of primary, secondary and tertiary schools.

Campaigns on raising awareness about climate change will be launched to underline benefits of low carbon policy for health and the environment.

It is important to develop and promote a low-carbon culture in public authorities through the development of energy management systems, openness and public participation policies. National and regional days on climate and energy agenda for public and budgetary organizations on an ongoing basis prove to be effective.

The interest of the younger generation will be raised through the involvement of youth and volunteer organizations in large-scale environmental projects.

The government will support citizens' engagement in the transition to low-carbon development through:

- encouraging people to consume goods reasonably;
- developing and disseminating digital tools enabling people to assess their environmental impact and offer tailored actions to reduce emissions based on individual behaviors;
- promoting and communicating the importance and benefits of good waste management practices (separate collection, recycling, etc.).

Effective implementation of the Strategy is impossible without transparency and feedback. Stakeholders will be able to monitor the progress of the Strategy-associated projects. It is important to continuously collect public suggestions on new drafts of the Strategy and discuss low-carbon development on a national scale.

Effective feedback will be collected through the surveys during the development and implementation of public policy in the field of decarbonization and at regular public consultations at various dialogue and expert platforms.

3.3.2.5. International cooperation

To achieve the objectives, Kazakhstan needs financial and institutional support from the international community to ensure a smooth energy transition across all sectors. Kazakhstan will implement projects under the sustainable development mechanism of the Paris Agreement.

Kazakhstan will continue collaboration with the UN's Climate Technology Center and Network and Green Climate Fund. Specific requests will be formulated, and specific projects will be initiated to approach these institutions.

An important area will be attracting technologies as part of commitments made by some advanced countries which support emerging economies in building their capacity in the emissions measurement, reporting and verification, blue carbon, national emissions inventory and accounting systems, carbon capture and storage, etc.

Kazakhstan will collaborate with the international community in innovations to be part of international research programs and projects.

Capacity building of decision-makers will be an important element of international cooperation. Such programs include technical assistance, for example in energy security and clean technology, development of technological standards (in building, energy efficiency and others), integration of climate change into national development policy, NDC updates and inclusion of adaptation.

Kazakhstan will advance international cooperation in energy security and clean technology, and development of technological standards. This will facilitate exchange and transfer of zero-carbon technologies, consolidate scientific evidence and expertise of various countries and potentially improve quality, speed and efficiency of research and development.

Kazakhstan would be interested in joint research in macroeconomic evaluation of climate policies and evaluation of public investment management through the lens of climate and management of public finance regarding environmental agenda.

The procedures for international investment, import of technology and skilled workforce will be streamlined.

Cooperation will continue with international financial institutions – UN Development Program, International Monetary Fund, Organization for Economic Cooperation and Development, World Bank, European Bank for Reconstruction and Development, Asian Development Bank, German Development Cooperation Agency, Eurasian Development Bank and others. This will help attract international mechanisms to support green growth of national economies with a high carbon footprint (fast decarbonization of the energy sector, energy transition, write-off of sovereign (corporate) debt to international financial institutions in exchange for green growth and others).

Kazakhstan will continue to build strategic relationships with partners who share the same climate ambitions, to promote knowledge exchange in global supply chains, and accelerate joint development and introduction of low-emission technologies. This will

support the country's technological approach to emission reductions through stronger global cooperation in the development and introduction of low-carbon technologies.

3.3.2.6. Climate change adaptation

Restructuring of the national economy in the interests of the low-carbon development and carbon neutrality should consider risks associated with climate change in all sectors. This will make decarbonization more resilient to effects of climate change. Adaptation of the economy and society to low-carbon development should be an integral part of climate action along with efforts of Kazakhstan on GHG emission reduction.

It is empirically proven that adaptation has a significant positive effect on economic development of the country.

Investment in improving irrigation infrastructure significantly limits yield losses during droughts, increases agricultural export potential and creates additional jobs.

Infrastructure investment in improving resilience to climate change of roads can mitigate the impact of extreme precipitation and floods, while shorter transit time due road quality can reduce transport costs.

The central and local authorities should implement all stages of climate adaptation and closely cooperate across sectors and agencies in the planning of sectoral and territorial development.

The most vulnerable sectors of the economy should be prioritized for adaptation.

Planning and implementation of climate adaptation for low-carbon development will be institutionalized, which includes expansion of the control of government organizations and establishment of mechanisms for financing adaptation as part of national planning and budgeting processes.

The system to collect and distribute relevant and accessible climate data, including data on physical and economic damages due to climate change, will be improved. The data collection system will enable the assessment of risks and vulnerabilities in different sectors and facilitate decision-making at different levels.

It is important to develop and improve methodologies to assess climate risks and vulnerability to climate change impacts, to monitor the effectiveness of adaptation measures, to make an economic assessment and modelling of climate change impacts and adaptation. An approach to climate action in Kazakhstan should be holistic and build upon a strong connection between adaptation and mitigation.

3.3.2.7. Carbon regulation

Carbon regulation is a strong incentive for the development of low carbon technologies. Sustainable carbon regulation can resolve a broad range of immediate challenges: lower carbon footprint in goods, decrease harm to the environment, save resources, and support domestic technological refit.

A sustainable system of carbon regulation will be established and include the following key elements:

- monitoring, reporting and verification;
- national framework of emission allowances and ETS;
- carbon taxation of facilities (processes, goods and services) uncovered by the national ETS;
- climate financing which includes carbon fund, taxonomy of projects, a pool of low carbon projects ready for implementation, green financing, green procurement;
- interaction with BATs;
- unified digital ecosystem of carbon regulation.

ETS is a key element of carbon regulation; effective operation of ETS has become even more important in light of the national commitments of Kazakhstan on GHG emission reduction in the framework of the Paris Agreement, and CBAM implementation mechanisms.

There will be a gradual introduction of fee-based allowance allocations, reducing the number of available carbon credits of GHG emissions will help to improve the effectiveness of ETS.

Coverage of carbon pricing instruments will be expanded; the approved specific emission factors will be revised towards tightening them to incentivize the businesses that receive allowances to improve their individual performance on GHG emissions per unit of production.

Control over verification of GHG emission inventory reported by businesses that receive allowances, and the activities of validation and verification bodies will also be strengthened. Methodologies for GHG emission calculations will be improved by using enterprises' data.

4. Conclusion

To join international community efforts in addressing climate change the Republic of Kazakhstan decided to develop a Strategy for achieving carbon neutrality.

Stronger international climate policy may turn investment in energy- and resource-intensive projects into stranded assets soon. Withholding a carbon price from carbon-intensive goods at the border of importing countries, if it is not paid in the country of origin, will reduce investor returns.

The phased global decline in fossil fuel demand will inevitably lead to reduction of hard currency proceeds for exporters and accordingly a decrease in public revenues. This may significantly limit the capacity to spend on education, health, social security and decrease the potential for creating new jobs and economic growth.

As a large exporter of critical minerals, Kazakhstan needs to decarbonize its economy and build a sustainable low-carbon model of economic growth to generate new drivers of growth.

Low-carbon development and achievement of carbon neutrality by 2060 for such a large and sparsely populated country as Kazakhstan requires careful planning of next steps in the coming four decades.

This Strategy is the basis for such major transformations.

The Strategy's goal is low-carbon development and achievement of carbon neutrality by 2060 based on an effective low-carbon model of development.

Achievement of ambitious climate goals is an enormous challenge for Kazakhstan. GHG emission reduction, calls for fundamental changes in production and consumption patterns, a fast and efficient shift away from dirty combustion of fossil fuel sources towards zero-carbon technologies, extensive technological modernization, attraction of green investments in all sectors of the national economy, including regions, cities and different spheres of business.

Low-carbon development and achievement of carbon neutrality will proceed in three main streams.

1. Decarbonization of industries and processes related to energy use.

This workstream covers major transformation of energy sectors, in particular switching to more sustainable energy sources by phasing down burning fossil fuels, electrification instead of direct burning of fossil fuel, more extensive use of natural gas during the transition period, and alternative and renewable energy sources.

At present, coal-fired generation dominates electricity and heat generation but for low-carbon development and achievement of carbon neutrality by 2060 the coal generation will steadily phase out.

Development of renewable energy will be the key to successful decarbonization. Wind energy, considering quality and availability will become the main resource for the development at earlier stages, while solar energy will be the key technology at a later stage when the cost of investment in solar power plants will drop.

In the long term, the use of renewables will be supported by power storage systems to balance power supply and better integrate renewable energy into the grid.

Technological modernization of manufacturing and its basic industries considering for energy saving and energy intensity is important. Energy saving principles will apply in other sectors of economy too.

Extensive electrification is one of the key elements of decarbonization of emissions associated with energy generation and use.

Biofuel and hydrogen can be used in modes of transport that are difficult or impossible to fully electrify (e.g. water and air transport).

2. Decarbonization of sectors and processes unrelated to energy use.

This work stream will aim to increase carbon efficiency –methods to promote low or zero emissions in manufacturing processes, develop sustainable agriculture and better waste management.

Transition to sustainable farming and livestock practices will take place in agriculture sector.

Further development of the industrial sector to upgrade equipment and modernize manufacturing in a way to unbundle processes or allow for easy modernization of equipment from low- to zero-carbon processes.

Reduction of overall GHG emissions in the waste sector will be achieved by gradual elimination of landfilling, increase of recycling and composting, rapid implementation of collection and sorting to reach full collection coverage.

3. Sequestration and offset projects.

This work stream will increase capacity to sequester carbon into forests, soils, as well as extensive use of carbon capture, use and storage technologies as soon as they become economically viable.

Sustainable forest use and restoration will offset GHG emissions from agricultural production and partly in other sectors by 2060.

Carbon capture and storage will be extensively used in the sectors of the economy when the technologies become cost-effective.

These work streams will allow for transformation of sectors of the economy and reduce GHG emissions. But the decarbonization process has certain challenges and risks which require the right approaches to be taken for a smoother transition.

Just transition and job creation should become important priorities of low carbon development. To ensure a just transition, additional legislative, policy and economic measures will be taken to distribute the burden and benefits of climate action in an equitable and acceptable manner among different social groups, creating new opportunities in sectors and regions affected by decarbonization policies and climate adaptation.

In this regard, workers involved in fossil fuel production and who are exposed to job loss in the energy transformation process should be protected and supported by social security measures, reskilling and retraining programs, and the creation of new jobs in low-emission sectors. Programs offering alternative employment and retraining for new green activities will be developed for this groups.

Transition to low-carbon development will require large investments into clean energy and complementary low-carbon technologies. Kazakhstan needs to redirect current carbon-intensive investments towards low-emission solutions and at the same time improve market conditions to incentivize the entry of private domestic and foreign actors capable of accelerating the energy transition.

The decarbonization process at the country level requires systematic work and the appropriate investment, regulatory and institutional reform in both public administration and development planning of the national economy and its basic sectors. Due to the cross-sectoral nature of low-carbon development and the importance for the country’s energy security, extensive coordination among all stakeholders will be ensured.

The Strategy for Achieving Cabron Neutrality of the Republic of Kazakhstan by 2060, as a strategy for economic diversification and technological breakthrough, should

become a new long-term strategic document during the reform of the country's socio-economic policy.