Approved by
the decision of the Board of Directors
JSC "NC "QazaqGaz"
Minutes of Meeting No.___dated____2025

JSC "NC "QAZAQGAZ"
LOW-CARBON DEVELOPMENT PROGRAM FOR 2025-2033

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Astana, 2025

Preface

Introduced: originally.

Revision date: 2033.

Content

Purpose and scope

The Low-carbon development Program of JSC NC QazaqGaz (hereinafter referred to as the Program) was developed as part of the implementation of the Company's strategic objectives to reduce greenhouse gas emissions, minimize negative environmental impacts and ensure sustainable development. The document is based on the provisions of the national legislation of the Republic of Kazakhstan, the Concept of Low-carbon Development of JSC Samruk-Kazyna and QazaqGaz Development Strategy for 2023-2032, as well as the Strategy to achieve carbon neutrality of the Republic of Kazakhstan by 2060.

QazaqGaz recognizes the need for changes in the approach to climate issues and actively supports the implementation of global initiatives such as the Paris Agreement and the Global Commitment on Methane. The company assumes responsibility for reducing the impact on the climate system and integrating low-carbon solutions into all aspects of production and corporate activities.

The program is a key element of QazaqGaz ESG transformation, reflecting the Company's ambitions to create an environmentally sustainable and socially responsible business. The development of the low-carbon development program allows the company:

- Reduce greenhouse gas emissions and thereby contribute to the achievement of national goals and reduce the negative impact on the environment;
- Minimize climate and regulatory risks;
- Increase investment attractiveness to attract "green" financing;
- Increase the energy efficiency of the main production equipment by reducing the specific energy consumption during the operation of the engineering trunk and gas distribution infrastructure;
- Maintain competitiveness in the context of the transformation of the energy market and the transition to lower-carbon solutions.

In the process of implementing the Low-Carbon Development Program for 2025-2033, it is necessary to annually monitor the results of the implementation of planned measures to reduce GHG emissions, as well as supplement the Program with new and relevant measures to achieve the set goals for reducing greenhouse gas emissions.

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Abbreviations and designations

No.	Abbreviations and designations	Full name of given designations and abbreviations
1	APS	Announced Pledges Scenario
2	CDP	Carbon Disclosure Project
3	CCUS	Carbon Capture Utilization and Storage
4	CMIP-6	Coupled Model Intercomparison Project Phase 6
5	EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
6	ENVID	Environmental Impact Identification
7	GGCS	Green Gas Certification Scheme
8	GMI	Global Methane Initiative
9	HSE	Health Safety and Environment
10	IFRS	International Financial Reporting Standards
11	I-REC	A certificate confirming that a certain amount of electricity has been generated using renewable energy sources.
12	LNG	Liquefied natural gas
13	NZE	Net Zero Emissions
14	QGA	QazaqGaz Aimaq
15	SPI	Standardized Precipitation Index
16	SSP	Shared Socioeconomic Pathways
17	TCFD	Task Force on Climate-related Financial Disclosures
18	RES	Renewable energy source
19	WMO	World Meteorological Organization
20	BSGP	Beineu-Shymkent Gas Pipeline
21	SA	Subsidiaries and affiliates
22	ICA	Intergas Central Asia
23	CRMS	Corporate Risk Management System
24	IPCC	Intergovernmental Panel on Climate Change – A set of possible future climate change trajectories based on different levels of greenhouse gas emissions and other factors.
25	CBM	Coal bed methane
26	IEA	International Energy Agency
27	BAT	Best Available Technique
28	UNO	United Nations Organization

29	GHG	Greenhouse gas
30	LCDP	Low-Carbon Development Programs
31	RK	Republic of Kazakhstan
32	UN FCCC	United Nations Framework Convention on Climate Change
33	CO2-eq.	An industry unit used to measure greenhouse gas emissions including account their impact on the climate
34	SDG	Sustainable Development Goals
35	FER	Fuel and Energy Resources

1. Introduction

1.1 Глобальная климатическая повестка

Currently, the climate agenda remains relevant for the global community. The main goal is to reduce greenhouse gas emissions through the development and implementation of new technologies, increase energy efficiency, transition to green energy and reduce dependence on fossil fuels.

The beginning of international climate cooperation was the United Nations Framework Convention on Climate Change (UN FCCC), adopted in 1992. The Kyoto Protocol[1] has set quantitative targets for reducing greenhouse gas emissions for developed countries and countries with economies in transition. The Paris Agreement[2] extended these commitments to all participating countries and set a goal to limit global warming below 2°C compared to pre-industrial levels.

At the 28th United Nations Climate Change Conference (COP28), for the first time, countries reached a political consensus on phasing out all fossil fuels by 2050, while maintaining the status of natural gas as a transitional fuel in the decarbonization process.

In developed countries, there are steady trends aimed at completely eliminating the use of natural gas in the long term. Decisions are already being taken in the European Union and some US states to ban the connection of new buildings to gas networks, accelerate the transition to electric heating, develop hydrogen infrastructure and support industrial decarbonization projects. Programs are also being implemented to develop smart energy management networks aimed at improving energy efficiency and reducing energy consumption.

The role of natural gas in scenarios of deep decarbonization may decrease significantly with an increase in the share of RESs and the volume of hydrogen production. By 2050, it is planned to replace natural gas with hydrogen, which will be used as an environmentally friendly fuel and a tool for balancing the energy system. This will become a serious challenge for gas producing companies, including QazaqGaz, and will require long-term strategic planning, rethink investment policies and diversifying activities, including possible participation in hydrogen projects.

The prospects for the development of the global fossil fuel market indicate that the volume of consumption of fossil fuels will decrease in the future and its gradual reduction. A growing number of countries and multinational corporations are making commitments to achieve carbon neutrality. Investments are shifting towards RES, hydrogen energy and carbon capture technologies. In the long term, demand for coal, oil and natural gas will decrease, especially in countries with strict climate policies, which will lead to a change in demand patterns, a possible drop in prices and stricter requirements for the carbon footprint of supplied energy resources.

For Kazakhstan, natural gas is considered as the most important element of the energy portfolio for the coming decades. However, this also means that QazaqGaz needs to take into account the growing influence of the climate agenda in its strategic activities. In the context of stricter international standards and requirements for environmental reporting, increasing demands from investors and consumers, as well as the transformation of global fuel markets, ignoring climate factors can lead to reputational and economic risks. In the context of stricter international standards and requirements for environmental reporting, increasing demands from investors and consumers, as well as the transformation of global fuel markets, ignoring climate factors can lead to reputational and economic risks.

Active participation in reducing methane emissions, improving energy efficiency, and implementing GHG monitoring and reporting systems is not only following global trends, but also a necessary condition for maintaining QazaqGaz's competitiveness in foreign and domestic markets.

[1] Kyoto Protocol
[2] Paris Agreement

Corporate initiatives to decarbonize various sectors of the economy play an important role in achieving national carbon neutrality (Net Zero) goals. As countries make long-term climate commitments, the importance of businesses implementing comprehensive programs to reduce GHG emissions, as well as introducing innovative solutions and adaptation and mitigation measures, increases. In the energy and gas sector, the integration of an operational strategy with national and international climate commitments is becoming an essential prerequisite for building a sustainable company base.

1.2 Kazakhstan's low-carbon development strategies and QazaqGaz role

The Republic of Kazakhstan, being an active participant in the international climate agenda, shares the global goal of combating climate change and mitigating its consequences. The country is a party to the United Nations Framework Convention on Climate Change (UN FCCC)[3], as well as the Kyoto Protocol and the Paris Agreement, which regulate the reduction of greenhouse gas emissions to combat climate change. By ratifying the Paris Agreement in 2016, Kazakhstan committed to reducing greenhouse gas emissions by 15% by 2030[4] and achieving carbon neutrality by 2060 compared to 1990

Due to international trends in combating climate change, Kazakhstan is also experiencing a tightening of the regulatory framework. Within the framework of the Environmental Code and other internal regulatory documents in the country, the requirements for monitoring, reporting and verification systems for greenhouse gas emissions are being strengthened.

Nationally determined contributions, or NDC, are national action plans aimed at combating climate change developed by each country within the framework of the Paris Agreement. In the Republic of Kazakhstan, the Ministry of Ecology and Natural Resources has developed the NDC and a roadmap for achieving the goals set by 2030 includes: strengthening the GHG emissions trading system, introducing a carbon tax, and reducing GHG emissions by economic sectors. The key measures of the roadmap for achieving the NDC goals are:

1) Coordinated climate and energy policy;
2) Creation of a carbon fund and a program to accelerate the NDC implementation;
3) Strengthening the measurement, reporting and verification (MRV) system, as well as expanding digitalization programs;
4) Capacity building for GHG reduction projects and development of international relations to achieve carbon neutrality goals

The programs for the development of the energy sector of the Republic of Kazakhstan (for the main sectoral companies) agreed with the NDC will allow for the implementation of a consistent policy to reduce GHG emissions, and NDC main goals should be taken into account when developing strategic decarbonization plans for energy companies (including QazaqGaz).

Natural gas has long been in second place in the structure of domestic consumption[5] and the national energy balance of the country. Coal occupies the main weight in the structure of total primary consumption of fossil fuels (on average, about 50% over the past ten years), due to its rich raw material base, low production costs and, as a result, affordable prices. The share of gas in terms of usage averaged 24% over ten years, but is gradually increasing from 19% in 2015 to 26% in 2022. According to IHS Markit forecasts, by 2040 the share of coal will decrease to 42%, while gas, on the contrary, will grow to 29%. The turning point and the main driver of the gas share growth was the adoption of a large-scale Regional Gasification Program, as well as Kazakhstan's commitments to reduce greenhouse gas emissions under the Paris Agreement. Compared to other types of fossil fuels, natural gas is the most

[3] United Nations Framework Convention on Climate Change
[4] Official information resource of the Prime Minister of the Republic of Kazakhstan
[5] AC_gas.pdf

environmentally friendly and affordable in the Republic of Kazakhstan, so its role will increase in the coming years. In the scenario of decarbonization of the energy sector, the share of coal-fired power generation will decrease, while the share of gas-fired power generation and renewable energy sources will increase. According to the Ministry of Energy of Kazakhstan[6] by 2050 the share of renewable energy sources in the country's energy structure will be 50%. In such a development scenario, natural gas will be assigned the role of fuel for maneuverable capacities (about 22% of gas-fired power plants in the power generation structure). They will allow balancing renewable energy generation during periods of peak consumer demand, as well as providing energy supply during periods of reduced generation due to weather and climatic conditions. Therefore, the demand for natural gas will continue in the medium term, and in the long term it will be necessary to introduce additional technological measures to reduce carbon intensity (for example, expanding the use of biogas and hydrogen fuels).

The country has significant potential to increase its gas resource base. National operators JSC NC KazMunayGas and JSC NC QazaqQaz plan to develop promising fields that together can provide an increase in natural gas production to 4.6 billion m³ by 2030.

Kazakhstan has adopted a number of official documents defining the prospects for the development of the gas industry:

- Comprehensive plan for the development of the gas industry of the Republic of Kazakhstan for 2025-2029;
- Comprehensive plan for the development of major oil and gas and petrochemical projects for 2023-2027;
- Energy Efficiency and Careful Gas Consumption Plan for 2023-2025.
- General scheme of gasification of the Republic of Kazakhstan for 2023-2030.

An important aspect of ensuring the effective implementation of the set goals is regular monitoring and analysis of the current regulatory framework related to the activities of QazaqGaz, in order to timely update the company's internal documents and adapt them to changing market conditions and legislation.

In accordance with these documents, the priority and efforts of the Government of the Republic of Kazakhstan are focused on a number of measures to ensure uninterrupted supply of gas to consumers of the Republic of Kazakhstan, while steadily fulfilling obligations on gas transit, expanding the gas resource base and increasing exports. In addition, QazaqGaz has developed a new development strategy for the Company, as well as anti-crisis measures for the Kazakh gas industry, which also reflect these primary objectives. QazaqGaz operates the largest network of main gas pipelines in the Republic of Kazakhstan with a total length of more than 21.3 thousand km. km, including (branches – 2.991 km). The throughput capacity is 255 billion m³ per year. Gas distribution networks have a length of more than 72.167 thousand km.

Since QazaqGaz is the national operator in the gas market of Kazakhstan, the company's contribution to the strategies of low-carbon development and GHG emission reduction will have a significant role in the gas industry of Kazakhstan and will contribute to achieving national goals of achieving carbon neutrality.

In QazaqGaz[7] implemented measures to reduce GHG emissions:

1) Optimization of CS-5 loading (with electric drive) of Taraz GMPM - reduction of GHG emissions by 3 082 tCO2-eq.;
2) Replacement of the condensing units of Opornoye CS (reactive power compensation system) - reduction of GHG emissions by 49 tCO2-eq.;

[6] You Exec (https://youexec.com/plus)

3) Replacement of the Zhana-Ozen CS condenser units (reactive power compensation system) - reduction of GHG emissions by 7.8 tCO2-eq.;
4) Replacement of outdated cathodic protection stations with energy-efficient analogues at Aktau, Atyrau, Taraz, Almaty GMPM (1 station - saving 18.6 thousand kW*h) - reduction of GHG emissions by 473.5 tCO2-eq.;
5) Installation of LED outdoor lighting fixtures at the AGDS-1 industrial sites and the Operator houses of Akshabulak-Kyzylorda GP - reduction of GHG emissions by 3.4 tCO2-eq.;
6) Automation of outdoor lighting control in the territories of Akshabulak-Kyzylorda GP - reduction of GHG emissions by 11.5 tCO2-eq.;
7) Replacement of outdoor lighting with LED equivalents (БЛПУ, ЖЛПУ, ОЛПУ) – reduction of GHG emissions by 85 tCO2-eq.;
8) Replacement of internal lighting with LED equivalents (БЛПУ, ЖЛПУ, ОЛПУ) - reduction of GHG emissions by 174 tCO2-eq.;

The measures implemented by QazaqGaz in 2024 to improve energy efficiency and reduce energy consumption are listed in Appendix 1 to this document. Measures with the potential to reduce fuel and energy consumption are presented in Table 4.

The energy efficiency measures implemented by QazaqGaz can be divided into the following technical areas:

- modernization of boiler equipment;
- installation of variable frequency drives (VFD);
- conversion of fluorescent lighting to LED lighting;
- introduction of reactive power compensation systems;
- installation of heat recovery units for secondary use of waste gas energy.

The measures implemented during the previous period to reduce GHG emissions from AGP are listed in Appendix 2 to this document.

An energy management system in accordance with ISO 50001 is being implemented in SAs. Energy service contracts are also being used: when energy-saving measures are implemented by specialized energy service organizations that invest their own funds, the cost recovery mechanism is based on the level of energy savings achieved (the level of savings is converted into financial indicators and regularly transferred to energy service companies to cover their costs under the contract).

Given the scale of the company's operations, the implementation of GHG emission reduction programs by QazaqGaz is an important condition for achieving Kazakhstan national goals of carbon neutrality. It also contributes to strengthening the country's position in the international arena, as the Republic of Kazakhstan consistently implements its international climate commitments.

2. Analysis of greenhouse gas emissions and structure of fuel and energy resource consumption

2.1 Analysis of direct and indirect greenhouse gas emissions

2.1.1 Scope of greenhouse gas emissions inventory

To ensure transparency and improve the reliability of reporting, greenhouse gas emissions are inventoried on an annual basis with mandatory verification by an independent third-party organization. Verification is carried out in accordance with the requirements of ISO 14064–3 standards and the GHG Protocol methodology.

The inventory of GHG emissions at QazaqGaz is provided based on the following standards and methodological documents:

- GHG Protocol: Corporate Accounting and Reporting Standard;
- IPCC Guidelines for GHG inventories (2006, with updates from 2019);
- Order of the Minister of Ecology and Natural Resources of the Republic of Kazakhstan dated January 17, 2023 No. 9 "On Approval of Methods for Calculating Greenhouse Gas Emissions and Absorption";
- ISO 14064-1 and ISO 14064-3 — for calculation and verification, respectively.
- Assessment covers the following emission sources:
- Scope 1 — direct emissions: stationary combustion, fugitive emissions, solid waste disposal;
- Scope 2 — indirect energy emissions: consumption of purchased electricity and heat energy;
- Scope 3 — other indirect emissions in the value chain (categories 1, 6, 7, 11).

In accordance with international standard ISO 14064–1, the scopes for quantifying GHG emissions were established in accordance with operational control, which covers the following subsidiaries and affiliates:

- Main natural gas transportation: Intergas Central Asia JSC, Beineu-Shymkent Gas Pipeline LLP, Asian Gas Pipeline LLP.
- Transportation via distribution gas pipelines: QazaqGaz Aimaq JSC.
- Natural gas production: QazaqGaz Exploration and Production LLP.

During the period 2021–2024, the Company total gross greenhouse gas emissions (Scope 1 and Scope 2) ranged from 3,672,533 to 3,994,420 tCO_2eq. Direct emissions (Scope 1) accounted for the largest share, exceeding 98% of total emissions annually.

Total GHG emissions for Scope 1, 2, and four Scope 3 categories (categories 1, 6, 7, 11) amounted to 4 866 902 tCO2-eq in 2024.

Other subsidiaries whose production sites with technological facilities operating on fossil fuels and emitting less than 20,000 tCO_2eq per year are not subject to national regulation and are not included in the calculation perimeter of this Program.

Direct greenhouse gas emissions (Scope 1)

The methodology for calculating GHG emissions is based on the application of national emission factors (Order No. 9 of the Minister of Ecology and Natural Resources) approved by the authorized body, and in cases where these are not available, on international factors recommended by the Intergovernmental Panel on Climate Change (IPCC, 2006). Scope 1 covers the following emission categories according to the IPCC classification:

- Stationary combustion: greenhouse gas emissions generated by the combustion of natural gas in gas pumping units, as well as in the Company’s own electricity and heat generation facilities at its production sites;
- Volatile emissions: leaks and venting of natural gas occurring during gas transportation and distribution, as well as during equipment maintenance;
- Solid waste disposal: direct emissions arising from the placement and disposal of waste at the landfill site owned by QazaqGaz Exploration and Production LLP.

In 2024, the largest contributors to Scope 1 were:

- Asian Gas Pipeline LLP — 41%,
- Intergas Central Asia JSC — 29%,
- Beineu-Shymkent Gas Pipeline LLP — 19%.

Indirect energy emissions (Scope 2)

Scope 2 indirect GHG emissions reflect GHG emissions associated with the purchase of electricity, steam, heat, or cooling. Although these indirect GHG emissions occur at the facility where they are generated, they are included in an organization's GHG inventory because they result from the organization’s use of energy.

Scope 2 GHG emissions are calculated using the location-based method and specific GHG emission factors for electricity and heat based on a list of benchmarks approved by Order No. 260 of the Acting Minister of Ecology, Geology, and Natural Resources of the Republic of Kazakhstan dated July 19, 2021, No. 260. The document contains normative values of specific GHG emission factors for various types of fuel used in the energy sector, as well as the structure of electricity generation by fuel type.

In the overall structure of QazaqGaz, the Scope 1, 2, and 3 GHG emissions, share for Scope 2 accounts for 1.06%. The main contributor to indirect energy emissions is Intergas Central Asia JSC, which accounts for 79.47% of the total volume in this category.

Other indirect emissions (Scope 3)

Scope 3 emissions are assessed in accordance with the Greenhouse Gas Protocol standard: Corporate Value Chain (Scope 3) Standard, covering the entire product life cycle – from suppliers to end users.

In accordance with the GHG Protocol, in 2024 QazaqGaz conducted the inventory of Scope 3 GHG emissions in the following categories:

- Category 1 — purchase of goods and services;
- Category 6 — employees business trips;
- Category 7 — employees’ trips to work;
- Category 11 — use of manufactured products.

Scope 3 emissions were calculated in accordance with the GHG Protocol methodology using industry-specific emission factors. Going forward, QazaqGaz plans to improve the accuracy of its assessments by refining its source data and actively involving suppliers of goods and services in the process of calculating Scope 3 GHG emissions. The share of Scope 3 emissions in the total greenhouse gas structure of QazaqGaz for 2024 is 17.9% (872,482 tCO2-eq.).

2.1.2 Analysis of GHG emissions for 2021–2024

Between 2021 and 2024, the QazaqGaz group of companies’ total greenhouse gas emissions (Scope 1 and Scope 2) showed a steady upward trend, reflecting an increase in gas transportation volumes, growth in technological losses, and infrastructure expansion. At the end of 2024, gross emissions amounted to 3,994,421 t CO_2-eq, of which Scope 1 accounted for 3 942 768 t CO_2-eq. (98.7%), and Scope 2 accounted for 51 653 tons of CO_2 eq. (1.3%).

Diagram 1. Gross emissions (Scope 1,2)[8] by QazaqGaz group of companies for 2021–2024, tCO2-eq.

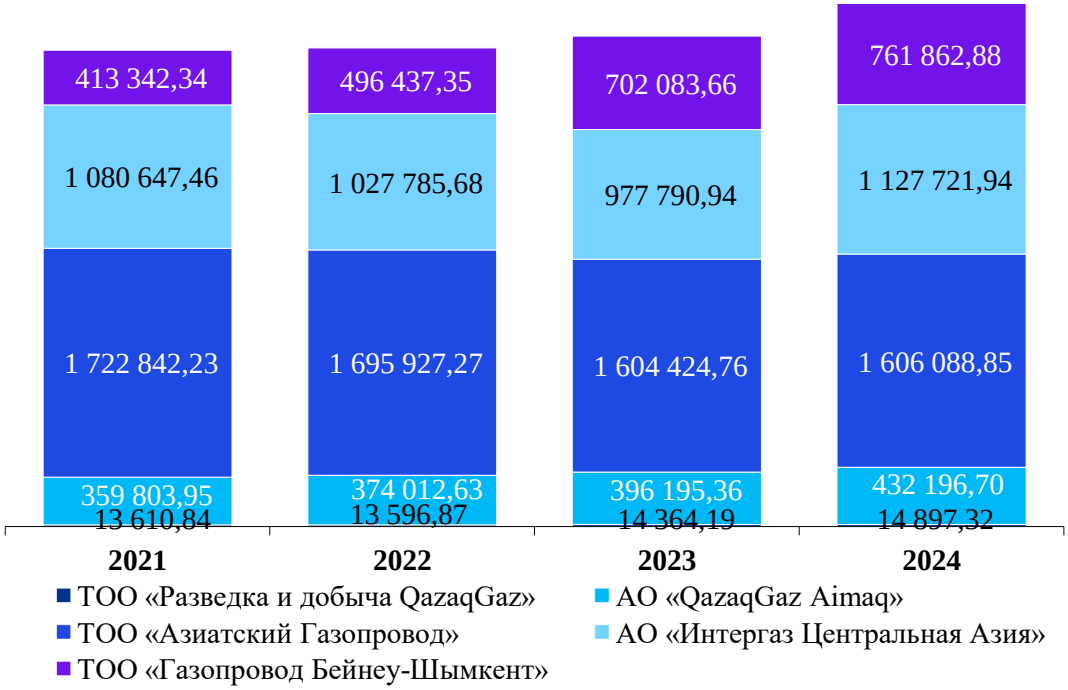
Analysis of Scope 1 GHG emissions

Direct greenhouse gas emissions account for the majority of QazaqGaz carbon footprint. The main sources are fuel combustion at compressor stations, flaring emissions, and gas leaks during transportation and distribution. The increase in emissions in 2024 was due to a number of factors, including the non-linear relationship between the volume of gas transported and fuel consumption. In particular, QazaqGaz Aimaq JSC and Beineu-Shymkent Gas Pipeline LLP recorded an increase in transported volumes, which led to an increase in emissions, while Intergas Central Asia JSC and Asian Gas Pipeline LLP saw a decrease.

An increase in fugitive emissions has also been recorded, particularly in the distribution networks of QazaqGaz Aimaq JSC, indicating potential for reducing specific gas emissions per kilometer of pipeline length, as well as optimizing equipment operating modes and implementing preventive measures. According to data for 2024, the largest increase in emissions was recorded by Beineu-Shymkent Gas Pipeline LLP, at +84.27% compared to 2021, due to the transfer of the Karaozek compressor station from Intergas Central Asia JSC Intergas Central Asia JSC and a significant increase in production indicators for natural gas transportation volumes in the period 2021-2024. QazaqGaz Aimaq JSC saw a 20.22% increase in emissions due to higher gas losses during processing. At the same time, Asian Gas Pipeline LLP reported a 6.8% decrease in emissions due to lower fuel transportation and consumption volumes.

[8] Greenhouse gas emissions associated with compressor stations are usually accounted for separately and do not include gas used for underground gas storage (UGS) operations.

Diagram 2. Distribution of direct emissions by SAs for 2021-2024, tCO2-eq.



In 2024, the main contributor to the total direct greenhouse gas emissions of the QazaqGaz Group was Asian Gas Pipeline LLP, which accounted for 40.7% of total emissions. The significant contributions were also made by Intergas Central Asia JSC (28.6%) and QazaqGaz Aimaq JSC (11%). Beineu-Shymkent Gas Pipeline LLP accounted for 19.32% of total emissions. The contribution of QazaqGaz Exploration and Production LLP remains insignificant, accounting for less than 0.4% of the total.

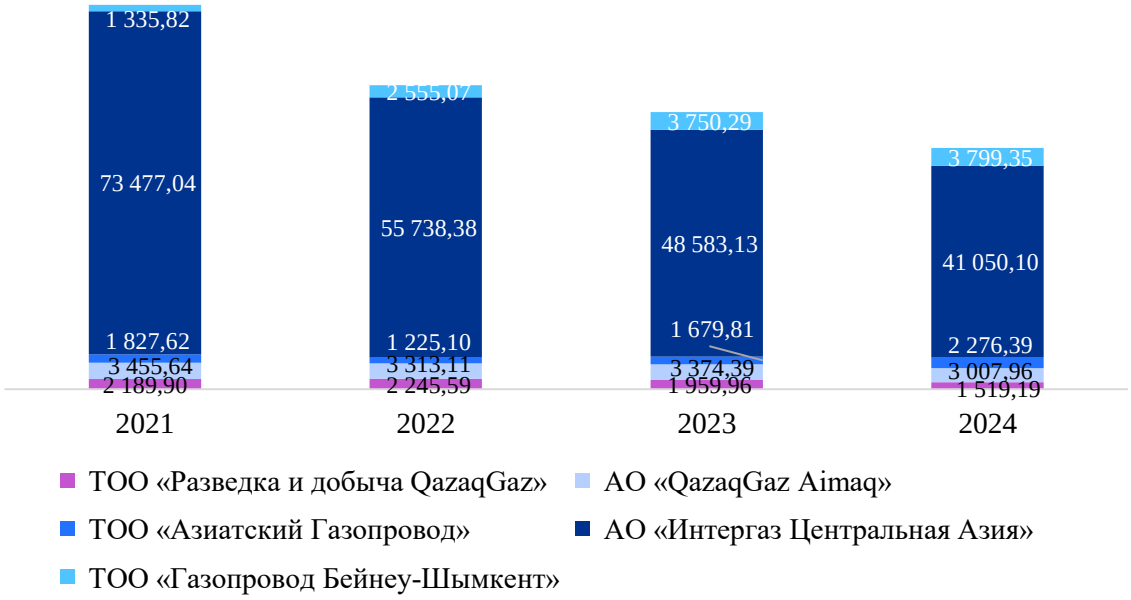
Given that direct GHG emissions (Scope 1) account for the largest share of QazaqGaz's carbon footprint, the Low Carbon Development Program sets the reduction of direct GHG emissions as a priority area.

Analysis of Scope 2 GHG emissions

Indirect greenhouse gas emissions remain low (1.06% of total Scope 1, 2, and 3 emissions), which is explained by the high share of autonomous gas energy supply to facilities. In 2024, Scope 2 emissions decreased by 37.23% compared to the previous period, which is associated with the transition to a new location-based approach in connection with the introduction of a Single Electricity Purchaser in the Republic of Kazakhstan from July 1, 2023.

Mixed specific GHG emission factors for purchased electricity ($tCO_2eq/MW*h$) are calculated taking into account the structure of national electricity generation (coal, gas, etc.). The use of the location-based method shows lower calculated values of indirect GHG emissions compared to the coefficients used previously (before 2023) (e.g., for coal-fired power generation), which, with comparable volumes of purchased electricity, shows lower values. To calculate Scope 2 emissions for 2024, only the location-based method is used, reflecting the weighted average value of specific GHG emissions from electricity generation in Kazakhstan.

Diagram 3. Distribution of indirect energy emissions by SAs for 2021–2024, tCO2-eq.



Indirect emissions (Scope 2) can be reduced by increasing the RES share in the company’s own electricity generation structure and reducing the volume of purchased electricity, as well as through tools such as I-REC certificates confirming the purchase of electricity from RES.

2.2 Analysis of methane leaks

Methane (CH_4) is a key component of QazaqGaz Group’s emissions, with a high global warming potential. Since QazaqGaz’s main production activities are related to the transportation and distribution of natural gas through a network of gas pipelines, the main methane emissions are associated with various types of leaks and technical losses of natural gas in the course of its main production activities.

In accordance with the methodology of the Intergovernmental Panel on Climate Change (IPCC 2006 Guidelines), the following categories of volatile emissions are included in the greenhouse gas inventory:

- burning natural gas in flares;
- emissions during gas production;
- emissions during gas transportation;
- emissions from natural gas distribution;
- technological losses and gas venting

The total methane emissions for the QazaqGaz group in 2024 amounted to 54 964.30 tons (a total of 1 539 000.44 tCO2-eq for SAs in 2024). This figure is 3.71% higher than in the base year of 2021.

When analyzing the dynamics of QazaqGaz methane emissions, it can be noted that in 2022 there was a 5.6% decrease in methane emissions compared to 2021, while in the period 2023-2024 there was an increase in methane emissions: in 2024, total methane emissions exceeded 2021 levels by 3.7%. This is due to an overall increase in fugitive emissions from gas transportation and distribution processes (the main increase in fugitive emissions in QGA is associated with an increase in the length of the gas distribution infrastructure). The increase in methane emissions in 2024 requires additional assessment of the effectiveness of technical and organizational measures implemented to eliminate leaks, as well as the technical potential for reducing methane emissions.

Diagram 4. Methane emissions dynamics QazaqGaz for 2021-2024, in tCH4

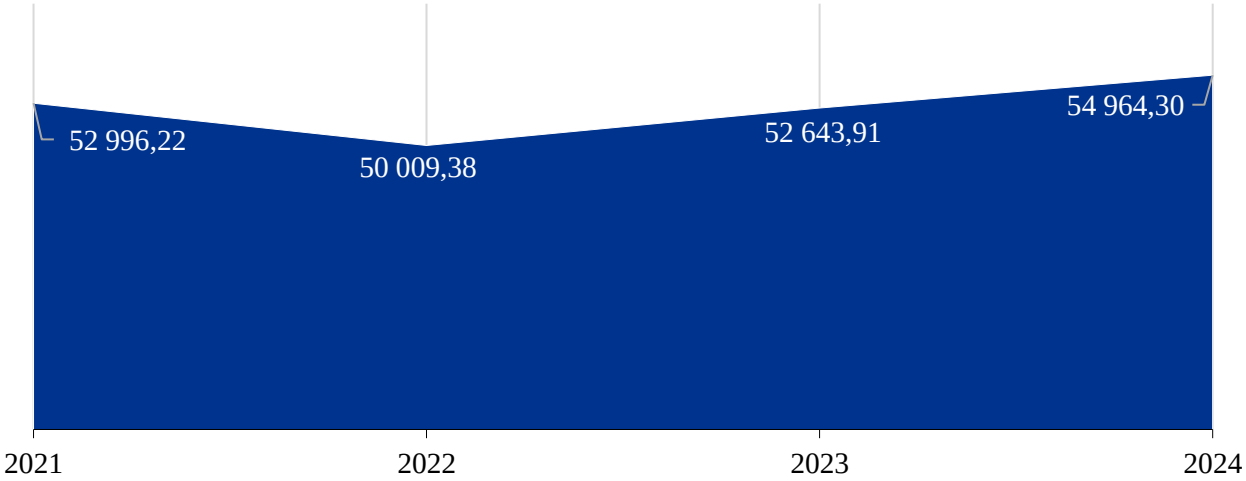
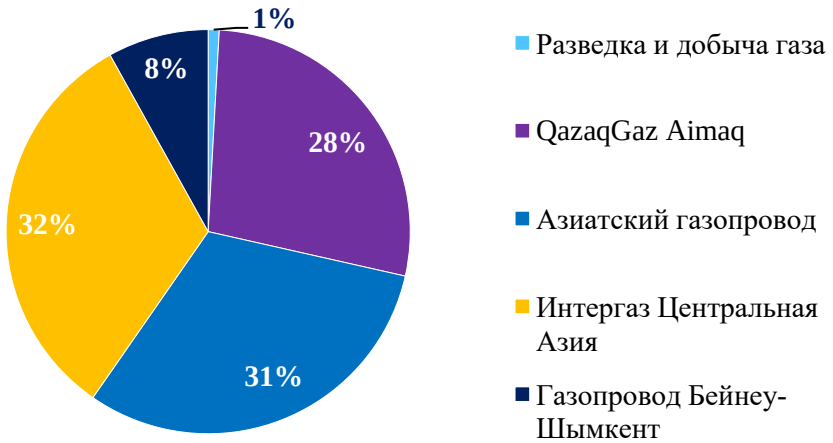


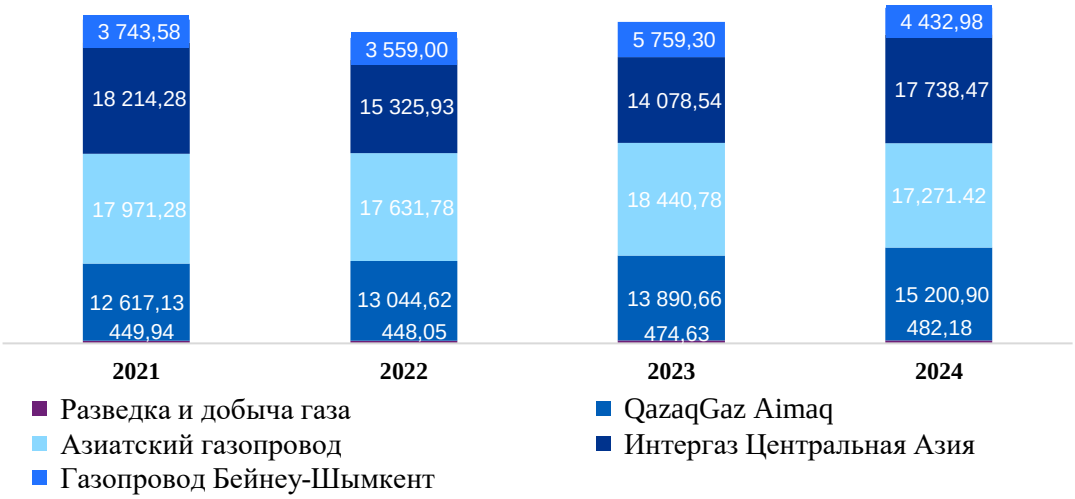
Diagram 5. Structure of methane emissions by QazaqGaz SAs for 2024, in %



The largest volume of methane emissions comes from three companies: Intergas Central Asia JSC (17 737 tCH4), Asian Gas Pipeline LLP (17 272 tCH4), and QazaqGaz Aimaq JSC (15 200 tCH4). These organizations account for a total of 91.06% of all methane emissions of the QazaqGaz group in 2024.

At Intergas Central Asia, increased emissions are associated with leaks during transportation and technical losses (gas venting during repair work and technical maintenance) at compressor stations due to the high technical wear and tear of the main technological equipment. In AGP, methane emissions are mainly associated with technical losses from gas distribution in the main gas pipeline system. In the case of QazaqGaz Aimaq, methane leaks are due to technological gas losses during the operation of an extensive distribution network supplying gas to end users.

Diagram 6. Distribution of methane emissions across the Group of Companies for 2021-2024, tCH4



Between 2021 and 2024, the structure of methane emissions for the QazaqGaz Group of Companies remained relatively stable, with the highest volumes recorded in 2024 (total methane emissions for 2021-2024 are shown in Figure 4).

2.3 Analysis of the structure of fuel and energy resource consumption

As part of the preparation of the Program, an analysis was conducted of the structure of fuel and energy resource (FER) consumption by QazaqGaz JSC based on the results for 2024, broken down by subsidiaries included in the calculation perimeter. The dynamics of energy consumption for 2021-2023 were also analyzed to assess changes over time.

Conversion factors are used to correctly compare different types of energy carriers. In particular, the following are used: conversion factor for natural gas (39 gigajoule per thousand cubic meters of gas), density values for gasoline and diesel fuel (1300 l/t for diesel fuel and 1370 l/t for gasoline) used in calculations of QazaqGaz[9], as well as universal reference values for converting electrical and thermal energy in GJ (4.1868 GJ for 1 Gcal and 3.6 GJ for 1,000 kW*h).

The energy consumption structure of SA companies is based primarily on the use of natural gas, which is used both to operate production equipment (including gas pumping units at compressor stations) and to generate heat and electricity at their own facilities.

To avoid double counting, only primary fuels were taken into account when determining total energy consumption: natural gas, diesel fuel, and gasoline. The volumes of thermal and electrical energy generated within the SA companies, as well as purchased energy and technical gas losses, were not included in the calculation.

The summary results for the energy consumption of the five subsidiaries are shown in Table 1, where the gross consumption of primary energy resources is indicated in GJ.

[9] Data on internal coefficients for FER from QazaqGaz Production and Technical Department.

Table 1. Consumption by FER type of QazaqGaz for 2021-2024, in GJ

Natural gas accounts for the largest share of energy consumption at QazaqGaz JSC, totaling 97.4% according to data for 2024.

FER	Unit measure	2021	2022	2023	2024
Natural gas consumption	GJ	50 916 173	44 030 875	45 200 990	48 283 899
Diesel fuel consumption	GJ	5 515	8 502	5 811	6 948
Gasoline consumption	GJ	745	52 740	42 373	45 741
Total energy consumption	GJ	51 220 207	44 327 071	45 498 379	48 577 358

A similar indicator of the share of gas in the base year 2021, and for the period 2022-2023, the share of natural gas in the total energy consumption structure ranged from 99.33% to 99.35%, i.e., during the period under review, the dynamics of changes in QazaqGaz's energy consumption structure are insignificant, and natural gas accounts for the overwhelming share of energy consumption.

The total energy consumption of primary energy resources (natural gas, diesel fuel, and gasoline) in 2024 amounted to 48 577 358 GJ. Energy consumption in 2024 increased by 6.77% compared to 2023, which is associated with an increase in production volumes: the amount of gas transported increased (in the ICA and AGP), and therefore the consumption of energy resources (mainly natural gas) required to operate production equipment increased. Compared to the base year of 2021, primary FER consumption in 2024 decreased by 5.16% (2.643 million GJ).

Diagram 71. Energy consumption dynamics of QazaqGaz JSC for 2021-2024 period, in GJ

The diagrams below show the dynamics of primary energy consumption by SA companies for 2021-2024 period: natural gas (excluding technical losses, only stationary combustion volumes), as well as diesel fuel and gasoline.

Diagram 8. FER consumption dynamics for 2021-2024 QGA (left graph) and EP and Production (right graph), in GJ

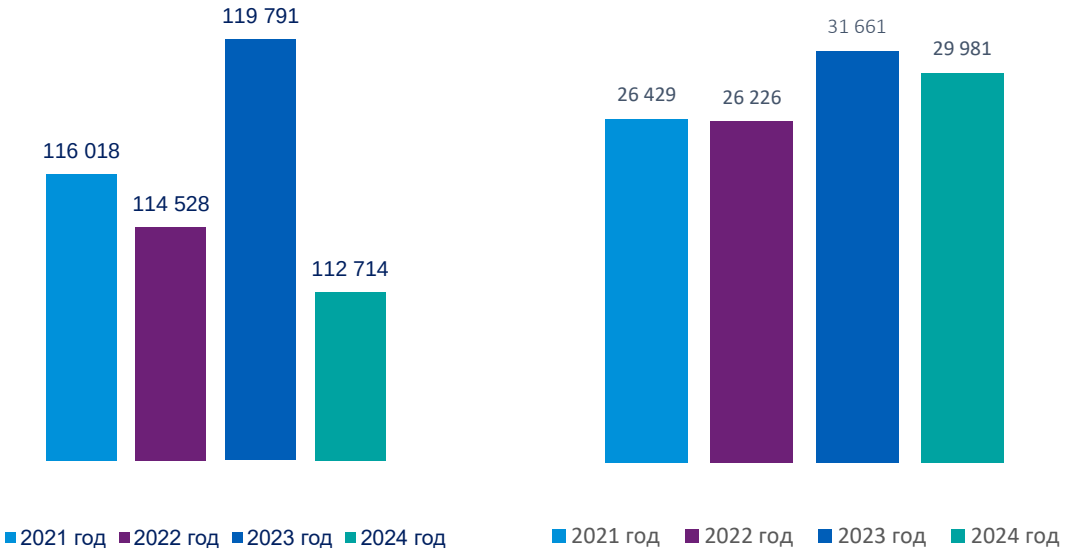


Diagram 9. FER consumption dynamics for 2021-2024 ICA (left graph) and BSGP (right graph), in GJ

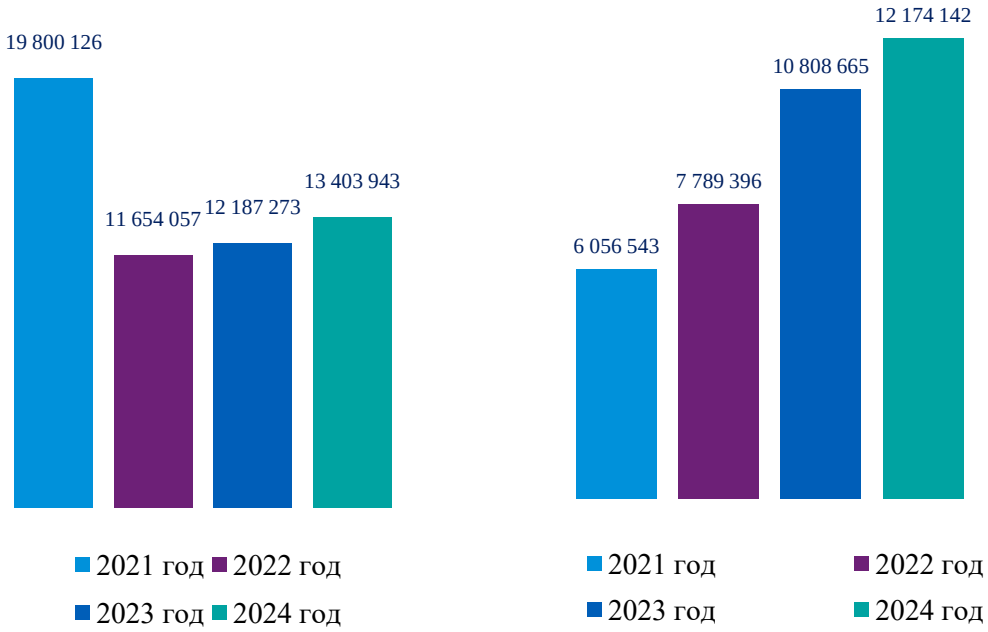
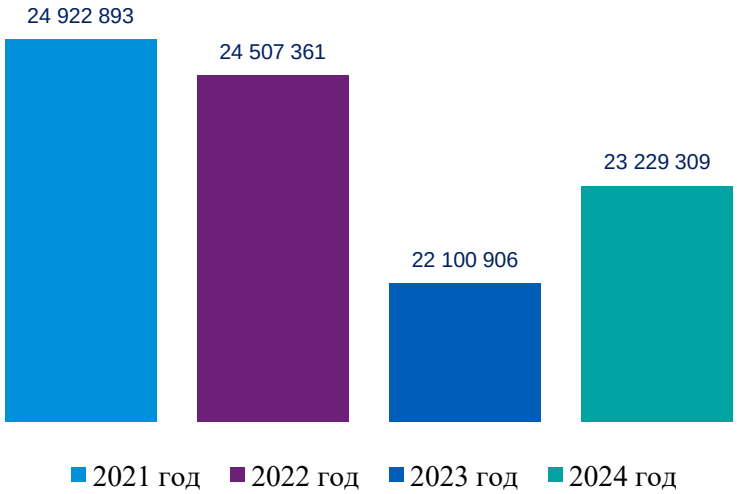
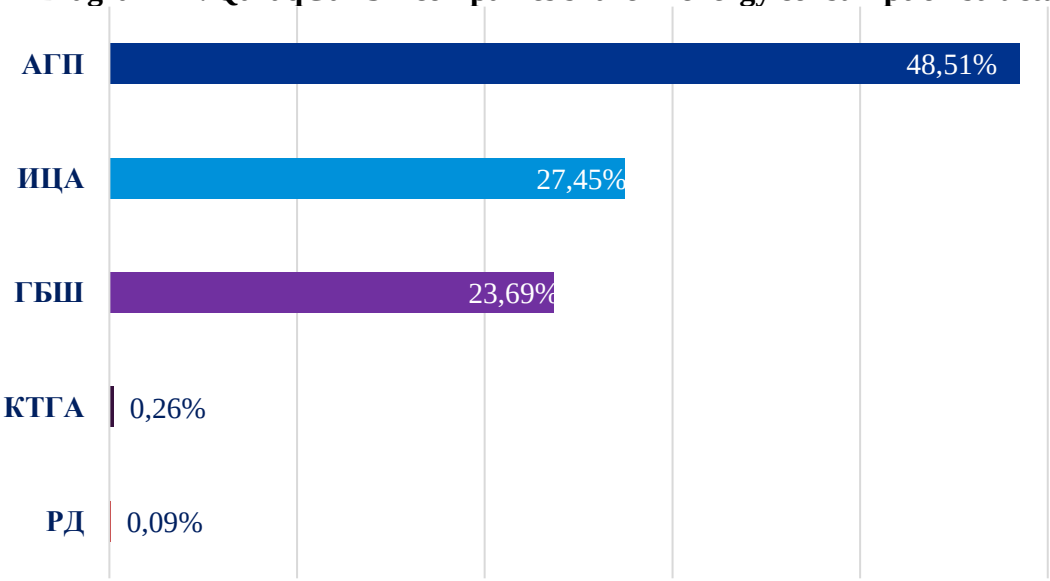


Diagram 10. FER consumption dynamics for 2021-2024, AGP in GJ



The share of each subsidiary in QazaqGaz’s energy consumption structure for 2024 is shown in Diagram 11.

Diagram 11. QazaqGaz SA companies share in energy consumption structure for 2024, in %



Based on the analysis, it can be concluded that more than 99% of the energy consumption of 5 SA companies included in the scope of work is accounted for by AGP, ICA, and BSGP: 48.6%, 27.5%, and 23.5%, respectively. QGA and EP account for less than 1% of total energy consumption in the overall structure.

Based on the provided annual forecast values for SA companies, energy consumption is projected to increase by 2033 due to the planned growth in natural gas transportation and production volumes. According to the forecast data on energy consumption for the five subsidiaries of QazaqGaz, it will increase by 6.71% by 2033 compared to 2024, which is equivalent to 3.259 million GJ.

Sections summary:

The natural gas is used as fuel for the operation of main production equipment (gas pumping units, compressor stations, gas power plants, etc.) and is the main type of fuel (99.4% of energy consumption). AGP, ICA, and BSGP account for the majority of energy consumption:

- 98,6% in the structure of ICA energy consumption;
- 99,85% in the structure of BSGP energy consumption;
- 99,73% in the structure of AGP energy consumption.

The energy efficiency measures actually implemented in 2024 in subsidiaries and affiliated companies are listed in Appendix 1: energy savings from the implementation of energy efficiency measures in ICA per year amounted to 13 592 tfoe (395 527 GJ or 2.9% of the total energy consumption of the ICA), including: natural gas savings of 10 651.4 thousand m³ worth 166.4 million tenge, electricity savings of 8 543.6 thousand kW*h worth 287.3 million tenge. The energy efficiency measures implemented at AGP are presented in Appendix 2. Other SA companies do not conduct regular annual monitoring and assessment of the effect of the energy efficiency measures implemented.

The summary list of planned energy efficiency measures broken down by subsidiaries and associated companies, with an assessment of the technical potential for energy savings and estimated reductions in GHG emissions, is presented in Appendix 3.

2.4 Assessment of carbon footprint and carbon intensity of products

As part of the Low Carbon Development Program, two key indicators were used to assess the carbon intensity of QazaqGaz's production activities: tCO_2-eq/TJ and tCO_2-eq/billion $m^3 \cdot km$. The indicators were selected taking into account the specific nature of the Company’s activities — gas production and transmission. The tCO_2 eq/TJ indicator is applied to all five subsidiaries and reflects the intensity of direct greenhouse gas emissions in relation to fuel and energy resources consumed. The tCO_2-eq/billion $m^3 \cdot km$ indicator is calculated for four transport subsidiaries (ICA, BSGP, AGP, QGA) and reflects the carbon intensity of transport operations. The calculations are based on industry recommendations from IPIECA/API/IOGP and OGMP 2.0, where these indicators are recognized as relevant for assessing the energy efficiency and carbon footprint of gas products within the Company's operational responsibility.

For the production stage, carbon intensity is calculated as the ratio of GHG emissions to the volume of produced gas. For the transportation stage, as the ratio of the total emissions of subsidiaries and affiliates providing gas transportation to the volume and distance of transportation.

Table 2. Dynamics of carbon intensity index of gas distribution processes (for QGA) and transportation (for ICA, AGP and BSGP) for 2021-2024, tCO2-eq./billion m3*km (direct emissions)

SA name	2021	2022	2023	2024
QazaqGaz Aimaq	2,49	2,51	2,49	2,49
Asian Gas Pipeline	28,44	28,40	28,07	29,67
Intergas Central Asia	0,78	0,88	0,92	0,84
Beineu-Shymkent Gas Pipeline	22,08	28,01	31,63	32,57

When applying this carbon intensity indicator (tCO2-eq/billion m3*km), it can be noted that carbon intensity for AGP, ICA, and BSGP increased by 4.32%, 7.69%, and 47.51%, respectively. At the same time, the carbon intensity of the gas distribution process for QazaqGaz Aimaq for the period 2021-2024 remains approximately at the same level of 2.49 tCO2-eq/billion m3*km. In some cases, the increase in this indicator is due to the nonlinear relationship between the volumes of gas transported and the level of energy consumption for key production processes, the volumes of volatile emissions, and technical limitations in the operation of main gas pipelines.

Table 3. Dynamics of the carbon intensity indicator for processes in 2021-2024, tCO2-eq/TJ (direct emissions)

Affiliates	2021	2022	2023	2024
Exploration and Production QazaqGaz	0,507	0,508	0,441	0,484
QazaqGaz Aimaq	3,101	3,266	3,307	3,834
Asian Gas Pipeline	0,069	0,069	0,073	0,069
Intergas Central Asia	0,055	0,088	0,080	0,084
Beineu-Shymkent gas pipeline	0,068	0,064	0,065	0,065
Total	***0,071***	***0,082***	***0,082***	***0,082***

After analyzing the carbon intensity indicators of production processes, where the ratio of tCO2-eq/TJ is used as an indicator, the following can be noted:

1) In terms of gas distribution for QazaqGaz Aimaq, the carbon intensity of processes increased by 23.6% compared to 2021;
2) For AGP, the carbon intensity of gas transportation for the period 2021-2024 remained at the same level;
3) The carbon intensity of the gas transportation process at ICA has increased significantly compared to 2021 - by 54%;
4) For BSGP, the carbon intensity of the gas transportation process decreased by 4.3%;
5) In terms of production (EP), a 4.5% reduction in the carbon intensity of the process was recorded between 2021 and 2024. This trend is due to a number of factors, including fluctuations in production volumes and a decline in the energy efficiency of equipment at certain sites.

Overall, for the QazaqGaz group of companies, carbon intensity increased by 15.4% between 2021 and 2024. The carbon intensity of key production processes is significantly influenced by the operating modes of the main production equipment and their operating load, as well as technological losses, leaks, and gas venting during operation.

The carbon intensity values obtained are key indicators for setting emission reduction targets and identifying priority areas for decarbonization. They enable the establishment of reasonable targets, the assessment of the effectiveness of measures implemented, and the adjustment of strategic approaches to take into account changes in production capacity utilization and the technical condition of equipment.

3. Measures to reduce GHG emissions

In the Development Strategy of JSC NC QazaqGaz until 2032, an important goal in the field of energy efficiency, decarbonization, and combating climate change at the national level and the Samruk-Kazyna Fund is to reduce the carbon footprint. Therefore, QazaqGaz has set itself the goal of reducing greenhouse gas emissions (Scope 1 and Scope 2) by 10-12% by 2032 from 2021 levels, in accordance with the Strategy for Achieving Carbon Neutrality in the Republic of Kazakhstan by 2060, as well as the Concept of Low-Carbon Development of Samruk-Kazyna JSC.

Since the Low Carbon Development Program of QazaqGaz JSC until 2033 is based, among other things, on the Development Strategy of QazaqGaz JSC QazaqGaz JSC until 2032, as well as on the Samruk-Kazyna Low Carbon Development Concept, the quantitative parameters for reducing GHG emissions for QazaqGaz JSC correspond to each other. As part of the QazaqGaz Low-Carbon Development Program, the targets have been set to reduce GHG emissions by 10% by 2033 compared to the base year of 2021. Specific GHG emission indicators (a ratio of direct GHG emissions in tCO2-eq to the volume of fuel and energy resources consumption in GJ) are used as target indicators, since GHG emissions will increase in line with the projected growth in energy consumption and production indicators. In this regard, it will be extremely difficult for the company to achieve a reduction in direct emissions amid growing energy consumption, and specific GHG emissions will correlate with the growth in energy consumption, so it will only be possible to achieve a reduction in the context of the projected growth in production indicators. To achieve QazaqGaz's greenhouse gas emission reduction targets, a combination of technical, organizational, and auxiliary (compensatory) measures must be implemented. Details of these measures and the technical potential for improving energy efficiency are provided below.

3.1 Technical measures

Based on an analysis of best international practices in the gas industry, as well as the provisions of the Climate Risk Management Program, Samruk-Kazyna's Low Carbon Development Concept, and the Development Strategy until 2032, QazaqGaz has identified a number of priority technical measures to reduce greenhouse gas emissions. These measures are aimed at improving energy efficiency, optimizing energy consumption, and reducing gas losses during the operation of key technological equipment, especially during transportation.

Based on the analysis of GHG emissions, technical measures were aimed at reducing emissions in subsidiaries and affiliates that contribute most to the total GHG emissions of QazaqGaz JSC. The main efforts are focused on reducing emissions associated with the natural gas transmission and distribution segment. The implementation of these measures will enable the Company to reduce GHG emissions and support socially oriented reforms, including gas price regulation with a focus on protecting vulnerable segments of the population. The technical potential for reducing emissions was determined based on a quantitative assessment using the following criteria:

- volume of initial emissions and energy resources prior to the implementation of the measure;
- type of energy source (natural gas, electricity, thermal energy) and emission category (Scope 1, Scope 2);
- level of technological maturity and scalability of the solution;
- expected effect in tCO_2 eq. upon implementation of the measure.

The assessment was carried out for each area: electrification, equipment modernization, introduction of renewable energy sources, process automation, reduction of gas leaks and venting. This

area includes the largest number of initiatives (18) within the Low-Carbon Development Program, as it has high potential for reducing GHG emissions and improving operational efficiency through technological modernization.

3.1.1 Energy saving potential

The list of energy saving measures with an assessment of the technical potential for reducing fuel and energy consumption, indicating the category of greenhouse gas emissions (Scope 1 and Scope 2), as well as applicability according to the subsidiaries and affiliates is presented in Table 4. The largest number of measures are aimed at reducing natural gas consumption in the technological processes of the ICA and AGP. The initiatives with the greatest effect in reducing GHG emissions include: major repairs and modernization of GPU equipment, the introduction of renewable energy sources, replacing electricity with solar panels, using mobile compressor stations and washing compressor units.

Table 4. List of energy saving measures with assessment of potential to reduce fuel consumption

No.	Measures	Name of the energy resource being reduced and unit of measures	Reduction engineering potential	GHG emissions category	SA
1	Major repairs of 19 GGS plants at compressor stations	natural gas, thousand m^3	571	Scope 1	AGP
2	Replacement of power supply system for crane units with solar panels (renewable energy sources)	natural gas, thousand m^3	65	Scope 1	AGP
3	Optimization of the use of electricity generated by GPPP at CS-6	natural gas, thousand m^3	642	Scope 1	AGP
4	Using low-emission fuel combustion technology in combustion chambers of the gas generator of the fuel system of gas pumping units (DLE chamber)	natural gas, thousand m^3	35 680	Scope 1	AGP
5	Use of dry gas seal system on centrifugal compressors	natural gas, thousand m^3	387	Scope 1	AGP
6	Maintaining the main equipment in good condition	natural gas, thousand m^3	295	Scope 1	AGP
7	Installation of active harmonic filters for frequency converter GPA No. 1 of Turkestan CS	electric power, kWh	233 600	Scope 1	BSGP
8	Optimization of equipment operating modes. Determination of the optimal operating mode of the gas pumping unit while maintaining the gas transportation mode.	natural gas, thousand m^3	13 727	Scope 1	BSGP
9	Adjustment works of existing reactive power compensation devices (RPCD) at Aral CS, Korkyt Ata CS, Turkestan CS	electric power, kWh	2 942	Scope 1	BSGP
10	Increasing the share of RES in the structure of own electricity generation, to reduce the volume of purchased electricity from traditional generation	electric power, kWh	473 250	Scope 2	QGA
11	Using a compressor flow part flushing system	natural gas, thousand m^3	2 226	Scope 1	ICA
12	Using mobile compressor stations (MCS) to conserve natural gas during repairs on a single gas supply system	natural gas, thousand m^3	46 189	Scope 1	ICA

13	Improving the energy efficiency of a gas pumping unit during major repairs of a gas turbine engine	natural gas, thousand m^3	3 584	Scope 1	ICA
11	Replacing existing lamps with energy-efficient LED analogs	electric power, kWh	170 360	Scope 2	ICA
12	Replacing inefficient cathodic protection stations with new generation stations	electric power, kWh	762 600	Scope 2	ICA
13	Replacement of outdated domestic and drinking water supply pump units with energy-efficient automatic twin-pump stations with horizontal pumps	electric power, kWh	39 400	Scope 2	ICA
17	Modernization of the power supply system using renewable energy sources of autonomous hybrid power plant AGEU	electric power, kWh	172 800	Scope 2	ICA
18	Replacement of shut-off valves with diameters ranging from Ø800 mm to Ø1440 mm	natural gas, thousand m^3	4 840,04	Scope 1	ICA
19	Modernization of the existing power supply system at four crane nodes on the linear section of BBS MGP taking into account the introduction of renewable energy sources	natural gas, thousand m^3	136,6	Scope 1	BSGP
20	Implementation of RES at railway crossings in the amount of 6 units	electric power, kWh	10 000	Scope 2	BSGP

Table 5. Assessment of reduction in energy consumption by SA companies as a result of the implementation of technical measures to improve energy efficiency

Affiliates	Total reduction in natural gas consumption, thousand m^3	Total reduction in electricity consumption, thousand kW*h	Total natural gas consumption in 2024, thousand^3	Total purchased electricity in 2024, thousand kW*h	Achievable percentage reduction in natural gas, %	Achievable percentage reduction in electricity consumption , %
QGA		473	2 889	3 154	0,00%	15,00%
BSGP	13 863,6	247	311 997	4 806	4,44%	5.14%
AGP	37 640		591 000	1 947	6,3%	0,00%
ICA	51 999	1 145	303 625	56 308	17,12%	2,03%

Based on an assessment of the total potential of implementing energy efficiency measures, the greatest effect is predicted in ICA affiliates subsidiary, where the level of natural gas reduction is estimated at 17.12%, due to the technical potential of the measures being implemented. A significant effect is predicted in AGP, where the percentage reduction in natural gas consumption will be approximately 6.3%. Particular attention should be paid to the measure to introduce renewable energy sources in QGA, which will allow up to 15% of imported electricity to be replaced by own generation. This measure, planned for implementation by 2033, reflects the potential for reducing indirect Scope 2 GHG emissions.

Overall, a number of measures are having an impact not only on Scope 1 (reducing gas consumption), but also on Scope 2 - particularly in terms of electrification projects, modernization of cathodic protection stations (estimated reduction in electricity consumption of 762,600 kW*h), and the introduction of renewable energy sources.

To set energy efficiency targets for the future, it is necessary to take into account the projected growth in energy consumption, i.e., apply energy consumption reduction targets in accordance with the adjustment to comparable conditions.

The projected increase in electricity and natural gas consumption by subsidiaries and affiliated companies by 2033 is shown in Table 6.

Table 6. Forecast values for changes in electricity and natural gas consumption by 2033

Affiliates	Type of energy resource *	Unit of measure	2021 (basic)	2024	2033	Relative growth in energy consumption by 2033 compared to 2024, %	Reduction in FER from the implementation of energy saving measures, % %	Total difference in FER volumes change, %	Conversion to GJ for 2021	Conversion to GJ for 2024	Conversion to GJ for 2023
Intergas Central Asia	Purchased electricity	MW*h	74 381	56 308	70 612	25.40%	1.73%	23.67%	267 771	202 709	254 206
	Natural gas	thous.m^3	285 347	343 804	357 430	3.96%	15.12%	-11.16%	11134274	13415245	13 946 953
Asian Gas Pipeline	Purchased electricity	MW*h	1 135	1 947	1 947	0%	0%	0%	4 089	7 009.98	4 582
	Natural gas	thous.m^3	638 613	594 038	655 110	10.28%	0.22%	10.06%	24918703	23179368	25 562 392
Beineu-Shymkent Gas Pipeline	Purchased electricity	MW*h	1 322	4 806	6 044	25.75%	4.92%	20.83%	4 760	17 302	21 758
	Natural gas	thous.m^3	155 216	311 997	343 747	10.18%	4.4%	5.78%	6 056 543	12174141	12 174 141
QazaqGaz Aimaq	Purchased electricity	MW*h	1 400	3 154	3 154	0%	15%	-15%	5 040	11 354	11 354
	Natural gas	thous.m^3	2 888	3 086	3 243	5.10%	0	5.10%	112 713	120 418	112 713
Exploration and Production	Purchased electricity	MW*h	2 223	1 921	2 850	48.30%	0	48.3%	8 003	6 918	10 260
	Natural gas	thous.m^3	677.33	629.45	629.45	0.00%	0	0	26 429	24 561	24 561

As can be seen from Table 6, the real achievement of reducing fuel and energy complex consumption compared to 2024 from the implementation of energy efficiency measures will be achieved:

1) for the natural gas ICA by 11.16%;
2) for QGA on purchased electricity by 15%;

For the rest of the FER, energy consumption is expected to grow even with the implementation of energy efficiency measures:

1) For ICA, the growth in purchased electricity consumption was 23.67%;
2) For AGP, natural gas consumption grew by 10.06%:
3) For BSGP, natural gas consumption increased by 5.78% and purchased electricity consumption increased by 20.83%.

It is advisable to set energy efficiency targets for subsidiaries and affiliates, taking into account the final change in energy consumption, especially for those types of FER where energy consumption is expected to grow by 2033.

Most measures are planned to be implemented in the short term, while the introduction of renewable energy sources (by QGA) is planned for the longer term, until 2033. Operational repairs and optimization of technological equipment are planned to be carried out throughout the entire period of the Low-Carbon Development Program (until 2033). The cost of implementing technical measures to improve energy efficiency is specified in Section 5 (economic analysis) of this document.

3.2 Organizational measures

Organizational measures encompass a range of internal management and behavioral changes aimed at the rational use of energy resources and the reduction of greenhouse gas emissions. These include the implementation of energy management systems (e.g., ISO 50001), environmental management (ISO 14001), internal energy conservation policies, and motivating staff to follow resource-friendly practices. Such measures contribute to the optimization of equipment operating modes and the improvement of planning, monitoring, and coordination processes for reducing energy consumption.

The implementation of organizational initiatives involves staff training, systematic tracking of achievements, setting up accounting and control systems, as well as improving methodologies for quantifying results. The measures are aimed at creating a sustainable internal culture of resource conservation, in which each employee contributes to the Company's overall decarbonization goals.

Table 7 shows the priority organizational measure for implementing an energy conservation policy and motivating staff to implement energy-efficient approaches in the framework of production and administrative activities. The applicability of this measure covers key production subsidiaries and affiliates: ICA, QGA, AGP and BSGP. Despite the fact that the expected percentage of savings is relatively small in absolute terms, this area is considered highly efficient in terms of the possibility of implementation without high labor costs, as well as scalability to various and systemic impacts on the Company's energy consumption processes.

Table 7. Distribution of the potential for reducing natural gas and GHG emissions by subsidiaries and affiliates

No.	SA	Technical reduction potential, natural gas, thous. m^3	GHG emission reduction effect, tCO2-eq.
1	QazaqGaz Aimaq	7	14,09
2	Asian Gas Pipeline	1 418,36	2 704,25
3	Intergas Central Asia	728,73	1 514,13
4	Beineu-Shymkent Gas Pipeline	748,79	1 530,54

As part of the assessment of the technical potential of organizational measures, the expected savings were calculated based on an average effect of about 0.24% (based on an assessment of the potential of organizational measures for open sources) of the total annual energy consumption

Taking into account the fact that the main type of energy resource for QazaqGaz is natural gas, the total technical reduction potential in this area is estimated at 2,901 thousand m^3 (from the base consumption volume of 1 204 535 thousand m3 for subsidiaries and affiliates: ICA, AGP, BSGP, QGA and EP for 2024).

3.3 Mitigation measures

In addition to technical and organizational measures, QazaqGaz is considering the use of compensation instruments to achieve climate goals. Offsetting measures are aimed at reducing both direct (Scope 1) and indirect (Scope 2) greenhouse gas emissions through the implementation or support of external climate projects that are not included in the Company's operational perimeter. Such measures include, in particular, the purchase of carbon offsets, I-REC certificates, and participation in international climate initiatives. For example, purchasing I-REC allows to confirm that the electricity you purchase is produced from renewable sources, thereby offsetting indirect GHG emissions from the electricity you purchase. (in QazaqGaz group of companies, approximately 97% of Scope 2 GHG emissions come from imported electricity). In 2024, Scope 2 GHG emissions amounted to 51 653 tCO_2eq, which represents 1.3% of the Company's Scope 1 and Scope 2 emissions, and taking into account the calculated emissions from Scope 3 categories, Scope 2 GHG emissions accounted for only 1.06%. I-REC certificates can be purchased centrally through QazaqGaz and distributed among subsidiaries to achieve the set targets for reducing Scope 2 GHG emissions.

In the long term, the main effect of reducing Scope 1 emissions under the Low-Carbon Development Program may be achieved through the purchase of verified carbon units (offsets) issued under international and national climate projects, which may include projects on renewable energy, energy efficiency, ecosystem restoration, and methane utilization. However, in order to expand the possibilities for using offsets in Kazakhstan, it is necessary to refine the regulatory framework: introduce mechanisms for recognizing and accounting for verified climate projects, including foreign ones, and develop a national market for GHG emissions trading.

Table 8 lists the compensation measures proposed for implementation under the Low-Carbon Development Program. These include both measures with proven reduction potential (e.g., purchase of I-REC) and pilot initiatives (e.g., implementation of the MIST system and participation in international alliances). OGMP 2.0 and the MIST tool have been included in the compensation measures because they create a standardized and verifiable database on methane leaks, which is necessary for the correct calculation of offsets. Even without current accurate figures, their application improves operational reliability and lays the foundation for subsequent verification of reductions.

The purchase of carbon credits and I-REC certificates can be carried out centrally through QazaqGaz and then distributed among subsidiaries depending on the required GHG emission reduction values for Scope 1 and 2 categories, taking into account existing environmental regulations.

The main purpose of compensation measures is to reduce residual GHG emissions after the implementation of technical and organizational measures in order to achieve the established GHG emission reduction targets by 2033 (end of the Low-Carbon Development Program period).

Table 8. Mitigation measures to GHG emission reduction

No.	Measures	GHG emissions category	Potential reduction in GHG emissions from the implementation of measures, tCO2-eq.	Implementation
1	Launch of the Green Office project for administrative buildings of subsidiaries and affiliated companies	Scope 2		QGA, EP
2	Purchase of I-REC certificates to reduce indirect Scope 2 emissions	Scope 2		Procurement through QazaqGaz and distribution among subsidiaries to achieve GHG emission reduction targets
3	Formation of a portfolio of offset projects (climate, RES)	Scope 1, 2		
4	MIST implementation - Methane Intensity Screening Tool**	Scope 1		ICA
5	Joining the initiative Oil and Gas Methane Partnership (OGMP) 2.0	Scope 1		ICA

** The potential for reducing GHG emissions for a number of compensation measures has not been calculated due to the insufficient maturity of practices, as well as the lack of clear methods for calculating the achievement of GHG emission reduction effects and the planned degree of implementation by subsidiaries and affiliated companies.*

*** MIST is designed for systematic inventorying of methane emission sources in the oil and gas industry and identifying priority measures for their reduction. The tool covers more than 28 categories of methane sources. MIST does not eliminate leaks directly, but provides companies with a clear action plan. Practice shows that when MIST is fully implemented and the identified measures are carried out, companies achieve a significant reduction in emissions of tens of percent. For example, OGCI members have reduced methane emissions by 50% since 2017, and ExxonMobil by more than 60% since 2016. The tool is being actively implemented by international and national oil and gas companies, including EP Petroecuador, Midland Oil (Iraq), KazMunayGas, and Uzbekneftegaz, and is supported by the UN's OGMP 2.0 program.*

3.4 Additional measures

Additional measures to reduce GHG emissions include the use of an LDAR system, which allows monitoring of natural gas leaks in the engineering gas infrastructure system. In the case of Asian Gas Pipeline LLP, the LDAR system is installed at several production facilities and can potentially be scaled up to other AGP production facilities to enable more comprehensive leak control.

For Beineu-Shymkent Gas Pipeline LLP: LDAR emission control methods are implemented by the operator under a contract for gas pipeline infrastructure operation services. In the future, it may be possible to increase the level of automation and improve leak control methods as LDAR technical control and monitoring methods themselves are improved and developed.

4. Scenario modeling

4.1 Modeling forecasts for the development of Kazakhstan's economy and fuel and energy complex

In order to develop realistic low-carbon development scenarios within the framework of the Program, an assessment was conducted of the projected macroeconomic and energy parameters that determine the potential dynamics of greenhouse gas emissions. The analysis was based on official data and scenario projections developed by national and international organizations.

The analysis includes the following sources:

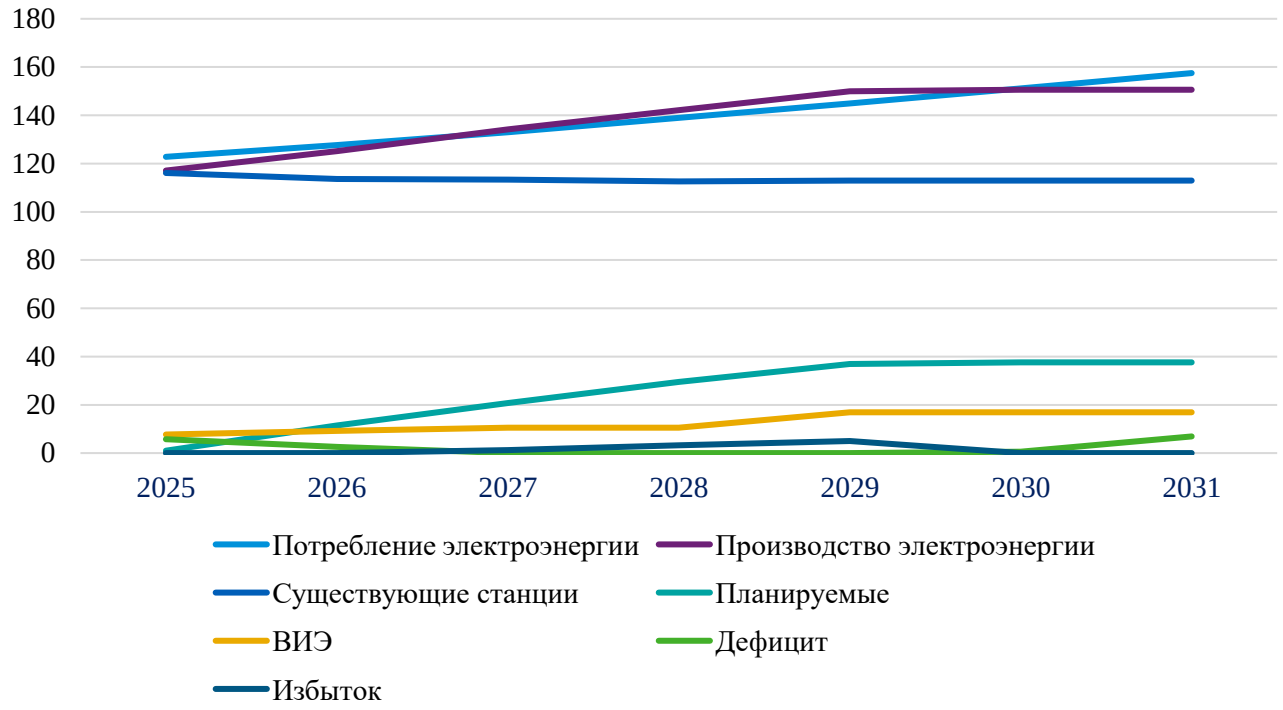
- Ministry of National Economy of the Republic of Kazakhstan – macroeconomic guidelines and GDP dynamics;
- Ministry of Energy of the Republic of Kazakhstan – fuel and energy balance forecast;
- Kazakhstan's carbon neutrality strategy until 2060;
- IEA - Stated Policies Scenario and Net Zero Scenario;
- Kazakhstan's National Energy Report (KAZENERGY, 2023).

According to the baseline scenario, Kazakhstan's GDP growth will average 3.7% per year until 2035. This implies a steady increase in demand for energy, especially in energy-intensive industries such as metallurgy, chemicals, construction, and transportation.

Forecast indicators show moderate growth in domestic gas consumption due to the development of gasification and the need to replace coal in the power sector. At the same time, there is still significant export potential for pipeline deliveries to CIS countries and China. In the Stated Policies scenario (IEA), Kazakh gas exports will stabilize at 17-20 billion m³ per year, provided that the infrastructure is modernized. At the same time, a structural transition is expected in Kazakhstan's energy system:

- share of coal in power generation will decrease from 69% in 2020 to 50% in 2035.
- share of gas will increase from 20% to 27%.
- share of renewable energy sources will increase from 3% to 15% (according to Kazakhstan's Carbon Neutrality Strategy).

Diagram 12. Forecast by the Ministry of Energy of the Republic of Kazakhstan on projected electricity balances for the period 2025-2031, in billion kW*h



According to forecasts, electricity shortages are expected in 2025-2026 and 2030-2031. At the same time, the share of renewable energy sources in the electricity generation structure is projected to grow. Based on calculations of the volume of electricity generated by RES, the share of RES in the overall electricity generation balance is determined, as shown in Table 9.

Table 9. Forecast for increase in RES share in Kazakhstan's energy structure until 2031, billion kW*h

Indicators	2025	2026	2027	2028	2029	2030	2031
Electricity generation	117,1	125,2	134,2	142,1	149,9	150,6	150,6
Share of RES in Kazakhstan's energy mix, %	6,58	7,35	7,82	7,39	11,27	11,22	11,22
Electricity generation by RES	7,7	9,2	10,5	10,5	16,9	16,9	16,9

By 2029, it is expected that the share of renewable energy sources in the structure of electricity generation will amount to 11.22% and will remain at this level until 2031. Only two subsidiaries and affiliates have their own renewable energy generation - the Asian Gas Pipeline (96 kW*h of electricity, or 4.93% of the volume of purchased electricity in 2024) and Intergas Central Asia (31 kW*h of electricity, or 0.06% of the volume of purchased electricity in 2024), as of early 2025, these volumes insignificant.

According to QazaqGaz, the implementation of decarbonization measures in the fuel and energy sector should take into account not only technological capabilities, but also the nature of macroeconomic

growth. Improving energy efficiency, reducing gas losses, and optimizing traffic flows should be key priorities in any development scenario.

The forecast parameters of macroeconomics and FEC are used in the following sections in the formation of GHG emission scenarios (basic, green development and deep decarbonization scenarios).

4.2 Options of carbon regulation

The Carbon Emissions Trading System (CETS) is one of the tools that encourages companies to reduce their own GHG emissions among companies operating in Kazakhstan, which contributes to the achievement of national carbon neutrality goals. The price per ton of carbon is the cost applied to greenhouse gas pollution (including CO2) to encourage companies that emit GHG emissions into the atmosphere to reduce their GHG emissions.

The CETS first pilot phase was launched in 2013 (when the National Plan of Allocation of Greenhouse Gas Emissions Quotas for 2013 was approved), the second stage began in 2014-2015 (GHG emission quotas for 2014-2025 were established). In 2014, the quotas were first sold on the stock exchange. In 2015, the 3rd National Plan for the allocation of Greenhouse Gas Emissions Quotas was developed, but in 2016 the system had to be suspended for improvements, especially in terms of quota allocation. After making comprehensive amendments, the third CETS trading period was launched on January 1, 2018.

Kazakhstan's CETS covers the oil and gas industry, the energy sector, mining, metallurgy, chemical industry, as well as the manufacturing industry related to the production of building materials such as cement, lime, gypsum and brick. The amount of 20,000 tons of carbon dioxide emissions per year is used as a threshold value, according to which quota installations (sources of GHG emissions) are included in the National Plan of Allocation of Greenhouse Gas Emissions Quotas. To date, the CETS quotas only carbon dioxide emissions.

Taking into account the analysis from Zhasyl Damu (Green Development), information on the volume of carbon quotas for 2023 is presented in table 10.

Table 10. Information on all regulated economy sectors per 2023

Regulated sector of economy	Carbon quota volume for 2023	Postponement of carbon quotas from 2022	Total CO2 emissions by installations in 2023	Balance of carbon quotas and emissions	Withdrawal	Redistribution	Additional quotas	Trades	
								Sales	Purchase
Electric power industry	93 872 612	1 380 629	93 312 975	1 940 266	5 952 205	615 759	5 735 785	1 039 482	2 305363
Oil and gas industry	22 692 972	2 445 395	20 619 287	4 519 080	1 475 018	119 655	1 471 079	134 074	187 466
Mining industry	7 224 011	462 718	3 051 153	4 635 576	91 007	66 402	70 483	1 308 670	229 347
Metallurgical industry	30 285 148	463 958	24 242 843	6 506 263	4 868 812	72 227	259 790	275 883	82 287
Chemical industry	1 689 335	122 194	1 444 152	367 377	275 537	36 167	20 740	0	42 006
Manufacturing industry	7 899 302	511 307	7 141 135	1 269 474	594 797	0	541 519	48 897	45 626

Data on total GHG emissions and total quota values per 2023 are presented in table 11.

Table 11. Data on all regulated economy sectors per 2023

Economy sector	Total quota including transfer, redistribution, withdrawal, and additional quotas, purchases/sales	Actual emissions per 2023	Final difference
Electric power industry	96 070 359	93 312 975	2 757 384
Oil and gas industry	25 146 724	20 619 287	4 527 437
Mining industry	6 810 947	3 051 153	3 759 794
Metallurgical industry	25 946 488	24 242 843	1 703 645
Chemical industry	1 671 072	1 444 152	226 920
Manufacturing industry	8 357 551	7 141 135	1 216 416
Total	**164 003 141**	**149 811 545**	**14 191 596**

As shown in table 11, in 2023, CO2 emission quotas exceeded the values of actual GHG emissions by 14 191 596 tons of CO2. The data for 2022 are shown in tables 12-13.

Table 12. Data on all regulated economy sectors per 2022

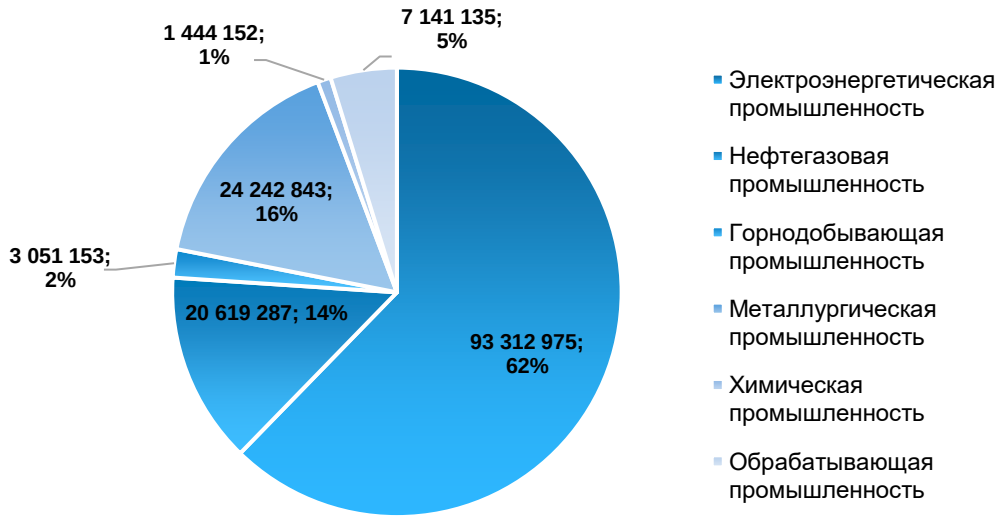
Regulated sector of economy	Carbon quota volume for 2022	Total CO2 emissions by installations in 2022	Balance of carbon quotas and emissions	Withdrawal	Redistribution	Additional quotas	Trades	
							Sales	Purchase
Electric power industry	95 304 595	94 999 190	305 405	5 682 888	584 014	6 299 292	1 476 927	2 846 166
Oil and gas industry	23 039 146	19 546 927	3 492 219	1 412 463	109 770	1 559 993	370 454	414 769
Mining industry	7 334 212	3 185 394	4 148 818	303 765	194 965	148 650	1 144 895	4 539
Metallurgical industry	30 747 135	26 018 847	4 728 288	3 819 274	481 122	15 554	5 195	40 264
Chemical industry	1 715 105	1 573 950	141 155	94 974	174 844	27 132	0	49 510
Manufacturing industry	8 019 802	7 542 324	477 478	235 598	24 872	614 575	49 093	80 829

Table 13. Data on all regulated economy sectors per 2022

Regulated sector of economy	Total quota including withdrawal, additional quotas, purchases/sales Общая квота с учетом изъятия, доп. квот, покупки/продажи	Actual emissions for 2022	Final difference
Electric power industry	97 290 183	94 999 190	2 290 993
Oil and gas industry	23 230 991	19 546 927	3 684 064
Mining industry	6 038 741	3 185 394	2 853 347
Metallurgical industry	26 978 484	26 018 847	959 637
Chemical industry	1 696 773	1 573 950	122 823
Manufacturing industry	8 430 515	7 542 324	888 191
Total	**163 665 687**	**152 866 632**	**10 799 055**

According to the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[10] total GHG emissions in 2022 amounted to 352.97 million tons of CO2-eq., that is, emission quotas for 2022 covered only 46.3% of total national GHG emissions

Diagram 13. Distribution of GHG emissions by sectors of the economy of the Republic of Kazakhstan per 2023, in tCO2-eq.



For the CETS functioning, a register of carbon units and the State Carbon Cadastre are maintained, in which up-to-date information on quota subjects is entered annually (in 2024, 227 GHG emission reports were submitted by quota subjects) information on the quoted GHG emissions. In 2024, the average price per ton of carbon was 474 tenge per ton of carbon (1.02 USD at the average exchange rate per 2024). This price is one of the lowest carbon prices in the world[11].

Table 14. Data on the cost of carbon per ton in the world in 2024

Countries	Average price per ton of carbon, USD	Price range per ton of carbon to meet the requirements of the Paris Agreements, USD	Cost per ton of carbon by country worldwide, USD
Uruguay	32	40-80	167
Switzerland			132
Sweden			127
Norveria			108
Netherlands			71

[10] Environmental monitoring and assessment indicators - Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan
[11] The Price of Carbon Around the World in 2024

European Emissions Trading system	61
Kazakhstan	1
Ukraine	1
Indonesia	1

To calculate the carbon quota for 2026-2030 in Kazakhstan, data from GHG emission inventory reports of quota entities per 2023-2024 will be used (average value in 2023-2024).

Main findings

It is planned to introduce amendments to the Environmental Code of the Republic of Kazakhstan, which will regulate the procedure for implementing projects in Kazakhstan under Article 6 of the Paris Agreement, which speaks of cooperation between countries in achieving their climate goals. Amendments to the detailed regulation of the circulation of carbon offsets in the Republic of Kazakhstan.

According to preliminary estimates, carbon quotas will be reduced by at least 2.26% [12] starting in 2026. Considering that in 2023 the volume of quotas for the oil and gas industry exceeded actual GHG emissions by 9.14% (data in Table 14), the reduction will not cause a shortage of GHG emission quotas in the near future, since in order to stimulate oil and gas companies of the Republic of Kazakhstan to reduce their GHG emissions, the reduction in quotas should be at least 10%.

4.3 Analysis of the impact of rising electricity prices on QazaqGaz operating activities

According to the data of QazaqGaz subsidiaries and affiliates for 2024, the volumes of purchased electricity amounted to 63,451 thousand kWh and the corresponding costs amounted to 2 139 848 thousand tenge. The information by subsidiaries and affiliates is presented in Table 15.

Table 15. Amount of electricity purchased in 2024 and costs

No.	Affiliates	Volumes of purchased electricity in 2024	Unit of measure	Electricity costs in 2024	Unit of measure
1	Asian Gas Pipeline	1 947 216	kW*h	46 710 310	tenge
2	Beineu-Shymkent Gas Pipeline	4 805 648	kW*h	136 467 730	tenge
3	Intergas Central Asia	51 600 339	kW*h	1 779 647 800	tenge
4	QazaqGaz Aimaq	3 176 999	kW*h	109 740 800	tenge
5	Exploration and Production	1 921 790	kW*h	67 281 352	tenge
	Total:	**63 451 992**		**2 139 847 992**	

According to open source data[13] at the end of 2024, share of renewable energy sources in the overall structure of electricity generation in the Republic of Kazakhstan amounted to 6.47% (and 5.92% at the end of 2023). More detailed information on the installed capacity of renewable energy facilities by type is presented in Table 16.

[12] Information of Zhasyl Damu JSC

[13] https://qazaggreen.com/news/kazakhstan/2513/
https://www.gov.kz/memleket/entities/energo/press/news/details/736134?lang=ru
https://www.gov.kz/memleket/entities/energo/activities/215?lang=ru
https://ekaraganda.kz/?mod=news_read&id=149212

Table 16. Installed capacities of RES in Kazakhstan at the end of 2024

Item	Installed capacity, MW	Share of this type of RES in energy structure
Wind power plants	1 520,05	50,13%
Solar power plants	1 222,61	40,32%
Hydroelectric power stations	287,68	9,49%
Biofuel power plants	1,77	0,06%
Total installed capacity of RES facilities:	**3 032,11**	**100%**

Based on the order[14] of the Ministry of Energy of Kazakhstan "On approval of fixed tariffs", which entered into force in mid-December 2024, the following tariffs for renewable energy are approved:

Table 17. Electricity rates by RES types, tenge per kW*h

Item	Rate amount for RES, tenge per kW*h
Wind power plants	34,61
Solar power plants	22,68
Hydroelectric power stations	41,23
Biofuel power plants	32,23

Taking into account the shares of various types of renewable energy sources in the installed renewable energy capacity as of the end of 2024, the average tariff for renewable energy sources as of the end of 2024 is 29.26 tenge per kW*h.

At the same time, according to the information provided by QazaqGaz for 2024 on electricity rates in the regions of presence of subsidiaries and affiliates, the lowest rate was recorded at 22.27 tenge per kW*h in Kyzylorda region for Intergaz Central Asia, and the highest rate value and the highest rate value was 44.63 tenge per kW*h in Aktobe production branch of QazaqGaz Aimaq.

When calculating the average rate value, the volumes of expenses for purchased electricity in QazaqGaz subsidiaries and affiliates for 2024 were used, the shares of which exceed 1% in the total structure of electricity costs (in total, such costs account for 90.85% of the total costs for the purchase of electricity). Data on rates and shares of purchased electricity exceeding 1% in the structure of electricity costs for QazaqGaz are presented in Table 18.

[14] http://zan.gov.kz/client/#!/doc/203773/kaz

Table 18. Data on rates and volumes of purchased electricity in 2024

Affiliates	Regions	Parameters	Unit measure	Data per 2024	Value of share of costs for electricity paid for at this rate in the total cost structure of purchased electricity
Asian Gas Pipeline	Region 3	Volume of purchased electricity	kW*h	1 947 216,12	2,19%
		Cost of purchased electricity	Tenge	46 710 310,23	
		Value of rate	tenge per kW*h	29,37	
Beineu-Shymkent Gas Pipeline	Kyzylorda region	Volume of purchased electricity	kW*h	3 813 238,00	4,52%
		Cost of purchased electricity	Tenge	96 790 855,72	
		Value of rate	tenge per kW*h	*25,94*	
	Turkestan region	Volume of purchased electricity	kW*h	992 410,00	1,85%
		Cost of purchased electricity	Tenge	39 676 874,16	
		Value of rate	tenge per kW*h	39,83	
Intergas Central Asia	Atyrau region	Volume of purchased electricity	kW*h	9 145 017,00	14,25%
		Cost of purchased electricity	Tenge	304 963 366,85	
		Value of rate	tenge per kW*h	33,35	
	Mangystau region	Volume of purchased electricity	kW*h	7 494 759,00	11,15%
		Cost of purchased electricity	Tenge	238 634 142,34	
		Value of rate	tenge per kW*h	31,84	
	West Kazakhstan region	Volume of purchased electricity	kW*h	8 707 564,00	9,50%
		Cost of purchased electricity	Tenge	203 395 531,86	
		Value of rate	tenge per kW*h	23,36	
	Aktobe region	Volume of purchased electricity	kW*h	12 983 994,00	24,86%

		Cost of purchased electricity	Tenge	532 104 037,21	
		Value of rate	tenge per kW*h	40,98	
	Turkestan region	Volume of purchased electricity	kW*h	5 395 077,00	8,94%
		Cost of purchased electricity	Tenge	191 252 102,88	
		Value of rate	tenge per kW*h	35,45	
	Zhambyl region	Volume of purchased electricity	kW*h	5 124 461,54	10,44%
		Cost of purchased electricity	Tenge	223 365 231,36	
		Value of rate	tenge per kW*h	43,59	
Exploration and production	Zhambyl region, Amangeldy branch	Volume of purchased electricity	kW*h	1 921 790	3,14%
		Cost of purchased electricity	Tenge	67 281 352	
		Value of rate	tenge per kW*h	29,63	
*The average rate is 31.91 tenge per kW*h in the cost structure (for the main share of 90.85%).*					

The average electricity rate for 2024 is lower than the rates from wind farms, hydroelectric power plants and biogas power plants, but higher than from solar power plants. Based on the value of electricity tariffs in QazaqGaz subsidiaries and affiliates and data on renewable energy rates and their share in the structure of QazaqGaz's purchased energy, no significant increase in electricity charges is expected in the period up to 2031 due to the projected increase in the share of renewable energy in Kazakhstan's energy structure. With the development and scaling of renewable energy technologies, electricity tariffs are becoming more affordable and competitive compared to traditional electricity generation facilities.

According to a report by the International Renewable Energy Agency (IRENA)[15] of the 473 gigawatts (GW) of renewable energy facilities commissioned in the world in 2023, the costs of 81% (382 GW) of new renewable energy projects were lower than for alternative solutions based on fossil fuels. From 2010 to 2023, the cost of battery energy storage systems fell by 89%, which contributes to the integration of significant solar and wind energy generation capacities, helps to reduce the problems of load fluctuations in the grid during periods of changing consumer demand, since RES are dependent on weather conditions and for their effective operation in conditions of changing demand and electricity market offers require energy storage and storage systems. In 2023, the global weighted average cost of electricity generated by newly commissioned renewable energy projects decreased by most technologies: for solar photovoltaic (SPV) by 12%, for onshore wind energy by 3%, for offshore wind energy by 7%, for concentrated solar energy (CSE) by 4%, and for hydropower by 7%.

When analyzing electricity consumption in QazaqGaz subsidiaries and affiliates in 2023, the following can be noted: the total consumption of purchased energy amounted to 65 646 568 kW*h (which is 3.32% higher compared to the level of 2024), and the total cost of purchased electricity amounted to 1 794 034 183 tenge (which is 19.3% lower compared to from the level of 2024). From this, it can be concluded that the value of the average electricity tariff in 2024 increased by 24.3%. In 2022, the total electricity consumption was 64 735 863 kWh, which is 1.1% lower than in 2023, and the total cost of 1 579 887 753 tenge, is 13.55% lower than in 2023. The average annual rate in 2022 was 10.7% lower than in 2023. This means that the average annual increase in the tariff for purchased electricity for the period 2022-2024 increased by an average of 16.43% per year, despite the fact that the volume of purchased electricity changed slightly during this period (from 1.41% to 3.32%).

The increase in QazaqGaz's costs for paying for purchased electricity in the period 2021-2024 is mainly due to tariff increases, rather than changes in electricity consumption.

According to the modeling of the development of the electric power industry in Kazakhstan until 2035, performed by KEGOC and Energy System Research LLP based on the data[16] from KEGOC, and also taking into account the consideration of the Samruk-Kazyna Low-Carbon Development Concept. The maximum scenario is determined by the active development of agriculture, electric transport, information technology (data processing centers) and a significant increase in the specific norms of municipal consumption.

[15] Renewable power generation costs in 2023
[16] QazaqGreen | Kazakhstan News | Projected balance until 2035 - vision of development of the country's electric power industry

Diagram 142. Structural scheme of modeling scenarios for development of Kazakhstan's energy system until 2035

The following are the results of modeling the optimization problem of covering the demand for electricity and capacity of the UES of the Republic of Kazakhstan until 2035 with minimal system costs, as well as taking into account the boundary conditions for CO2 emissions, availability and cost of fuel, CAPEX and OPEX for various generating technologies, the topology of the energy system and reliability requirements. In terms of the size and structure of generating capacities in the Republic of Kazakhstan as a whole, an increase in installed capacity by 19.2 GW under the Green scenario and 17.6 GW under the Green with NPP scenario is expected by 2035.

Under the Green scenario, the main commissioning of electric generating facilities falls on gas sources (CCGT - 2,7 GW + TPP gas - 2,2 GW + GTU- 1,1 GW = 6,0 GW), wind farms (= 8.2 GW) and SPP (= 1.0 GW), as well as hydroelectric power plants (HPP - 0.4 GW + mHPP - 2.0 GW = 2.4GW).

According to the Green with NPP scenario, in comparison with the Green scenario, the commissioning of nuclear power plants in the period 2032-2035 (= 2.4 GW) leads to a decrease in inputs to CCGTs by 0.9 GW (= 1.8 GW) and to wind farms by 2.7 GW (= 5.5 GW). Inputs at hydraulic power plants are also decreasing by -0.35 GW (HPP - 0.05 GW + mHPP - 2.0GW = 2.1GW).

In terms of electricity generation at power plants of the Republic of Kazakhstan at the level of 2035:

• Under the Green scenario, the share of coal-fired power plants will decrease to 40%, gas-fired power plants will increase to 24%, hydroelectric power plants, including small hydroelectric power plants, will amount to 13%, and wind farms and SPP - 23%. The total expected gas consumption will be 7.5 billion m^3.

• According to the Green with NPP scenario, in comparison with the Green" scenario, the share of electricity generation at nuclear power plants will be 12%, at gas - 18%, at wind farms and SPP - 17%. At the same time, the total expected gas consumption will be 6 billion m^3.

CO2 emissions have been decreasing since 2028, reaching the unconditional targets under the Paris Agreement of 15% in 2030 and continuing to decrease. At the same time, at the level of 2035,

the share of emissions from coal-fired power plants is 90-91%, while gas-fired power plants account for only 9-10%.

By 2035, the ICUF at CCGT is increasing, and at GTU it is decreasing, which indicates the transition of GTU to work in the peak part of the load coverage schedule. At coal-fired TPPs and CCPs, the ICUF is also decreasing, due to the requirements for limiting CO2 emissions.

It should be noted that, in general, taking into account the planned optimization of the development of generation, the UES of Kazakhstan is self-balancing in terms of electricity. Without taking it into account, an increasing shortage of electricity and capacity is expected, which at the level of 2030-2035 may exceed 40/60 MW*h and 3/7 GW, respectively.

The main measures aimed at ensuring coverage of the projected demand for capacity and electricity in the UES of Kazakhstan include:

1. The balance of electricity for 2035 in the Northern and Western zones is formed with a deficit of 14.7 TW*h and 9.0 TW*h, respectively, in the Southern zone - with an excess of 22.4 TWh due to a decrease in the production of coal-fired TPP and CHP plants and an increase in production at nuclear power plants, gas-fired thermal power plants and renewable energy sources, which are increasingly developing in the Southern zone.
2. The capacity deficit in the Southern Zone is gradually decreasing from 2.0 GW in 2022, and in 2035 the balance becomes 0.2 GW excessive.
3. In the Northern Zone, the excess capacity is gradually decreasing, and starting in 2032, the balance becomes deficient to 0.8 GW in 2035.
4. In the Western Zone, an excess capacity of up to 1.8 GW is forecast for the entire period. To cover the projected deficits in the North-South association, it is necessary to merge with Western Kazakhstan.

In the short term, this is:

- Participation of Zhambyl SDPP in full-block mode;
- Organization of electricity imports;
- Introduction of financial responsibility to cover deviations between the projected and actual capacity of RES as one of the incentives for the installation of energy storage systems;
- The introduction of a balancing market in real mode and a return to the practice of tariffs differentiated by hours of the day for wholesale and retail consumers as the initial stage of the implementation of the demand management program (tariff increases during peak hours and decreases during peak hours, especially relevant for the Southern zone).

Medium-term measures include:

- Implementation of all planned reconstruction, expansion and modernization projects, including the commissioning of units at EGRES 1 (500 MW) and EGRES 2 (636 MW);
- Implementation of plans for the development of gas generation (Turkestan CCGT 1000 MW, Shymkent CCGT 450 MW, Kyzylorda CCGT 250 MW, Almaty CCGT 1-3);
- Implementation of plans for the development of hydropower;
- Development of RES projects and energy storage systems;
- Construction of nuclear power plants.

According to the analysis of possible tariff increases for the future[17], the price of electricity may increase for the period 2025-2030.

[17] Kazakhstan's energy sector: modernization will lead to a 7-fold increase in rates | Inbusiness.kz

The price of electricity from the tires of power plants through a single buyer represented by the Accounting and Financial center (AFC) under the Ministry of Energy, excluding electricity grid rates - Regional electric grid (REG) companies and KEGOC, capacity fees and sales, in the second half of 2024 fluctuates in the range of 19-21 tenge per kW*h, at the time of launch in the summer of 2023, it was fixed around 14 tenge per kWh, that is, in a year and a half it has grown by an average of 35-40%. It should be noted that the tariffs of KEGOC and regional electric grid companies (REG) have been increasing in parallel recently, which additionally inflated the final price of electricity.

The increase in the prices of a single buyer did not cause an improvement in efficiency for either electricity producers or energy savings for consumers, so electricity tariffs will continue to rise, since the "rate in exchange for investments" program announced in 2022 allows them to include additional refundable amounts in the tariff for upgrading their energy facilities and reducing the wear and tear of their assets, however, without there are no counter obligations to increase their efficiency. The total cost of electricity and capacity in the wholesale market, when implementing measures only for projects planned with a high degree of probability, may amount to 40-45 tenge per kW*h by 2029, subject to restrictions on further tariff growth in the daily single buyer market below the inflation rate. In the absence of such restrictions, the price can reach 50-60 tenge per kW*h. In the absence of a competitive marginal electricity market, the main driver of the increase in wholesale electricity prices will be an increase in the cost of capacity for investment projects, since the return on investment in these conditions is carried out exclusively through the payment of capacity.

Findings:

The average annual increase in electricity costs for QazaqGaz over the period 2022-2024 averaged 16.43%, while electricity costs in 2024 amounted to 2.140 billion tenge (Table 18). With an increase in the tariff to 60 tenge per kW*h in 2029, the estimated cost of purchased electricity for QazaqGaz will be about 3.81 billion tenge, and with the continuation of the trend of average annual growth in electricity costs for the period 2022-2024 for QazaqGaz by an average of 16.43%, it is possible to estimate the cost of imported electricity in 2029 in the amount of 4.57 billion tenge. These costs will need to be taken into account in future budget planning.

Large electricity consumers in the context of rapidly rising electricity tariffs need to invest more in improving energy efficiency, as well as introduce their own modern energy generation, including implementing RES projects, as the payback period for such projects will decrease with the development of technologies and lower costs of RES facilities and higher tariffs from traditional fossil fuel-powered power generation facilities.

4.4 GHG emission reduction assessment in modeling development scenarios

4.4.1 Basic scenario (business as usual)

The basic development scenario reflects the trajectory of the functioning of JSC NC QazaqGaz in conditions of maintaining current technological and operational parameters, without introducing additional climate initiatives or decarbonization measures. The approach is based on the Business as usual principle and takes into account the actual production capacity, the historical dynamics of carbon intensity and energy intensity, as well as existing industry and government policies without adjustments for decarbonization goals.

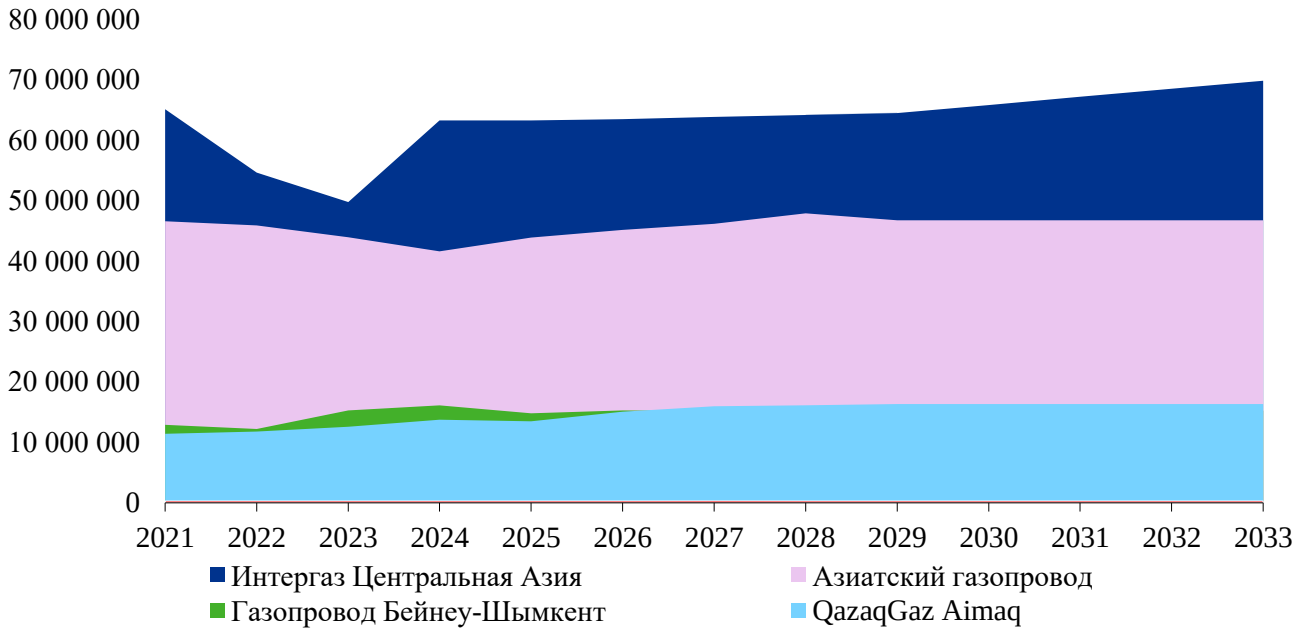
The basic scenario:

- no new investment projects aimed at reducing greenhouse gas emissions are expected to be implemented;
- current structure of energy consumption and the level of dependence on traditional energy sources are maintained;
- gas production, transportation, and processing volumes are growing in proportion to projected economic and industry trends;
- there are no initiatives to switch to alternative energy sources (for example, renewable energy sources) and large-scale modernization of equipment

QazaqGaz forecast production figures[18]

According to the forecast data, while maintaining current approaches to equipment operation and without modernization, GHG emissions by 2033 will show steady growth due to increased energy consumption, deterioration of infrastructure and expansion of operations. The chart shows the projected volumes of gas production and transportation, adjusted for the growth in fuel and energy consumption and the scale of operating activities.

Diagram 15. Forecast change in gas production and transportation volumes based on forecast data on changes in energy consumption, thousand m^3

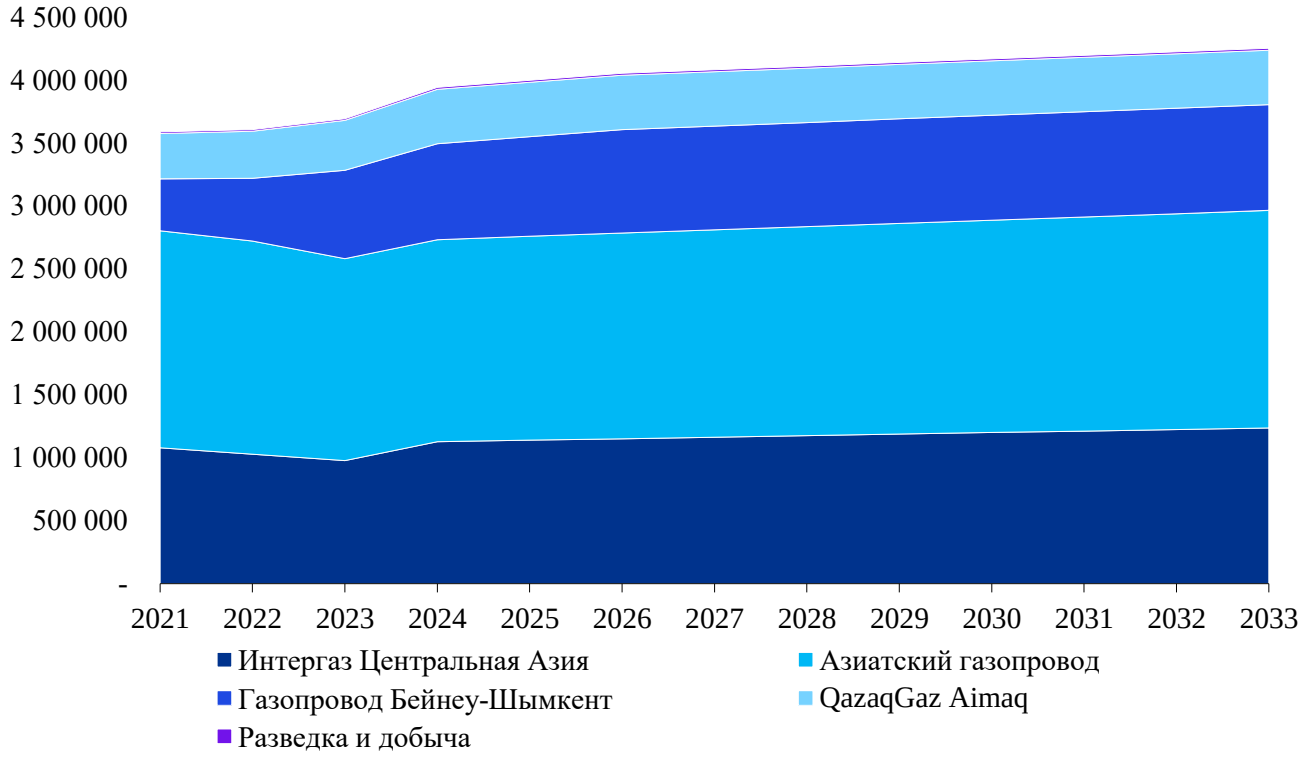


The analysis of the projected volumes of gas production and transportation until 2033 shows different dynamics of load growth among subsidiaries. The largest increase compared to the base year of 2021 is expected at QazaqGaz Aimaq, where volumes are increasing by 43%, due to plans to connect

[18] Forecast indicators can be adjusted to reflect updated data, changes in methodology, or the revealed correlation between energy consumption and GHG emissions.

new consumers to gas distribution networks and increase the length of gas distribution networks. The Beineu-Shymkent gas pipeline is growing by 18%; in 2026, it is planned to purchase the CS-1A Ustyurt compressor station from ICA in 2026. Intergas Central Asia has a growth rate of 7%, while the Asian Gas Pipeline and Exploration and Production remain stable with a slight increase of 0.4% and 8%, respectively.

Diagram 16. Forecast GHG emissions from Scope 1 based on the forecast growth in energy consumption, tCO2-eq.



The emissions forecast shows moderate growth due to the natural aging of equipment, increased energy consumption, and increased volume of operations. This scenario serves as a reference point for evaluating the effectiveness of alternative scenarios. Based on the analysis of the projected increase in FEC consumption, the expected increase in direct GHG emissions until 2033 is calculated. According to calculations:

• Expected increase in GHG emissions by 2033 compared to the base year of 2021 is 18,5%.

• Absolute projected value of direct GHG emissions (Scope 1) by 2033 is estimated at 4 253 thousand tCO2-eq. (increase in direct GHG emissions of 663.7 thousand tCO2-eq.)

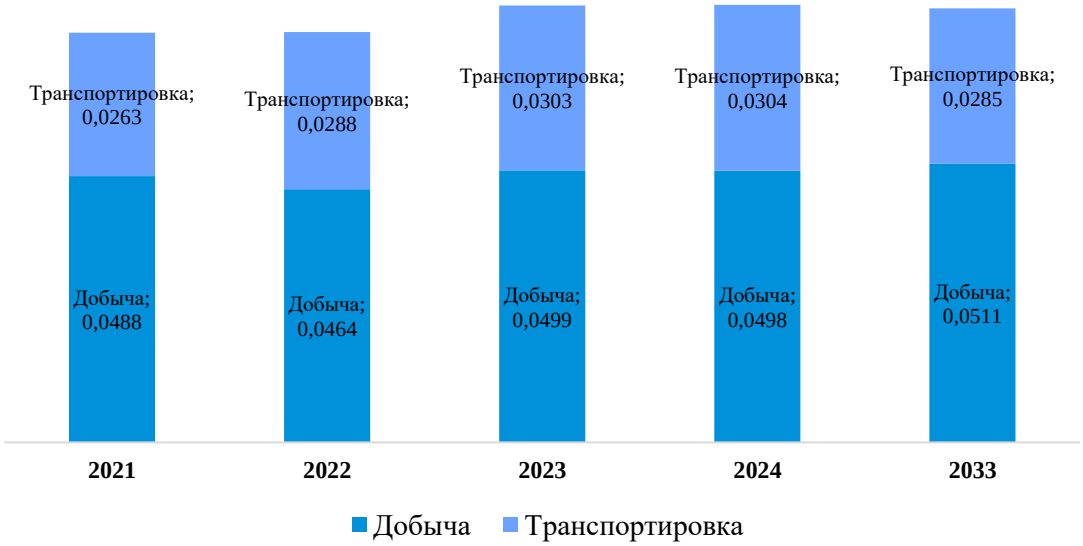
The forecast growth is due to both the expansion of the technical infrastructure and an increase in gas transportation volumes, which implies greater energy consumption by the main production equipment.

QazaqGaz forecast carbon footprint of QazaqGaz products

The carbon intensity of QazaqGaz products under the baseline scenario does not show significant improvement, remaining at a level comparable to current values. The carbon footprint values at the

production and transportation stages for the period 2021-2024 and the forecast for 2033 are presented below. There is moderate growth, especially in the transportation segment, due to an increase in the volume of transported gases. In 2033, the carbon footprint in the gas transportation segment is expected to grow by 8.4% compared to 2021 - from 0.263 to 0.285 tCO_2-eq./thousand m^3. The gas production segment is projected to increase by 5.9%, from 0.0488 to 0.0511 tCO_2-eq./thousand m^3.

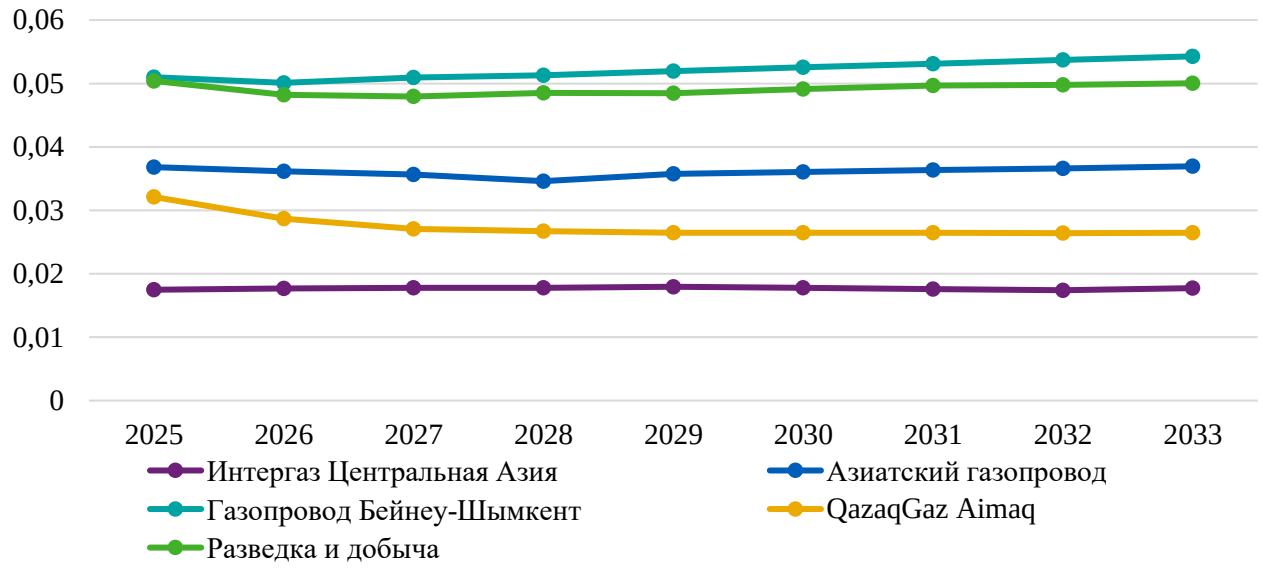
Diagram 17. QazaqGaz carbon intensity indicators of processes by business segment for period 2021-2024 and forecast figures for 2033, in tCO2-eq./thousand m³



The forecast values of carbon intensity of products for all key subsidiaries and affiliates for the period 2025-2033 are presented below. In different subsidiaries and affiliates, there are different dynamics of carbon intensity for the future period. According to calculations based on projected data on energy consumption and transportation of products:

- Intergas Central Asia: by 2033, specific emissions will amount to 0.01774 tCO_2-eq./thousand m^3, which is 4.4% higher compared to the level of 2021.
- Asian gas pipeline: a slight decrease in specific emissions is expected from 0.037 to 0.03694 tCO_2-eq./thousand m^3, which is equivalent to a reduction of 0.2%.
- Beineu-Shymkent gas pipeline: demonstrates significant growth - from 0.032 to 0.05427 tCO_2-eq./thousand m^3, which corresponds to an increase of 69.6%.
- QazaqGaz Aimaq: on the contrary, there is a decrease in specific emissions from 0.032 to 0.02647 tCO_2-eq./thousand m^3, which is -17.3%.
- Exploration and production: by 2033, the indicator will increase from 0.049 to 0.05005 tCO_2-eq./thousand m^3, which is an increase of 2.1%.

Diagram 18. Forecast values of the carbon footprint of products by subsidiaries and affiliates for the period 2025-2033, tCO2-eq./thousand m³



QazaqGaz Forecast specific indicators

As part of the assessment of the baseline scenario, the forecast of changes in the consumption of initial fuel and energy resources (fuel and energy complex) of natural gas, diesel fuel and gasoline at QazaqGaz subsidiaries and affiliates was also taken into account. The forecast is based on the expected pace of production activity, the scale of equipment operation, and the operational requirements for each subsidiary. The data is presented in gigajoules (GJ) for the period from 2021 to 2033. Based on the analysis:

• Beineu-Shymkent gas pipeline demonstrates the most significant projected increase in fuel and energy complex consumption, from 6.056 million GJ in 2021 to 13.413 million GJ in 2033 (+121.5%).

• Gas exploration and production the estimated increase in energy consumption will be 20.3% - increase from 26,853 to 32,292 thousand GJ.

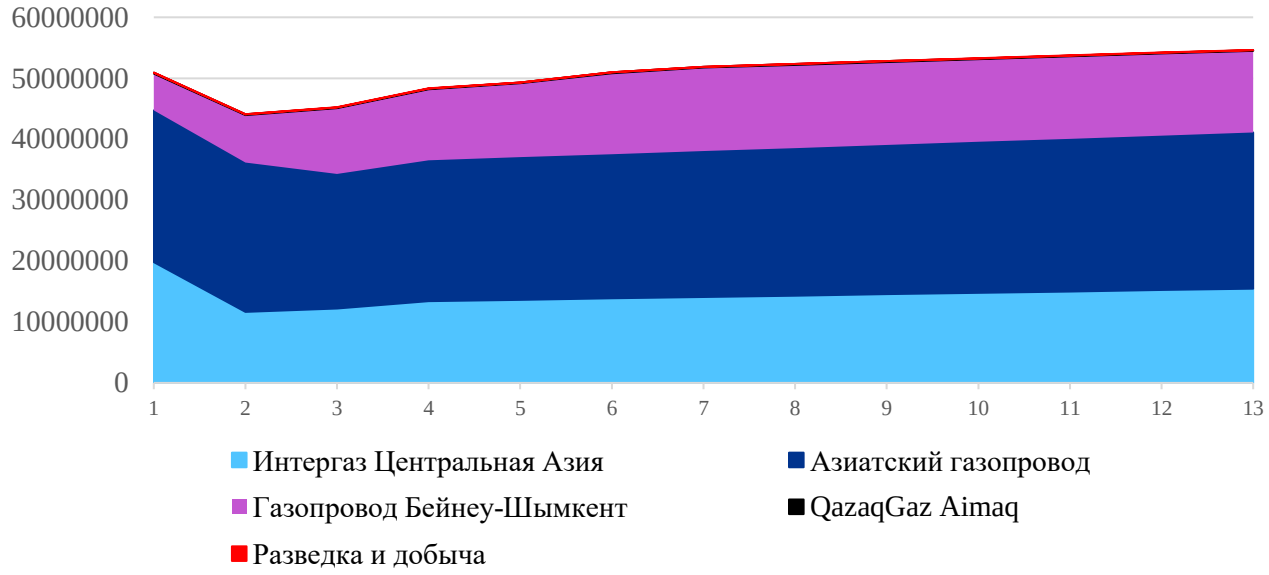
• Asian gas pipeline will increase energy consumption from 24.922 million to 25.612 million. GJ, which corresponds to an increase of 2.8%.

• QazaqGaz Aimaq also shows a moderate increase - by 2.4%, from 116,018 to 118,855 thousand. GJ.

• At the same time, Intergas Central Asia is the only organization that predicts a 21.9% decrease in fuel and energy consumption compared to the base year of 2021 (from 19.8 to 15.458 million GJ).

By 2033, combined fuel and energy consumption is projected to grow by 7.3% compared to the level of 2021.

Diagram 19. Projected change in consumption of raw fuel and energy sources (natural gas, diesel fuel and gasoline) per 2021-2033, GJ



The forecast values of specific greenhouse gas emissions per unit of fuel consumed by the fuel and energy complex for the subsidiaries of QazaqGaz are presented below. Compared to 2021:

- Intergas Central Asia demonstrates a 46.6% increase in specific emissions from 0.055 to 0.080 tCO_2-eq/GJ.
- Asian gas pipeline will reduce specific emissions by 2.4% from 0.069 to 0.067 tCO_2-eq./GJ.
- Beineu-Shymkent gas pipeline shows a decrease of 8.1% (from 0.068 to 0.063 tCO_2-eq/GJ).
- For QazaqGaz Aimaq, specific emissions are projected to increase by 17.3% from 3,101 to 3,639 tCO_2-eq./GJ.
- For Exploration and Production affiliates, it is projected to reduce specific GHG emissions by 8.4% by 2033, from 0.507 to 0.464 tCO_2-eq/GJ.

Table 19. Forecast indicators for specific emissions according to Scope 1 until 2033, tCO2-eq./GJ

Affilaites	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Intergas Central Asia	0.055	0.088	0.080	0.084	0.084	0.083	0.083	0.082	0.082	0.081	0.081	0.080	0.080
Asian Gas Pipeline	0.069	0.069	0.073	0.069	0.069	0.069	0.069	0.069	0.068	0.068	0.068	0.068	0.067
Beineu-Shymkent gas Pipeline	0.068	0.064	0.065	0.065	0.065	0.062	0.060	0.061	0.061	0.061	0.062	0.062	0.063
QazaqGaz Aimaq	3.101	3.266	3.307	3.834	3.812	3.789	3.767	3.745	3.723	3.702	3.681	3.660	3.639
Exploration and production	0.507	0.508	0.441	0.484	0.482	0.480	0.477	0.475	0.473	0.471	0.468	0.466	0.464
Total:	0.0705	0.082	0.082	0.082	0.081	0.080	0.079	0.079	0.078	0.078	0.078	0.078	0.078

When estimating specific GHG emissions based on the projected dynamics of fuel and energy complex consumption, it is possible to note an increase in the value of specific emissions by 10.43% for QazaqGaz from 0.0705 to 0.07786 eCO_2-eq./GJ by 2033. In this scenario, despite the dynamics of a decrease in specific GHG emissions for a number of subsidiaries, the overall projected changes in

specific GHG emissions for QazaqGaz will increase. Therefore, it is necessary to implement additional technological, organizational and auxiliary measures to reduce GHG emissions. In terms of direct GHG emissions, in this scenario, QazaqGaz emissions are projected to increase by 401.9 thousand tCO2-eq. by 2033 compared to the base year of 2021.

This specific indicator (i.e. the ratio of direct GHG emissions per unit of energy consumed in GJ) was the basis for the formation of targets for the decarbonization of QazaqGaz.

The Scope 2 emissions forecast shows that by 2033, the emission level will remain at the level of 2024 (about 52 thousand tCO_2-eq.), despite the gradual increase in consumption of purchased electricity, since despite the projected increase in the volume of purchased electricity, a decrease in the specific GHG emission factor is projected, associated with a decrease in the share of fossil fuels and increasing the share of renewable energy sources in the structure of electricity generation in the Republic of Kazakhstan.

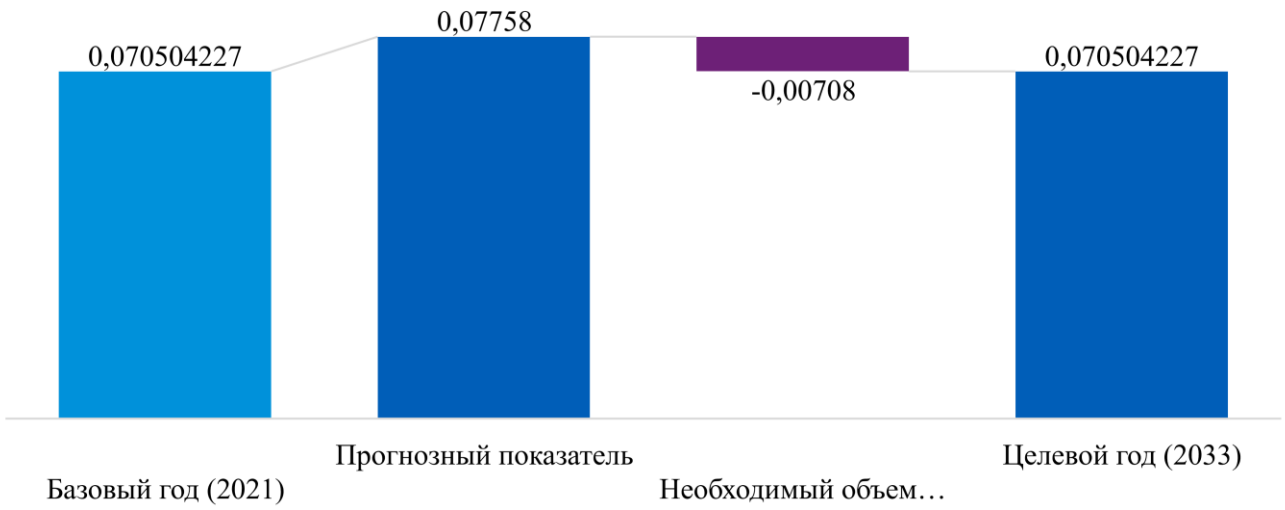
4.4.2 Green development scenario

The scenario of the "green" development of JSC NC QazaqGaz provides for maintaining the level of specific direct greenhouse gas emissions (Scope 1) by 2033 at the level of the base year 2021, despite the projected increase in energy consumption. The basis for achieving this goal is 20 technical measures, which are grouped into the following categories:

- Modernization and repair of basic technological equipment (energy efficiency);
- Introduction of more energy efficient equipment;
- Introduction of renewable energy sources;
- Automation and digitalization of processes.

The overall effect of the implementation of technical and organizational measures in the implementation of the green development scenario will only reduce the growth of projected specific GHG emissions from 10.43% to 10.04% by 2033 (from 0.07786 tCO_2-eq./GJ to 0.07758 tCO_2-eq./GJ in 2033). In terms of direct GHG emissions, a reduction of 170.6 thousand tCO_2eq is provided (implementation of planned technical and organizational measures). In this scenario, it is necessary to keep specific GHG emissions at the level of 0.0705 tCO_2-eq/GJ in 2021. To implement the green development scenario, the remaining part of GHG emissions (estimated 386.6 thousand tCO_2-eq.) should be reduced through the implementation of additional measures (including through the implementation of additional technical measures, such as electrification of the main production equipment and reduction of gas consumption, as well as the implementation of a set of additional measures, including offset projects in the period from 2030-2033).

Diagram 20. Estimated targets for specific greenhouse gas emissions under the green development scenario, tCO_2-eq./GJ



4.4.3 Deep decarbonization scenario

The “Deep Decarbonization” scenario represents the most ambitious way to reduce greenhouse gas emissions and is in line with international climate strategies aimed at limiting global temperature increases within 1.5°C in accordance with the Paris Agreement. The main focus is not only on technological renewal, but also on the widespread use of carbon footprint compensation tools and organizational measures.

Under this scenario, the Company envisions the implementation of an expanded set of 22 measures covering three key categories: technical, organizational, and compensatory. Unlike the “green development” scenario, which focuses primarily on upgrading equipment and improving energy efficiency, the deep decarbonization scenario also provides for the use of additional solutions that comply with the best international practices.

The implementation of this scenario will make it possible to achieve the following indicators by 2033:

- reduction of specific direct GHG emissions by 10% compared to the baseline level of 2021;
- reduction of indirect emissions in the Scope 2 category by 33% (by reducing GHG emissions from consumed electric energy. This will be achieved primarily by replacing imported electricity from fossil fuel facilities with energy from renewable sources.

The targets of the scenario can be achieved with an integrated approach to the implementation of measures, including the introduction of new technological solutions (additional options for reducing GHG emissions for gas transmission companies are given in section 6.1 of this document), the development of RES and the use of auxiliary tools such as the implementation of climate projects, the purchase of carbon offsets, I–REC certificates, etc.). The approach is based on the implementation of a set of the following measures:

- modernization of production equipment, improvement of energy efficiency and reduction of specific fuel consumption per unit of transported gas (for example, in tfoe/billion m^3*km), as well as the introduction of renewable energy sources;
- increasing the automation of production process management and strengthening control over volatile natural gas emissions (leaks);
- implementation of a system for monitoring the implementation of energy efficiency and GHG emission reduction measures, regular monitoring of the results achieved, as well as staff motivation for energy-saving behavior and implementation of organizational measures to reduce FER;
- implementation of comprehensive initiatives to reduce the carbon intensity of products (for more information, see section 6.1 of this document);
- implementation of climate projects, purchase of carbon offsets and I-REC certificates.

Table 20. Key tools for achieving the targets of the Deep decarbonization scenario

ЦЕЛЕВЫЕ ПОКАЗАТЕЛИ	Снижение удельных выбросов ПГ по Scope 1				Снижение выбросов ПГ по Scope 2
ИСТОЧНИК ВЫБРОСОВ ПГ	Природный газ		Электроэнергия	Выбросы ПГ	Электроэнергия
МЕРЫ ПО СОКРАЩЕНИЮ ВЫБРОСОВ ПГ	Капитальный ремонт 19 газопоршневых электростанций на компрессорных станциях	Оптимизация использования электроэнергии вырабатываемой на ГПЭС на КС-6	Установка активных фильтров гармоник для частотного преобразователя ГПА №1 КС «Туркестан»	Формирование портфеля офсетных проектов	Модернизация системы энергоснабжения с использованием ВИЭ
	Внедрение политик по энергосбережению и мотивации персонала к бережному отношению к энергоресурсам	Оптимизация режимов работы основного технологического оборудования (ГПА)	Проведение наладочных работ существующих устройств компенсации реактивной мощности на КС «Арал», КС «Коркыт Ата», КС «Туркестан»	Внедрение MIST — Methane Intensity Screening Tool	Замена существующих светильников на энергоэффективные светодиодные аналоги
	Замена системы электроснабжения крановых узлов на солнечные панели	Использование системы промывки проточной части компрессоров		Присоединение к инициативе Oil and Gas Methane Partnership (OGMP) 2.0	Замена неэффективных станций катодной защиты на станции нового поколения
	Проведение наладочных работ существующих устройств компенсации реактивной мощности	Использование мобильных компрессорных станций для сохранения природного газа при ремонте на единой системе газоснабжения.		Использование технологии низкоэмиссионного сжигания топлива в камерах сгорания газогенератора топливной системы ГПА	Замена устаревших насосных агрегатов хозяйственно-питьевого водоснабжения на энергоэффективные автоматические двухнасосные станции с горизонтальными насосами
	Повышение энергоэффективности газоперекачивающих агрегатов при проведении капитального ремонта газотурбинного двигателя	Развитие системы мониторинга за утечками газа и внедрение программы LDAR			Запуск проекта «Зеленый офис» для административных зданий ДЗО
	Замена запорной арматуры диаметром от Ø800мм до Ø1440мм	Использование мобильных компрессорных станций для сохранения природного газа при ремонте на единой системе газоснабжения.			Строительство станций ВИЭ
	Использование системы сухих газовых уплотнений на центробежных компрессорах	Поддержание исправного состояния основного оборудования			

4.4.4 Production development scenario: development of new fields and construction of new gas transportation and processing facilities

New projects for the development of new fields, the construction of new strands of main gas pipelines and a gas processing plant are at the design stage, and therefore the information used in this document based on design data to assess the potential for GHG emissions and energy consumption, as well as the stages of capacity utilization, is preliminary. The actual data on energy consumption and GHG emissions may differ from the design data and depend on the accuracy of the design data and operating modes of the production equipment.

QazaqGaz projects for the development of new Barkhannaya and Pridorozhnoye gas fields

Let's take a closer look at these projects and assess the potential GHG emissions from these projects on the horizon until 2033.

The Pridorozhnoye field is planned to be commissioned in 2027. Mangyshlak-Munai LLP is engaged in the development of this field, and corporate procedures are underway to establish a joint venture with 24.99% of Mangyshlak-Munai LLP and 75.01% of Gas Solutions Ltd. in the new joint venture.

The forecast natural gas production from the Pridorozhnoye field is presented in table 21.

Table 21. Forecast natural gas production at the Pridorozhnoye field until 2033, in million cubic meters

Indicator	2027	2028	2029	2030	2031	2032	2033
Production volume, million cubic meters	124,2	200,9	270,8	325,5	349,2	341	327,2

The projected consumption of natural gas for own needs during the operation of production equipment at the field is 0.5% per year of production volumes. We will estimate GHG emissions for the period 2027-2033 based on data on the projected gas consumption for our own needs and previously calculated specific GHG emissions for subsidiaries and affiliates (as part of the GHG emissions inventory for 2024 according to Scope 1, 2, 3) during natural gas combustion.

Table 22. Estimated values of direct GHG emissions from the development of the Pridorozhnoye field, in tCO_2-eq.

Indicators	2027	2028	2029	2030	2031	2032	2033
Own. needs, thousand cubic meters	621	1 005	1 354	1 628	1 746	1 705	1 636
Energy consumption, GJ	24 231	39 196	52 833	63 505	68 129	66 529	63 837
GHG emissions, in tCO_2-eq.	1 286	2 081	2 805	3 371	3 616	3 532	3 389

Assessment of potential GHG emissions from the Barkhannaya field

According to the development project, the commissioning of the Barkhannaya field is planned for the end of 2025. The extracted gas will be supplied to the Amangeldy field integrated gas treatment plant, then via a gas pipeline to ICA. On 13.02.2025, an agreement was signed with Meliorator LLP for the implementation of the development plan for the Barkhannaya field.

The forecast natural gas production from the Pridorozhnoye field is presented in table 23.

Table 23. Forecast natural gas production at the Barkhannaya field until 2033, in million cubic meters.

Indicator	2025	2026	2027	2028	2029	2030	2031	2032	2033
Production volume, million cubic meters	4,4	30,1	54,4	65,3	63,3	60,7	57	55,6	53,9

The main technological equipment at the Barkhannaya field under the project will be powered by electricity supplied via power transmission lines from external sources of generation (purchased electricity and associated indirect GHG emissions Scope 2). The estimated indirect GHG emissions of Scope 2 from purchased electricity are insignificant and are estimated at less than 500 tCO_2-eq. per year during peak production at the gas field (the estimate is based on a comparison of natural gas production and electricity consumption from the fields of EP Affilate and the projected production volumes of the Barkhannaya field.

There are no plans to build separate gas pumping stations at the gas pumping station from the gas field to the Amangeldy gas processing plant, therefore, no direct GHG emissions (Scope 1) are estimated for this field, as well as due to the fact that the main equipment will run on purchased electricity.

Assessment of potential GHG emissions from the Kashagan gas Processing plant

In accordance with the Construction of the main gas pipeline from the Kashagan integrated gas treatment plant project to Makat-North Caucasus Gas Processing Plant with a compressor station project, the energy consumption of the booster compressor station is as follows:

Total installed capacity - 1619.7 kW;

Total estimated power - 1073 kW;

Total estimated power of BCS taking into account the time difference factor of 0.9-928.4 kW.

Annual electric energy consumption - 928.4x 8760 = 8607.2 thousand kWh

Specific energy consumption per unit of production (commercial gas):

Volume of commercial gas = 815 million cubic meters/year.

Specific power consumption = 8607.2/815000= 0.1056 kWh/cubic meter.

The planned loading of BCS for the period 2026-2033 is presented in table 24.

Table 24. BCS planned load, in % of rated capacity

Indicator	2026	2027	2028	2029	2030	2031	2032	2033
% of load	50%	100%	100%	100%	100%	100%	100%	100%

Under the condition that the BCS is supplied with electricity from external sources of generation, emissions from purchased electricity are classified as indirect emissions of Scope 2 (the estimate is based on the specific coefficient of GHG emissions from purchased electricity for the power generation structure of the Republic of Kazakhstan for 2024):

Table 25. Assessment of indirect GHG emissions from the work of the BCS for the period 2026-2033

Indicator	2026	2027	2028	2029	2030	2031	2032	2033
Power consumption, MWh	4303,6	8607,2	8607,2	8607,2	8607,2	8607,2	8607,2	8607,2
GHG emissions Scope 2, tCO2-eq.	3 056	6 111	6 111	6 111	6 111	6 111	6 111	6 111

We will evaluate GHG emissions from the Integrated Gas Treatment Plant at the Kashagan field in Atyrau region.

The design capacity of the plant is processing 1 billion cubic meters of raw materials per year. The calculation of consumption per 1 ton of products was performed using a coefficient obtained based on the nominal volume of raw materials (crude gas) of 1 billion cubic meters. cubic meters/year and commercial gas output in the amount of 727 million cubic meters /year. Integrated gas treatment plant with a capacity of 1 000 000 000 nm³/year at the Kashagan field in Atyrau region (without external engineering networks) for the construction of a gas processing plant with a capacity of 1,150 billion m³/year based on raw materials from the Kashagan field.

Since July 27, 2022, 100% of the plant's share belongs to GPC Investment LLP, State Property and Privatization Committee of the Ministry of Finance of the Republic of Kazakhstan, and since August 25, 2022, the plant has been transferred to the trust management of QazagGaz with confirmation of the GPCI functions of the operator and administrator of the project "CGTU with a capacity of 1 000 000 000 nm³/year at the Kashagan field in Atyrau region".

The raw material of the integrated gas treatment plant is associated petroleum gas from the Kashagan field, which is located in Atyrau region. Associated petroleum gas is supplied to the gas processing plant via a pipeline with a diameter of 300 mm. Parameters of associated petroleum gas at the installation boundary: pressure 6.8 MPa, ambient temperature. The nominal capacity of the CGTU for processed raw materials is 1 billion nm³/year. The estimated range of productivity for raw materials is 50-115%. The operating mode is continuous, 8 400 hours per year. After compression, commercial hydrocarbon gas is supplied to Makat-North Caucasus MGP. Hydrocarbon liquefied fuel gas.

The CGTU complex is intended for processing associated petroleum gas from the Kashagan field in the amount of 500 to 1150 million nm3/year with the release of the following products:

- hydrocarbon fuel gas according to ST RK 1666-2007 or OST 51.40-93 - 727 million nm³/year;
- liquefied petroleum fuel gas grades PBA (propane-butane automotive) and PBT (propane-butane technical) according to ST RK 1663-2007 - 115.5 thousand tons/year;
- stable gas composite (SGC) according to ST TU PST RK 01-2013 - 17 thousand tons/year;
- granular sulfur according to GOST 127.1-93, GOST 127.4-93, GOST 127.5-93 - 218,5 thousand tons/year.

Table 26. CGTU main technical parameters

No.	Indicators	Unit measure	Indicators	
			Declared	Recommended for approval
1	CGTU capacity for raw materials	million nm³/year	500-1150	500-1150
2	Annual production output:			
2.1	Hydrocarbon fuel gas	million nm³/year	727	727
2.2	Liquefied petroleum gas grades PTA and PTB	thousand tons/year	115,5	115,5
2.3	Stable gas composite	thousand tons/year	17	17
2.4	Granular sulfur	thousand tons/year	218,5	218,5

The maximum electricity demand for the CGTU is 30 MW per hour, which is equivalent to an annual consumption of 252 000 MWh (or 252 million kWh). According to the project, it is planned to supply electricity to the production equipment of the CGTU from external sources of electricity generation (purchased electricity).

Part of the production equipment will use natural gas: the consumption of natural gas for the operation of the main production equipment of the CGTU is 10 000 cubic meters per hour. The design load of the plant is 8 400 hours per year.

In the middle of 2026, it is planned to launch production facilities and the duration of the work of the CGTU this year will be 6 months. Table 27 shows the design parameters of the CGPU load and estimated GHG emissions for the period of operation from the start of the plant until 2033.

Table 27. GHG emission potential assessment (Scope 1 and 2) of the CGTU until 2033.

Indicators	2026 (6 months of work)	2027	2028	2029	2030	2031	2032	2033
Power consumption, MWh	126000	252000	252000	252000	252000	252000	252000	252000
GHG emissions Scope 2, tCO2-eq.	3 056	6 111	6 111	6 111	6 111	6 111	6 111	6 111
Gas consumption, thousand cubic meters	42000	84000	84000	84000	84000	84000	84000	84000
Energy consumption GJ	1638840	3277680	3277680	3277680	3277680	3277680	3277680	3277680
GHG emissions Scope 1, tCO2-eq.	86994	173988	173988	173988	173988	173988	173988	173988

In addition to direct GHG emissions from natural gas combustion, emissions are expected from the production processes of processing raw gas and producing commercial gas and auxiliary products (propane-butane, gas composite and granular sulfur) as a result of chemical reactions and the material balance of the feedstock and final products.

In accordance with the material balance and design data for GHG and pollutant emissions, the following substances are released into the atmosphere:

1. Greenhouse gas emissions:
• CO_2 (carbon dioxide);
• CH_4 (methan);
• NO_2 / NOx (nitrogen oxides);
• CO (carbon monoxide);

2. Pollutants:
• SO_2 (sulfur dioxide);
• VOS (volatile organic substances);
• H_2S (hydrogen sulfide);
• Soot.

Specific GHG emissions from technological installations and an estimate of annual GHG emissions from chemical reactions of production are shown in Table 28. When converting 1 billion tons of feedstock gas into tons, taking into account the density, the volume of feedstock will amount to 700 thousand tons.

Table 28. Specific values of greenhouse gas emissions per 1 ton of raw materials

No.	GHG	Amount, tCO2-eq.	Number of emissions, tons of gas per year	Specific coefficients of GHG emissions, tons of gas per ton of raw materials	Number of raw materials, tons
1.	CO2 (GWP=1)	676.578	676.578	0,00096654	700 000
2.	CH4 (GWP=27)	6 246.45	231.35	0,00033050	700 000
3.	N2O (GWP=273)	29 733.25	108.913	0,00015559	700 000
	Total:	**36 656.28**			

Assessment of GHG emissions from the construction project of the 2nd line of the BBS MGP.

Pipeline diameter - 1067 mm.

Pressure in pipeline - 9.81 MPa at the Bozoi-Shymkent section and 7.35 MPa at the Beineu-Bozoi section.

Pipeline route total length - 1 450.2 km.

Number of GIS - 3 units (Beineu, Bozoi, Akbulak)

Number of CS - 6 units (Beineu 3 GPU, Bozoi 6 GPU, Karaozek 3 GPU, Aral 3 GPU, Korkyt-Ata 3 GPU, Turkestan 2 GPU).

Preliminary volumes of gas transportation in 2027-2033:

2027-2029 – 10 billion m3/year;

2030-2033 – 15 billion m3/year.

The volumes for own needs to ensure the operation of production equipment (gas pumping units and gas power plants) of BBS-2 MGP compressor stations and gas losses are about 5% of the design gas transportation capacity. The GIS and CS production equipment of the BBS-2 MGP is provided with electricity (secondary energy) generated at its own generation facilities (gas power plants).

According to preliminary estimates, electricity will be needed to ensure the operation of the MG at its design capacity. The total operating electricity capacity will be 15 445 kW / 135 298 200.00 kWh per year.:

at the first stage – 10605 kW / 92 899 800.00 kWh per year;

at the second stage – 4,840 kW / 42 398 400.00 kWh per year.

Including CS consumption:

Beineu CS: 1610 kW, energy consumption 14 103 600.00 kWh per year;

Bozoi CS: 1910 kW, 16 731 600.00 kWh per year;

Aral CS: 1610 kW, 14 103 600.00 kWh per year;

Korkyt Ata CS: 1,710 kW, 14 979 600.00 kWh per year;

Karaozek CS: 1680 kW, 14 716 800.00 kWh per year;

Turkestan CS: 1520 kW, 13 315 200.00 kWh per year.

Table 29. Assessment of GHG emissions from the operation of BBS-2 MGP in the period 2027-2033.

Indicators	2027	2028	2029	2030	2031	2032	2033
Gas consumption, thousand cubic meters	500 000	500 000	500 000	750 000	750 000	750 000	750 000
GHG emissions Scope 1, tCO2-eq.	1022003	1022003	1022003	1533004	1533004	1533004	1533004

Table 30. Summary table on specific GHG emissions for BSG affiliates (BBS MGP and BBS-2)

Indicators	2025	2026	2027	2028	2029	2030	2031	2032	2033
BBS: Gas transportation volumes, billion cubic meters	14.83	15.27	15.20	15.24	15.23	15.23	15.23	15.23	15.23
BBS-2: Gas transportation volumes, billion cubic meters			10	10	10	15	15	15	15
BBS: GHG emissions, tCO2-eq.	792 337	822 812	825 409	828 006	830 602	833 199	835 796	838 393	840 990
BBS-2: GHG emissions, tCO2-eq.			1 022 003	1 022 003	1 022 003	1 533 004	1 533 004	1 533 004	1 533 004
Total GHG emissions, tCO2-eq.	792 337	822 812	1 847 412	1 850 009	1 852 605	2 366 204	2 368 801	2 371 397	2 373 994
BBS: Energy consumption, GJ	12 131 566	13 298 062	13 697 004	13 656 476	13 615 947	13 575 419	13 534 891	13 494 363	13 413 306
BBS-2: Energy consumption, GJ			19 510 000	19 510 000	19 510 000	29 265 000	29 265 000	29 265 000	29 265 000
Total energy consumption GBS, GJ	12 131 566	13 298 062	33 207 004	33 166 476	33 125 947	42 840 419	42 799 891	42 759 363	42 678 306
Specific emissions of GHG, tCO2-eq./GJ	0.0653	0.0619	0.0556	0.0558	0.0559	0.0552	0.0553	0.0555	0.0556
GHG emissions after the implementation of technical measures to reduce GHG emissions, tCO2-eq.	789 050	819 522	821 936	824 718	827 036	829 912	832 509	835 105	837 702
GHG emissions, taking into account the implementation of those measures and operation of MG BBS-2, tCO2-eq.	789 050	819 522	1 843 939	1 846 721	1 849 039	2 362 916	2 365 513	2 368 110	2 370 707
Specific GHG emissions, taking into account the implementation of those measures and operation of BBS-2 MGP, tCO2-eq./ GJ	0.0650	0.0616	0.0555	0.0557	0.0558	0.0552	0.0553	0.0554	0.0555

The specific GHG emissions for GBS subsidiaries and affiliates for the base year 2021 are 0.0682 tCO2-eq./GJ, while the projected specific indicators for GBS for 2033 are estimated at 0.063 tCO2-eq./GJ (taking into account projected energy consumption and direct GHG emissions), that is, the planned reduction in specific emissions will be 4.3%. Taking into account the implementation of the planned technical measures (listed in Appendix 1 of this document), specific GHG emissions for GBS are estimated at 0.0624 tCO2-eq/GJ (a decrease of 8.5%).

Taking into account the contribution of the second BBS-2 line to direct GHG emissions and energy consumption of GBS subsidiaries and affiliates, specific GHG emissions by 2033 are estimated at 0.0556 tCO2-eq./GJ, that is, for this option, the reduction in specific indicators compared to 2021 will amount to 18.49%. Taking into account the implementation of those. measures to reduce GHG emissions and the operation of the BBS-2line, specific emissions will amount to 0.0555 tCO2-eq./GJ (a decrease of 18.61% compared to the base year of 2021).

Assessment of GHG emissions from the construction project of the MG CS-14 - Kostanay section (ICA facilities).

Project technical parameters:
MG length - **630 km**
Pipeline diameter - **1020 mm**
Compressor stations – **1 unit** (GPU is designed for a capacity of up to 5.66 billion m3/year (694 000 m3/hour). GPU unit capacity is assumed to be 15.9 MW)
Design capacity - **4.1 billion m3/year**
Implementation period - **2024-2026**
Energy consumption - to ensure the MGP operation at its design capacity, electricity in the amount of about 43 864.7 MW*h per year will be required. The energy consumption of natural gas for own needs and technical losses is 1% of the volume of natural gas transportation (41 million cubic meters) per year.

Assessment of the GHG emission potential from CS-14 MG – Kostanay site is presented in Table 31.

Table 31. Assessment of the GHG emission potential from CS-14 MG – Kostanay site operation in the period of 2027 - 2033

Indicators	2027	2028	2029	2030	2031	2032	2033
Gas consumption, thousand cubic meters	4 100 000	4100000	4100000	4100000	4100000	4100000	4100000
GHG emissions Scope 1, tCO2-eq.	85 189	85 189	85 189	85 189	85 189	85 189	85 189

Summary data on projected values of direct GHG emissions and specific GHG emissions, taking into account the implementation of those. measures to reduce emissions and operate the BBS-2 line until 2033 are presented in table 32.

Table 32. Summary table on specific GHG emissions for ICA affiliates (ICA and CS-14 Kostanay MGP)

Indicators	2025	2026	2027	2028	2029	2030	2031	2032	2033
ICA: Gas transportation volumes, billion cubic meters	63.30	63.53	63.87	64.20	64.54	65.87	67.21	68.54	69.88
CS-14 Kostanay MGP: Gas transportation volumes, billion cubic meters			4.1	4.1	4.1	4.1	4.1	4.1	4.1
ICA: GHG emissions, tCO2-eq	1 139 881	1 152 040	1 164 199	1 176 357	1 188 516	1 200 675	1 212 834	1 224 993	1 237 152
CS-14 Kostanay MGP: GHG emissions, tCO2-eq			85 189	85 189	85 189	85 189	85 189	85 189	85 189
Total GHG emissions, tCO2-eq.	1 139 881	1 152 040	1 249 388	1 261 546	1 273 705	1 285 864	1 298 023	1 310 182	1 322 341
ICA: Energy consumption, GJ	13 644 004	13 870 853	14 097 702	14 324 550	14 551 399	14 778 248	15 005 097	15 231 946	15 458 795
CS-14 Kostanay MGP: Energy consumption, GJ			1 599 820	1 599 820	1 599 820	1 599 820	1 599 820	1 599 820	1 599 820
Total energy consumption of ICA, GJ	13 644 004	13 870 853	15 697 522	15 924 370	16 151 219	16 378 068	16 604 917	16 831 766	17 058 615
Specific indicators of GHG emissions, tCO2-eq./GJ	0.0835	0.0831	0.0796	0.0792	0.0789	0.0785	0.0782	0.0778	0.0775
Total GHG emissions, taking into account the implementation of those measures and operation of CS-14 Kostanay MGP, tCO2-eq section.	1 122 967	1 140 042	1 237 390	1 249 549	1 261 708	1 273 867	1 286 026	1 298 185	1 310 343
Specific GHG emissions indicators, taking into account the implementation of those measures and operation of CS-14 Kostanay MGP section, tCO2-eq./ GJ	0.082	0.082	0.0788	0.0784	0.0781	0.0777	0.0774	0.0771	0.0768

The specific GHG emissions for ICA subsidiaries and affiliates for the base year 2021 are 0.055 tCO2-eq./GJ, while the projected specific indicators for ICA for 2033 are estimated at 0.080 tCO2-eq./GJ (taking into account projected energy consumption and direct GHG emissions), that is, the planned increase in specific emissions will be 54%. Taking into account the implementation of the planned technical measures (listed in Appendix 1 of this document), specific GHG emissions for ICA are estimated at 0.0793 tCO2-eq./GJ, that is, the increase in specific indicators, taking into account the implementation of technical measures to reduce GHG emissions, will amount to 45.2%. Taking into account the contribution of the CS-14 Kostanay main pipeline facilities to direct GHG emissions and energy consumption of ICA subsidiaries and affiliates, specific GHG emissions by 2033 are estimated at 0.0775 tCO2-eq/GJ, that is, for this option, a decrease in specific indicators compared to 2021 will amount to 42.03%. From this, it can be concluded that the introduction of a new section of the gas pipeline will lead to a decrease in the projected growth in specific GHG emissions by 2033 (instead of an increase in specific emissions by 54%, the increase will be 42.03%). Taking into account the implementation of those. measures to reduce GHG emissions and the operation of CS-14 Kostanay MGP section, specific emissions will amount to 0.0768 tCO2-eq./GJ (an increase of 40.7% compared to the base year 2021)

GHG emissions assessment from Taldykorgan-Usharal MGP construction project (ICA facilities).

Project technical parameters:
MG length - 302,4 km
Pipeline diameter – 530 mm
AGDS with branch gas pipelines – 6 units
The design capacity - 385 million cubic meters/year
Implementation period - 2024-2026
Automated gas distribution stations (AGDS): Usharal AGDS, Koylyk AGDS, Sarqand AGDS, Kabanbai AGDS, Zhansugurov AGDS, Kapal AGDS. The power consumption of AGDS site equipment is 28.1 kW. The total power consumption of 6 AGDS is 168.6 kW.

BLOCK VALVE STATIONS: BVS-1, BVS-2, BVS-3, BVS-4, BVS-5, BVS-6, BVS-7, BVS-8, BVS-9, BVS-10. The power consumption of the equipment of the linear part of the block valve stations is 5 kW. The total power consumption of 10 KU is 50 kW.

The total electric power consumption for the project is 238.6 *8760h = 2 090 136 kWh per year.
The energy consumption of natural gas for own needs and technical losses is 3 million cubic meters per year.

Table 33. Assessment of GHG emissions from the operation of Taldykorgan-Usharal MGP site in the period 2027-2033

Indicators	2027	2028	2029	2030	2031	2032	2033
Gas consumption, thousand cubic meters	3 000	3 000	3 000	3 000	3 000	3 000	3 000
GHG emissions Scope 1, tCO2-eq.	6 233	6 233	6 233	6 233	6 233	6 233	6 233

Table 34. Summary table on specific GHG emissions for ICA affiliates (taking into account the facilities of CS-14 - Kostanay" and MGP and Taldykorgan-Usharal MGP)

Показатели	2025	2026	2027	2028	2029	2030	2031	2032	2033
Total GHG emissions, tCO2-eq.	1 139 881	1 152 040	1 255 621	1 267 780	1 279 939	1 292 098	1 304 257	1 316 415	1 328 574
Gas transportation volumes of Taldykorgan-Usharal MGP, billion cubic meters	0.385	0.385	0.385	0.385	0.385	0.385	0.385	0.385	0.385
Taldykorgan-Usharal MGP: Energy consumption, GJ			117 060	117 060	117 060	117 060	117 060	117 060	117 060
ICA total energy consumption, GJ	13 644 004	13 870 853	15 814 582	16 041 430	16 268 279	16 495 128	16 721 977	16 948 826	17 175 675
Total GHG emissions, including implementation of those measures and operation of CS-14 – Kostanay section MGP and Taldykorgan-Usharal MGP section, tCO2-eq.	1 122 967	1 146 276	1 243 623	1 255 782	1 267 941	1 280 100	1 292 259	1 304 418	1 316 577
Specific GHG emissions indicators including implementation of those measures and operation of CS-14 – Kostanay MGP and Taldykorgan-Usharal section MGP, tCO2-eq./ GJ	0.0823	0.0826	0.0786	0.0783	0.0779	0.0776	0.0773	0.0770	0.0767

Taking into account the implementation of technical measures to reduce GHG emissions and the operation of CS-14 – Kostanay MGP and Taldykorgan-Usharal MGP sites, specific emissions will amount to 0.0767 tCO2-eq./GJ (an increase of 40.4% compared to the base year of 2021). That is, the impact of GHG emissions and energy consumption of Taldykorgan-Usharal MGP equipment on specific GHG emissions is insignificant (less than 0.3%).

It can be concluded that the implementation of new projects and technical measures to reduce GHG emissions will have a positive impact on the projected specific GHG emissions (based on the known project data for the implementation of projects for this stage of development and the assessment of potential energy consumption and GHG emissions based on this) for BSG and ICA affiliates.

Table 35. Forecast GHG emissions from QazaqGaz including contribution of new BSG and ICA projects to energy consumption and GHG emissions for 2027-2033

Indicators	2027	2028	2029	2030	2031	2032	2033
QazaqGAZ, tCO2-eq.	5 046 039	5 085 745	5 199 027	5 738 679	5 767 050	5 795 422	5 823 793
Total energy consumption of QazaqGaz (operation of new lines of ICA and BSG gas pipelines), GJ	73 112 376	73 577 478	74 042 580	84 262 683	84 727 785	85 192 887	85 617 461
Specific GHG emissions for QazaqGaz, tCO2-eq./GJ	0.0690	0.0691	0.0702	0.0681	0.06806	0.06802	0.06802
Energy consumption from Pridorozhnoye field, GJ	24 231	39 195	52 833	63 505	68 128	66529	63 836
GHG emissions from Pridorozhnoye field, tCO2-eq.	1 286	2 080	2 804	3 371	3 616	3 531	3 388
Energy consumption of CGTU Kashagan, GJ	3 277 680	3 277 680	3 277 680	3 277 680	3 277 680	3 277 680	3 277 680
GHG emissions Scope 1 from CGTU Kashagan, tCO2-eq.	210 645	210 645	210 645	210 645	210 645	210 645	210 645
Direct GHG emissions from QazaqGaz, including all projects, tCO2-eq.	5 257 970	5 298 471	5 412 476	5 952 695	5 981 311	6 009 598	6 037 827
Total energy consumption of QazaqGaz, including all projects, GJ	76 414 288	76 894 354	77 373 094	87 603 868	88 073 594	88 537 096	88 958 977
Specific GHG emissions of QazaqGaz, including all projects, tCO2-eq./GJ	0.0688	0.0689	0.06995	0.06795	0.06791	0.06787	0.06787

Taking into account energy consumption and direct GHG emissions from new lines of the BSG pipeline and ICA MGPs, a slight decrease in specific GHG emissions is projected by 2033 compared

to the base year 2021 (in 2021, specific GHG emissions for QazaqGaz amounted to 0.0705 tCO2-eq./GJ) by 3.52% (for the indicator of specific emissions in 2033, 0.0680 tCO2-eq./GJ). It should be noted that at the time of preparation of the document, the assessment was carried out on the basis of design data and, in fact, after the implementation of the projects, the actual ratio between direct GHG emissions and energy consumption may differ, including up (if the design volumes of energy consumption in the denominator of specific GHG emissions for new projects were overestimated).

The total value of GHG emissions from the implementation of projects, including the development of new deposits (Pridorozhnoye and Barkhannaya) and the operation of the CGTU by 2033 is estimated at 6 million tCO2-eq., and specific GHG emissions at 0.06787 tCO2-eq./GJ, i.e. in this development scenario, taking into account the implementation of new projects, a decrease in specific GHG emissions increased by 3.72% compared to the base year of 2021.

5. Finance analysis

5.1 Assessment of operating and capital costs for the implementation of developed measures to reduce GHG emissions

The section is devoted to the assessment of the economic feasibility of implementing the measures envisaged by the Low-Carbon Development Program. The analysis covers the assessment of capital and operating costs, as well as macroeconomic effects in the period from 2025 to 2033. The economic analysis is aimed at identifying the financial feasibility and effectiveness of the proposed solutions, taking into account the estimated costs and expected benefits.

JSC Intergas Central Asia plans to implement eight technical solutions aimed at increasing the energy efficiency of production processes and reducing greenhouse gas emissions. Most of the activities are planned for implementation in 2025 with the involvement of its own technical services, in order to minimize additional operating costs.

The plan is aimed at comprehensively increasing energy efficiency and sustainably reducing greenhouse gas emissions by optimizing technological processes and energy supply systems. To reduce direct emissions (Scope 1), it is envisaged to introduce mobile compressor stations that reduce emissions when bleeding natural gas during repair work and operational activities for servicing main gas pipelines, as well as to introduce measures to improve energy efficiency (flushing the flow path of compressors) and major repairs of equipment.

In order to reduce the consumption of purchased electricity and reduce indirect emissions under the Scope 2 category, obsolete lighting fixtures are being replaced with energy-efficient LED analogues, cathodic protection stations are being modernized, energy-efficient water supply pumping stations are being installed, reactive power compensation devices are being introduced, and the implementation of renewable energy sources is also planned.

The proposed measures are aimed at reducing operational losses, increasing equipment reliability and sustainably reducing the carbon footprint. A detailed breakdown of the measures by application area and SAs is presented in Tables 36-37.

Table 36. ICA technical measures information

No.	Measures	CAPEX, thousand USD	OPEX, thousand USD	Measures delivery deadlines
1	Energy efficiency: Using mobile compressor stations (MCS) to conserve natural gas during repairs on a single gas supply system	774,61	By ICA Technical Services	2025–2030
2	Energy efficiency: Using a compressor flow part flushing system	Cost-free event	By ICA Technical Services	2025
3	Operational repair and maintenance: Improving the energy efficiency of a gas pumping unit during a major overhaul of a gas turbine engine	712,38	By ICA Technical Services	2025
4	Energy Efficiency: Replacing existing lighting fixtures with energy efficient LED alternatives	207,31	By ICA Technical Services	2025
5	Energy Efficiency: Replacing Inefficient Cathodic Protection Stations with Next-Generation Stations	275,24	By ICA Technical Services	2025

6	Energy efficiency: Replacement of obsolete pumping units for domestic and drinking water supply with energy-efficient automatic two-pump stations with horizontal pumps	0,99	By ICA Technical Services	2025
7	RES: Modernization of the power supply system using RES Autonomous hybrid power plant AGPP	743,64	By ICA Technical Services	2030-2033
8	Prompt repair and maintenance: Replacement of shut-off valves with diameters from Ø800 mm to Ø1440 mm	21 461,32	By ICA Technical Services	2025

The AGP includes six measures aimed at modernizing the gas transportation infrastructure and implementing energy-efficient solutions. All initiatives are being implemented between 2025 and 2027.

The key project is a major overhaul of the equipment for in-house power generation at 19 gas power plants, which will improve their reliability and reduce specific gas consumption while maintaining optimal operating conditions. It is also planned to replace the power supply systems of crane units operating on natural gas with solar panels, which will reduce the volume of its combustion. The measure to optimize the distribution of electricity between compressor stations CS-6 and SCS-6 will optimize the load on the power plants and reduce the consumption of the original fuel - natural gas. A detailed list of measures planned for implementation is presented in Table 37.

Table 37. AGP affiliates technical measures information

No.	Measures	CAPEX, thousand USD	OPEX, thousand USD	Measures delivery deadlines
1	Energy efficiency: Optimization of the use of electricity generated at the GEGS at CS-6	8 160,0	By AGP Technical Services	2025–2026
2	Operational repair and maintenance: Major repairs of 19 GEGS at the compressor stations	7 400,0	By AGP Technical Services	2025-2026
3	Energy efficiency: Replacement of the crane power supply system with solar panels	3 600,0	180,0	2025-2026
4	Energy efficiency: Use of low-emission fuel combustion technology in the combustion chambers of the gas generator of the fuel system of gas pumping units (DLE chamber)	12 000,0	3 300	2025-2026
5	Energy efficiency: Use of dry gas seal system on centrifugal compressors	3 553,0	By AGP Technical Services	2025-2026
6	Operational repair and maintenance: Maintenance of the main equipment in good state	0	By AGP Technical Services	2025-2026

As part of the implementation of the Low-Carbon Development Program, measures aimed at improving energy efficiency and reducing greenhouse gas emissions are provided for BSG and QGA facilities. The implementation is planned for the period 2025-2033.

Optimization of the operating modes of the main production equipment (GPU) is planned for GBS, which will save natural gas consumption. The installation of harmonic filters will improve the quality of power supply and reduce power losses, and increase the reliability of technological equipment. In addition, it is planned to carry out commissioning work on cathodic protection installations to extend the service life of the power grid infrastructure and reduce non-production losses of electricity.

For QGA, the main focus will be the development of renewable energy generation itself and a partial transition to renewable energy sources, which will reduce the consumption of purchased electricity generated by external fossil fuel sources and, consequently, reduce indirect GHG emissions under Scope 2. Table 37 shows the key technical measures for these subsidiaries and affiliates.

Table 38. GBS and QGA affiliates technical measures information

No.	Measures	CAPEX, thousand USD	OPEX, thousand USD	Measures delivery deadlines
	GBS			
1	Energy efficiency: and optimization of operating modes of technological equipment	Cost-free event	By GBS Technical Services	2025-2033
2	Energy efficiency: Installation of active harmonic filters for frequency converter GPU No. 1 of Turkestan CC	3,70	By GBS Technical Services	2027
3	Operational repair and maintenance: Commissioning of existing power-factor correction units (PFCU) at the Aral CS, Korkyt Ata CS, Turkestan CS	Carrying out repairs and maintenance according to the regulations of subsidiaries and affiliates on the basis of the accepted operating budget	By GBS Technical Services	2026
4	Modernization of the existing power supply system for crane units on the linear part of BBS MGP taking into account the introduction of RES: Mangystau region block valve station No. 1; - Aktobe region block valve station No. 12; - Kyzylorda region block valve station No. 32; - Turkestan region block valve station No.43	3 261,0	163,0	2026-2028
5	Implementation of renewable energy sources at railway crossings in the amount of 6 pcs.	361,7	18,0	2026-2027
	QGA			
1	RES: Modernization of the energy supply system by creating its own generation based on solar panels, capable of covering up to 15% of the volume of purchased electricity	220,0	20,0	2030-2033

Based on the approved list of measures, the implementation of 20 key measures in the following areas is planned under the Low-Carbon Development Program: energy efficiency improvement, operational repairs and maintenance, and the development of renewable energy sources. The final distribution of investments is shown in figure 21.

Diagram 21. Timeline of budget for implementation of technical measures to reduce GHG emissions (2025-2033), thousand USD

The main capital expenditures shown in figure 22 relate primarily to the short-term period and are aimed at implementing energy efficiency measures. Since the budget planning of JSC NC QazaqGaz is carried out for a five-year period (until 2030), the costs for the period 2030-2033 include the costs necessary to reduce GHG emissions. In particular, it is the acquisition of I-REC certificates and the financing of additional emission reduction tools, including carbon offsets. Taking into account the emergence of new measures to reduce GHG emissions after 2028, additional planning of financial costs for their implementation will be required, since the current analysis covers only the currently known measures.

When using specific values of GHG emissions (the ratio of direct emissions to the volume of fuel and energy complex consumption, in GJ) as targets through technical measures, including energy efficiency improvements, QazaqGaz is achieving a reduction in direct GHG emissions of about 165 thousand tCO2-eq).

The operating costs associated with the implementation of the Program's activities are distributed as follows: USD 3.48 million Asian Gas Pipeline, 20 thousand USD for QazaqGaz Aimaq and 181 thousand USD for Beineu-Shymkent Gas Pipeline. Most of the technical solutions are planned to be implemented by our own subsidiaries and affiliates, which significantly reduces additional operating costs. The main items of operating costs are related to the maintenance of new energy-efficient systems and technical repairs, which ensures high investment efficiency and minimizes costs in the future.

Table 39. Summary table of investment and operating costs for the implementation of technical measures of Low-Carbon Development Program in the context of subsidiaries and affiliates

Subsidiaries and affiliates	Reduction of direct GHG emissions (Scope 1), tCO2-eq.	Reduction of indirect GHG emissions (Scope 2), tCO2-eq.	CAPEX, thousand USD	OPEX, thousand USD
Exploration and Production QazaqGaz	0	0	0	0
QazaqGaz Aimaq	0	374	220,0	20
Asian Gas Pipeline	21 896,4	0	34 713,0	3 480
Intergas Central Asia	112 894,4	1 025	24 175,5	0
Beineu-Shymkent Gas Pipeline	30 054,67	8	3 626,4	181
Total	**164 845,4**	**1 407**	**62 734,9**	**3 681,0**

In addition to the main technical measures that require capital and operational costs, the strategy for reducing greenhouse gas emissions also includes organizational and support measures. Given that the potential to reduce GHG emissions from the implementation of technical and organizational measures alone is insufficient to achieve targets by 2033, supportive measures have an important role to play, especially in the period 2030-2033.

Organizational measures aimed at improving energy efficiency and optimizing internal processes include the development of corporate energy conservation policies, the introduction of energy management programs, staff training, monitoring energy consumption indicators and a systematic approach to energy planning. In the absence of direct costs, such measures can achieve a measurable effect: collectively, the potential reduction in direct GHG emissions from natural gas consumption is estimated at 5,763 tCO2-eq. for key subsidiaries and affiliates, QGA, AGP and BSG.

Table 40. Information of organizational and support activities

Measures	Effect of reducing direct GHG emissions, tCO2-eq.	Estimated cost values, thousand USD	Measures delivery deadlines
Implementation of energy conservation and staff motivation policies to save energy resources and implement energy efficiency measures. Saving fuel and energy complex consumption due to more rational consumption of energy resources (incl.)	5 763	Cost-free event	2026-2028
Launch of Green Office project for administrative buildings of subsidiaries and affiliates	Effect is limited and refers to a decrease in Scope 2	Implemented by office staff and technical services	2025-2033

Purchase of I-REC certificates to reduce indirect emissions Scope 2	Effect depends on the scale of implementation. Targets to reduce Scope 2 by 33% by 2033	68,7	2030-2033
Formation of offset project portfolio	Reduction of Scope 1. Potential depends on the scale of implementation	from 3 939 to 12 122*	2030-2033
MIST introduction - Methane Intensity Screening Tool	Monitoring and reducing methane leaks	Cost-free event	2030-2033
Joining to Oil and Gas Methane Partnership initiative (OGMP) 2.0		Cost-free event	2030-2033

** Estimated value of the offset project portfolio may vary depending on market conditions and the time of purchase.*

Table 41. Range of potential costs to purchase carbon offsets

Average purchase price of carbon offsets	Residual GHG emissions by Group of Companies until 2033	Total purchase price of carbon offsets
Minimum cost - 6.5 USD/ton of CO2-eq.	605 800 tCO2-eq.	3 938 000 USD
Maximum cost - 20 USD/ton of CO2-eq.		12 116 000 USD

Table 41 shows the possible range of budget expenditures for the purchase of carbon offsets in the amount of 605.8 thousand tCO_2-eq. in the period 2030-2033. The cost of offsets is shown in two scenarios — at a price of 6.5 USD and 20 USD per tCO_2-eq., depending on the market situation and the time of purchase. Accordingly, the total cost may range from USD 3.94 million to USD 12.12 million. The costs will be centralized by subsidiaries and affiliates of QGA, AGP and BSG, which plan to use offset projects to compensate for residual emissions. At the same time, the actual need for offsets may change depending on the effectiveness of the implementation of technological measures to reduce emissions.

A mechanism for acquiring international I-REC (International Renewable Energy Certificates) certificates can be used to compensate for indirect GHG emissions. This will make it possible to achieve a 33% reduction in indirect GHG emissions in the Scope 2 category. The cost of one certificate confirming the generation of 1 MW*h of electricity from renewable sources is 2 US dollars. Under this program, the estimated cost of acquiring I-REC certificates is estimated at 68.7 thousand US dollars. However, given the possible change in specific GHG emission coefficients due to changes in the structure of electricity generation in the Republic of Kazakhstan in the future (due to an increase in the share of renewable energy sources), it is possible to reduce indirect GHG emissions from Scope 2 simply by changing specific emission coefficients, as well as the cost of certificates may increase by the time they are purchased and the total costs may change.

Total capital expenditures for the implementation of technical measures to reduce GHG emissions are estimated at 62.73 million US dollars, while operating expenses are estimated at 3.68

million US dollars. It is expected that these measures will lead to a reduction in direct greenhouse gas emissions by 163 thousand tCO_2-eq. and indirect emissions (Scope 2) by 1,407 tCO_2-eq.

However, given the limited list of technical measures to reduce GHG emissions, these measures will not achieve the target reduction level of 10% from the base year of 2021. The existing set of measures ensures only partial fulfillment of climate objectives and does not meet the established decarbonization targets. Thus, achieving the targets will require additional technical and support measures (for example, the implementation of offset projects and the purchase of carbon units), for which increased funding is required. It is necessary to conduct annual monitoring of the actual achieved effect on GHG emissions from the implementation of planned measures for each SAs and assess the necessary GHG emission reductions to achieve the set targets, as well as taking into account the fact that the implementation of the main technical measures is planned for the period up to 2030 (due to the fact that budget planning at QazaqGaz is carried out for a five-year period), then additional technical and support measures will be required for the period 2030-2033.

In this regard, additional investments will be required for the implementation of measures after 2030 to achieve GHG reduction targets (for example, the cost may range from USD 3.938 million to USD 12.116 million), but the cost structure after 2030 may change with the advent of new technical measures and a reassessment of GHG emission reductions necessary to achieve the targets. indicators after 2030, so that the value of the actual costs for the long-term period may change upward.

6. Analysis of low-carbon development opportunities

6.1 Assessment of potential to reduce carbon intensity and increase energy efficiency

During the preparation of the Low-Carbon Development Program of JSC NC QazaqGaz, a comprehensive analysis of the structure of greenhouse gas emissions and operational processes that have the greatest climate impact was carried out. According to the inventory for the base year 2021, more than 98.7% of the company's gross GHG emissions are accounted for by direct emissions (Scope 1), the main sources of which are methane leaks and gas combustion at technological installations. The Program focused on technical solutions aimed at reducing the carbon intensity of key processes in the gas transportation system, including subsidiaries and affiliates of Intergaz Central Asia JSC, Beineu-Shymkent Gas Pipeline, Asian Gas Pipeline and QazaqGaz Aimaq JSC.

Based on the analysis, the following decarbonization directions were identified (2021 was the base year for calculations:

- Reduction of specific GHG emissions in the process of fuel and energy complex consumption (Scope 1), by increasing energy efficiency, optimizing the operating modes of the main production equipment, carrying out operational repairs and maintenance, as well as implementing other technical measures.
- Reduction of indirect GHG emissions (Scope 2) by increasing the share of electricity from renewable energy sources, implementing energy conservation measures and acquiring international I-REC certificates.

In order to achieve GHG emission reduction targets for the period up to 2033, the goals were differentiated between key subsidiaries and affiliates, taking into account the scale of their operations and the structure of emissions. A system of key performance indicators (KPIs) is planned to be developed to monitor progress and evaluate the effectiveness of implemented activities. To assess and plan GHG emission reductions, the company uses three decarbonization scenarios: "Business as Usual", "Green Development" and "Deep decarbonization", which allows it to assess possible GHG emission reduction trajectories taking into account existing technological and financial constraints.

To achieve the goals of the Program, it is planned to implement measures in three main areas:

- **Technical** - aimed at improving operational efficiency, modernizing equipment, introducing alternative technologies, automating and digitalizing production processes.
- **Organizational** - include improvement of management, planning and control of emissions, staff training, implementation of monitoring systems and structuring of ESG management at the level of subsidiaries and affiliates.
- **Compensational** - cover the use of carbon offsets, the purchase of international I-REC certificates, and the financing of external climate projects.

The responsibility for the implementation of the activities under the Low-Carbon Development Program is assigned to Production and Technical Department, Procurement and HSE Depts.

When developing the targets, the following assumptions were taken into account:

- Gas production segment was not included in the calculations due to its insignificant contribution to total GHG emissions (0.4%).
- In the gas transportation segment, only the volume of trunk transportation is taken into account, without switching on distribution networks.

- Effect of activities common to several segments is distributed in proportion to the level of emissions for 2021.
- Coefficient of emissions from consumption of imported electricity is assumed to be at the average level, taking into account the location-based method and benchmarks of specific GHG emissions for electricity generation using various types of fossil fuels and taking into account the structure of electricity generation in the Republic of Kazakhstan from mid-2023.
- In the structure of direct GHG emissions, the share of emissions associated with volatile methane emissions is 39%, and the global warming potential (GWP) for methane is estimated at 28.

Under the Low-Carbon Development Program covering the period from 2025 to 2033, the activities are structured taking into account the time horizons of their implementation, which will ensure the systematic achievement of goals and the rational allocation of resources. Time horizons are classified as follows:

- Short-term period (2026-2027) - implementation of planned technical and organizational measures, for which financing has already been provided in the budgets of subsidiaries and affiliates.
- Medium term period (2027-2029) is to assess the achieved effect of reducing GHG emissions from implemented technical and organizational measures, expand the list of technical measures based on the results of energy audits conducted in subsidiaries and affiliates. Budget planning for the implementation of measures to reduce GHG emissions for the period after 2030;
- Long-term period (2030-2033) - implementation of measures requiring long-term preparation, including the development and implementation of new technical solutions and climate instruments (for example, offset projects), as well as the evaluation of the results of previously implemented activities of the Low-Carbon Development Program.

Given the scale and features of QazaqGaz's infrastructure, as well as the experience of international companies, the Low-Carbon Development Program has significant emission reduction potential for both Scope 1 and Scope 2. To achieve the technical potential of GHG emission reduction, it is necessary to implement integrated technological solutions to improve energy efficiency, optimize the operating modes of production equipment, combined with an organizational approach: existing energy management policies and goals to reduce energy consumption should correlate with established goals to reduce GHG emissions and be supported by specific metrics and a KPI system in the organization.

Table 42. Example of achieving Scope 1 targets for QazaqGaz subsidiaries and affiliates

Indicators	Base year (2021)	Long-term goal to reduce GHG emissions by 10% (2033)
Reduction of specific GHG emissions according to Scope 1 for QazaqGaz, tCO2-eq./GJ	**0,071**	**0,0635**
Distribution of Scope 1 targets by Affiliates, tCO2-eq./GJ		
Intergas Central Asia	**0,055**	**0,073**
Beineu-Shymkent gas Pipeline	**0,068**	**0,053**
Asian Gas Pipeline	**0,069**	**0,049**
QazaqGaz Aimaq	**3,101**	**2,84**

To achieve GHG emission targets by 2033 (0.0635 tCO2-eq./GJ) is necessary taking into account the projected increase in energy consumption (the projected energy consumption is estimated in total by the considered subsidiaries and affiliates at 54.6 million. GJ) reduce the volume of direct GHG emissions to a value of 3.469 million tCO2-eq. (excluding subsidiaries and affiliates of the Exploration and Production). In this case, with an estimated level of projected growth in energy consumption, the target values for reducing specific GHG emissions by 10% compared to the base year 2021 (0.0635 tCO2-eq/GJ) will be achieved.

Table 43. Example of distribution of GHG emission reduction targets by QazaqGaz subsidiaries and affiliates

Subsidiaries and affiliates	Target indicators, tCO2-eq./GJ	Share of subsidiaries and affiliates in reducing GHG emissions and achieving targets	Comments
Intergas Central Asia	**0,073**	15,7%	Targets are achieved through the implementation of planned technical measures.
Asian Gas Pipeline	**0,053**	49,5%	Additional technical and support measures to reduce GHG emissions are needed to achieve the targets.
Beineu-Shymkent Gas Pipeline	**0,049**	21,5%	
QazaqGaz Aimaq	**2,84**	13,3%	

Table 42 shows an example of a reduction in specific GHG emissions measured in tCO2-eq./GJ: when implementing the above-mentioned technical and organizational measures, the set specific GHG emission targets are not achieved, and when recalculating the difference between the target and achievable values of specific GHG emissions into direct GHG emissions (by multiplying the values of specific emissions by the projected energy consumption values by 2033 for each subsidiaries and affiliates, residual values are obtained to reduce direct GHG emissions). In total, after the implementation of the planned technical and organizational measures, it will remain to reduce about 605.8 thousand tCO2-eq., including through ancillary measures (carbon offsets and compensation projects).

Table 44. Necessary GHG emission reductions to achieve targets

Subsidiaries and affiliates	Target specific values of GHG emissions, tCO2-eq./GJ	Forecast values of direct GHG emissions by 2033, tCO2-eq.	Forecast energy consumption values by 2033, GJ	Potential reduction of direct GHG emissions from current measures, tCO2-eq	Remaining necessary reduction in direct GHG emissions to achieve the targets, tCO2-eq.
Intergas Central Asia	**0,073**	1 237 151	15 458 795	115 922	-
Asian Gas Pipeline	**0,053**	1 728 311	25 612 333	27 304	356 100
Beineu-Shymkent Gas Pipeline	**0,049**	840 989	13 413 306	31 585	154 800
QazaqGaz Aimaq	**2,840**	432 516	118 855	14,09	95 000
					605 800

Table 45. Targets for specific GHG emissions by QazaqGaz

Name	Specific GHG emissions in 2021, tCO2-eq./GJ	**Values of direct GHG emissions to achieve the targets, tCO2-eq.**	Forecast values of direct GHG emissions by 2033, tCO2-eq.	Forecast energy consumption values by 2033, GJ	Achievable specific values of GHG emissions, tCO2-eq./GJ
QazaqGaz	0.0705	3 469 818	4 238 969	54 603 289	0.0635*

*Сокращение удельных выбросов ПГ на 10% по сравнению с базовым 2021 годом

Table 46. Assessment of potential to reduce direct GHG emissions from delivery of technical and organizational measures for period 2025-2033, tCO2-eq.

Affiliates	**2025 год**	**2026 год**	**2027 год**	**2028 год**	**2029 год**	**2030 год**	**2031 год**	**2032 год**	**2033 год**
ICA	17 082	12 166	12 166	12 166	12 166	12 166	12 166	12 166	12 166
AGP	11 249	11 249	300	300	300	300	300	300	300
BSG	3 288	3 290	3 472	3 567	3 567	3 567	3 567	3 567	3 567
QGA	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5

Table 47. Reduction of direct GHG emissions, taking into account the implementation of planned measures for period 2025-2033, tCO2-eq.

Affiliates	2025 год	2026 год	2027 год	2028 год	2029 год	2030 год	2031 год	2032 год	2033 год
ICA	1122798	1139874	1152033	1164192	1176351	1188510	1200668	1212827	1224986
AGP	1608420	1622001	1646830	1660410	1673990	1687570	1701151	1714731	1728311
BSG	789050	819522	821936	824718	827036	829912	832509	835105	837702
QGA	432232	432268	432303	432339	432374	432410	432445	432481	432516

Table 47 shows projected GHG emissions, taking into account the implementation of planned technical and organizational measures for the future (the list of measures is given in annex 3) and does not take into account possible additional measures and the purchase of offsets, which will have to be implemented in the period up to 2033 to achieve the targets of specific GHG emissions (reduction of specific GHG emissions by 10% relative to the base year of 2021).

Approach to distributing target values between subsidiaries and affiliates

When allocating the contribution of subsidiaries and affiliates to GHG emission reduction, the following logic was applied to achieve the targets:

1) For ICA, the main share of GHG emission reductions relates to the implementation of planned technical measures (see Annex 3 for a complete list);

2) AGP accounts for the majority of GHG emissions reduction, as these subsidiaries and affiliates account for the largest amounts of GHG emissions. Since the technical potential of the current technical measures to reduce GHG emissions is very limited, after the implementation of the planned measures, additional measures will need to be developed and included in the Low-Carbon Development Program, as well as the use of additional tools such as offset projects (from RES, climate).

3) For BSG and QGA, the available set of technical measures to reduce GHG emissions is also limited, therefore, their share in reducing GHG emissions implies the introduction of additional measures during the period of the Low-Carbon Development Program, including offset units.

The purchase and distribution of offsets is supposed to be centralized through QazaqGaz, as this will allow the distribution of offsets to direct GHG emission plants in accordance with industry regulatory requirements in the Republic of Kazakhstan.

Table 48 shows specific GHG emissions for the period 2025-2033, taking into account the implementation of technical and organizational measures to reduce direct GHG emissions.

Table 48. Specific GHG emissions indicators, including delivery of measures to reduce direct GHG emissions, tCO2-eq./GJ

Affiliates	2025	2026	2027	2028	2029	2030	2031	2032	2033
Intergas Central Asia	0,0823	0,0822	0,0817	0,0813	0,0809	0,0804	0,0800	0,0796	0,0793
Asian Gas Pipeline	0,0688	0,0685	0,0688	0,0685	0,0683	0,0681	0,0679	0,0677	0,0675
Beineu-Shymkent Gas Pipeline	0,0651	0,0616	0,0600	0,0604	0,0608	0,0611	0,0615	0,0619	0,0625
QazaqGaz Aimaq	3,8116	3,7892	3,7670	3,7450	3,7233	3,7019	3,6807	3,6597	3,6390

Table 49 shows estimated reductions in indirect GHG emissions from Scope 2 by 2033.

Table 49. Example of achieving Scope 2 targets

Name	Base year (2021)	Long-term goal (2033) Scope 2 reduction by 33%, tCO2-eq.
Reduction of GHG emissions by Scope 2 from purchased electricity from QazaqGaz, tCO2-eq.	**82 286,02**	**55 131,63**

The purchase and distribution of I-REC certificates is supposed to be carried out centrally through QazaqGaz, as this will allow regulating the mechanism and effectively distributing certificates across subsidiaries and affiliates to achieve targets for reducing indirect GHG emissions.

The goal of achieving the share of renewable energy sources to replace 15% of the purchased electricity is planned by 2033 at QazaqGaz Aimaq. To achieve the targets for reducing indirect GHG emissions of the Scope 2 category, it is necessary to use tools such as I-REC certificates confirming the purchase of electricity from RES.

Table 50. Achieving the share of RES to replace 15% of the purchased electricity by 2033

Name	RES share in 2021 (base year)	RES share in 2023	Renewable energy generation by 2033, MW*h per year	Expected reduction of GHG emissions Scope 2, tCO2-eq.
RES share	**0%**	**15%**	**474**	**374***

**Calculation based on a mixed coefficient of specific GHG emissions using the located-based method and benchmarks of the structure of electricity generation in the Republic of Kazakhstan for 2024. In the future, the coefficients of specific GHG emissions from electricity generation will decrease due to an increase in the share of renewable energy sources in the structure of electricity generation, therefore, the final reduction in indirect GHG emissions should be recalculated according to actual coefficients in 2033.*

A general list of measures planned by QazaqGaz to reduce GHG emissions, with an assessment of the potential for reducing GHG emissions and costs, as well as periods for the implementation of measures, is provided in Appendix 3 of this document.

6.2 Assessment of achievement of target indicators (efficiency) of specific values of greenhouse gas emissions

In order to verify the achievement of specific GHG emission targets, it is necessary to conduct annual monitoring of the achieved GHG emission indicators and compare the actual values of specific GHG emissions with the data given in table 48 (this table shows the specific values of GHG emissions, taking into account the implementation of planned technical and organizational measures to reduce GHG emissions). Monitoring is carried out according to the formula:

Efficiency = Vfact (reporting period) / total fuel and energy complex consumption for the reporting period (in tCO2-eq./GJ)

where Vfact - Volume of gross greenhouse gas emissions Scope 1 for the reporting period, calculated according to a unified approach under QazaqGaz Low-Carbon Development Program (in tCO2-eq.);

The total consumption of fuel and energy complex for the reporting period is the total consumption of fuel and energy resources of JSC NC QazaqGaz (in GJ) for the reporting period.

At the same time, it should be borne in mind that the potential to reduce GHG emissions from the current planned technical and organizational measures to reduce GHG emissions (shown in the table in Annex 3 of this document) is insufficient to achieve the targets for reducing GHG emissions of JSC NC QazaqGaz by 10% and requires additional measures.: both technical and compensatory (for example, the purchase of offsets).

The form of the efficiency assessment document is given in Appendix 4 of this document.

6.3 Assessment of risks from Kazakhstan’s joining the Global Methane Pledge initiative

In 2023, Kazakhstan officially joined the Global Methane Pledge (GMP) international initiative, announced at the COP26 conference. GMP’s goal is to reduce anthropogenic methane emissions by 30% by 2030 compared to 2020 levels. By the beginning of 2025, more than 159 countries, including all the world’s leading economies, have confirmed their participation in the initiative. Kazakhstan’s accession has become an important step towards strengthening the national contribution to achieving global climate goals, especially given the high proportion of methane in the country's greenhouse gas emissions.

The GMP initiative is accompanied by unprecedented international financial and technical support. Since COP27, more than $1 billion has been mobilized in new grants aimed at implementing projects to reduce methane emissions. Kazakhstan, among other countries, gets access to these resources, as well as to expert support from UNEP, IEA, CCAC and other international structures. At the same time, joining GMP means for the country and business the acceptance of certain obligations and risks that require timely assessment and strategic management.

Risks associated with the implementation of the GMP initiative in Kazakhstan:

1. Economic risks

To achieve GMP’s goals, a large-scale modernization of the gas transportation and production infrastructure, compressor stations, the introduction of digital monitoring and automation technologies, as well as increased control over methane leaks is required. According to preliminary estimates, more than 570 million tenge is required annually for the maintenance and replacement of technically outdated equipment alone, and in the context of growing GMP requirements, these costs may increase significantly. Additional capital investments will increase the burden on the operating budgets of companies, especially against the background of limited tariff potential.

2. Technological risks

The integration of advanced technologies such as LDAR systems, satellite monitoring systems for gas leaks, and optical leak sensors requires adaptation of existing processes and training of engineering and technical personnel. The extensive, worn-out technical infrastructure in the gas transportation segment reduces the potential for introducing new technologies and significantly reducing volatile gas leaks.

Therefore, significant investments are needed in structural modernization and technical re-equipment of physically worn-out production equipment and gas infrastructure, as well as staff training to work with new equipment. Without this, the implementation of GMP measures will be ineffective and will not bring the expected results.

3. Compliance risks

As of early 2025, Kazakhstan is in the process of developing a national strategy to reduce methane emissions, but the regulatory framework has not yet been formed. Uncertainty about offset certification, verification of results, and access to international support programs can lead to delays in implementation, legal gaps, and reporting difficulties. The introduction of new obligations without step-by-step business adaptation increases the risk of regulatory pressure and loss of investor confidence.

4. Reputation risks

Late fulfillment of obligations or demonstration of the low effectiveness of the measures taken may negatively affect Kazakhstan's international reputation, especially in the context of the growing attention to ESG factors from financial institutions, international ratings and export partners. Under OGMP 2.0 commitments and other global agreements, companies that fail to ensure transparency and progress in reducing methane emissions may face restrictions on access to capital, project financing, and international markets.

QazaqGaz, as a backbone company of the Kazakh gas industry, plays a key role in the implementation of the climate agenda and can become a flagship in fulfilling GMP obligations in Kazakhstan. Despite the fact that QazaqGaz accounts for a relatively small share (about 2%) of total methane emissions in Kazakhstan, the company's participation in GMP opens up strategic opportunities, including:

- access to international financing for modernization;
- improved operational efficiency by reducing gas leaks and losses;
- strengthening ESG positions and improving ratings for investors and creditors;
- increased transparency and trust from regulators and partners.

Kazakhstan’s participation in the Global Methane Pledge initiative opens up both strategic opportunities and calls for a rapid response to new regulatory and technological challenges. In the absence of obligations for oil and gas companies at the current stage, a methane emissions management system is being formed at the national level, including the development of a program, regulatory framework and government support mechanisms.

For QazaqGaz, this means the need for timely planning, risk assessment, infrastructure modernization and the formation of internal competencies. Timely integration of the company into global climate processes will minimize operational and reputational risks, as well as demonstrate the company’s responsible role in energy transition processes at the national and international levels.

Table 51. SWOT-analysis QazaqGaz to GMP joining

Strong points	Weak spot	Угрозы	Возможности
Economic benefit: natural gas, whose emissions are prevented into the atmosphere, can be used for sale and make a profit. (In 2023, about 170 billion m3 of natural gas was lost in the world). QazaqGaz is not one of the largest sources of methane emissions in Kazakhstan (its share in total emissions is 2%), therefore, strict regulation or high target commitments are not expected when developing a national strategy. QazaqGaz can effectively use associated gas: reduce its emissions into the atmosphere and send the saved gas for sale.	Despite government support, QazaqGaz is experiencing financial difficulties due to low domestic tariffs (≈22 tenge/m³) with a purchase price of 33 tenge/m³. Gas transmission system built during the Soviet period is worn out, with a high risk of leaks, and control of methane emissions remains limited. In order to achieve the GMP goals, it is necessary to attract additional investments and cooperate with partners, since QazaqGaz's own production is small (~298 million m³ in 2024), and the bulk of the gas comes from KazMunayGas and foreign companies.	Regulation of methane emissions is being tightened, and Kazakhstan, within the framework of GMP, undertakes to eliminate methane ventilation and implement LDAR. Failure to fulfill obligations can lead to reputational and financial costs. Equipment modernization requires USD 70 million annually, but rapid changes are difficult due to the scale of the infrastructure. The lack of necessary investment in modernization will increase the risks of meeting GMP targets.	Kazakhstan and the United States are already cooperating within the framework of the Global Methane Pledge initiative, including the IFC and the World Bank. The estimated investment requirement - USD 1.4 billion by 2030, and negotiations are underway with the EBRD. Kazakhstan plans mandatory implementation of LDAR by 2030, and QazaqGaz can become a leader in this process. QazaqGaz may consider the possibility of producing compressed natural gas (CNG), introducing liquefaction technologies (LND), and considering the possibility of building its own gas-fired power generation facilities.

6.4 Main promising areas for JSC NC QazaqGaz to reduce greenhouse gas emissions

Reducing greenhouse gas emissions for such a large source of emissions as QazaqGaz is an important task that meets the national climate goals for achieving carbon neutrality for Kazakhstan and commitments under the Paris Agreement and will minimize the negative impact on the environment and maintain the sustainability of QazaqGaz's business in the context of the global transition to a low-carbon economy.

The range of possible measures to reduce the carbon footprint of a company operating a gas transportation infrastructure can be divided into several main areas. The main promising areas include the implementation of technical measures (for example, measures aimed at improving energy efficiency), design technical studies and pilot projects in cooperation with national research institutes and foreign organizations (for example, research into the possibility of obtaining and using hydrogen), best practices in the development of gas fields (aimed at reducing gas combustion on torches), implementation of advanced systems to reduce volatile methane emissions during gas transportation and distribution (LDAR), as well as participation in advisory boards on improving the national regulatory framework of the gas industry of the Republic of Kazakhstan.

The following are the main possible directions for QazaqGaz to reduce GHG emissions in the future.

1. Possible technical directions to reduce GHG emissions

In the conducted study of the main ways of decarbonization[19], which examines the experience of the main gas transportation companies of the European Union: Enagás (Spain), Fluxys (Belgium), GRTgaz (France) and Snam (Italy). It is possible to identify the main promising areas for reducing GHG emissions and carbon intensity of products by reducing direct and indirect GHG emissions[20]:

1) Electrification[21] of the main production equipment (for QazaqGaz, these are gas pumping units, which account for the main consumption of natural gas in the fuel and energy complex consumption structure) and maximum use of heat recovery from exhaust gases (use of modern recovery boilers is relevant for ICA, since many recovery boilers are inoperable due to outdated production equipment). Upgrading the main technological equipment and replacing worn-out equipment that has exhausted its technical life with modern and energy-efficient ones will reduce specific GHG emissions from gas consumption by the main production equipment and thus reduce the carbon intensity of gas transportation processes;
2) Reduction of direct GHG emissions associated with the main activity is also facilitated by the conversion of the company's vehicles to biofuels (using bioethanol, biodiesel, etc.) and the gradual replacement of cars with internal combustion engines with electric vehicles;
3) Development of own electric generation based on renewable energy sources. Application of intelligent electricity metering devices in power distribution networks.

[19] Gas-for-Climate-Gas-Decarbonisation-Pathways-2020-2050.pdf
[20] 4 solutions to help reduce carbon emissions from industrial clusters | World Economic Forum
[21] Report of WorldBank Cost-Effective Air Quality Management in Kazakhstan and Its Impact on Greenhouse Gas Emissions

2. Conducting scientific and technical research and implementing pilot projects

4) Conducting research on the possibility of introducing direct greenhouse gas capture[22] technologies at the main greenhouse gas emission facilities. Assessment of the possibility of implementing pilot projects. These greenhouse gas capture plants in combination with carbon dioxide-derived technologies are one of the promising areas of decarbonization for large industrial sources of GHG emissions;

5) Conducting R&D on the production and application of biomethane in QazaqGaz production processes[23]. Biomethane production usually involves purification from undesirable components of biogas such as hydrogen sulfide (H2S) and moisture (H2O), as well as enrichment in a process that includes the removal of carbon dioxide (CO2) to increase the concentration of CH4 to 95-99% and reduce the concentration of CO2 to 1-5% with minimal hydrogen sulfide (H2S) or without it. Biomethane is a flexible and easily stored fuel with properties and applications similar to natural gas, and does not require changing the settings of devices and equipment designed for natural gas. Biomethane can be used in industry and everyday life, including for heat and electric power, as a raw material for processes such as the Fischer-Tropsch (FT) process for fuel production, as well as for direct electricity generation in hydrogen or biogas fuel cells, for example, for the production of environmentally friendly hydrogen. Thus, biomethane promises to play a leading role in the energy transition through the production of hydrogen, electricity and other renewable fuels.

The production of biomethane by biogas purification methods includes variable pressure adsorption, which can be supplemented by variable temperature adsorption, amine-based adsorption technologies, membrane separation, cryogenic separation and biological separation. The choice of technology may depend on factors such as cost, product quality, location, technology maturity, and requirements. Biogas is a mixture of gases formed as a result of the action of microorganisms during anaerobic digestion, which is a complex process consisting of four stages: hydrolysis, acidogenesis, acetogenesis and methanogenesis, resulting in the formation of biogas. The composition of biogas is influenced by the type of raw materials used and the control of the anaerobic digestion process. In addition to production in anaerobic reactors, biogas can also be produced in landfills and in the processes of thermal pyrolysis and gasification of biomass. The resulting mixture usually consists of 30-75% methane (CH4), 25-55% carbon dioxide (CO2) and other components or impurities such as hydrogen (H2), oxygen (O2), nitrogen (N2), hydrogen sulfide (H2S), water (H2O) and ammonia (NH3), dust particles, siloxanes, aromatic and halogenated compounds that are often present in small amounts. Biogas, containing mainly 48-76% methane, is most often produced in plants called biogas plants operating through the process of wet mesophilic fermentation (temperature 36-42°C). Worldwide, at more than 50 million operating plants (usually small ones), the biogas produced is used directly by consumers or, in the case of larger plants, after drying and desulfurization, in local biogas networks or, after purification to biomethane, is introduced into the natural gas network through a direct connection or transported by tanker trucks (the so-called virtual gas pipelines).

Biomethane is a purified form of biogas, consisting of almost 100% methane and approximately equal in quality to natural gas. Biomethane can also be produced by gasification. It has many uses:

a) Fuel (bio-LNG) liquefied biomethane used as a substitute for liquefied natural gas (LNG),

[22] Oil & Gas Research - Sustainable Practices in Oil and Gas: A Decarbonization Perspective
[23] Biomethane Production and Applications

for example, in vehicles, especially buses, trucks and passenger cars equipped with engines powered by natural gas.

b) Injection into gas networks biomethane meeting quality standards can be injected into existing distribution networks to replace natural gas.

6) Conducting research on the production of hydrogen from natural gas. Planning and implementation of the pilot project by QazaqGaz in the medium and long term. Much of the hydrogen produced today is obtained through methane steam reforming, a mature manufacturing process in which high-temperature steam (700-1000°C) is used to produce hydrogen from a methane source such as natural gas. During steam reforming of methane, methane reacts with steam at a pressure of 3-25 bar in the presence of a catalyst to form hydrogen, carbon monoxide and a relatively small amount of carbon dioxide. Steam reforming is an endothermic process, that is, heat must be applied for the reaction to proceed. Then, in the so-called "water gas shear reaction", carbon monoxide and steam react with the catalyst to form carbon dioxide and more algae. In the last step of the process, called "variable pressure adsorption", carbon dioxide and other impurities are removed from the gas stream, leaving virtually pure hydrogen. Steam reforming can also be used to produce hydrogen from other fuels such as ethanol, propane, or even gasoline.

Steam reforming reaction of methane $CH_4 + H_2O$ (+ heat) → $CO + 3H_2$

The shift reaction of water gas is $CO + H_2O \rightarrow CO_2 + H_2$ (+ a small amount of heat).

During partial oxidation, methane and other hydrocarbons contained in natural gas react with a limited amount of oxygen (usually from the air), which is insufficient to completely oxidize hydrocarbons to carbon dioxide and water. In the presence of oxygen in an amount less than stoichiometric, the reaction products contain mainly hydrogen and carbon monoxide (as well as nitrogen if the reaction takes place with air rather than pure oxygen), as well as relatively small amounts of carbon dioxide and other compounds.

Then, in a water gas shear reaction, carbon monoxide reacts with water to form carbon dioxide and more hydrogen. Partial oxidation is an exothermic process - it releases heat. This process is usually much faster than steam reforming and requires a smaller reactor. As can be seen from the chemical reactions of partial oxidation, this process initially produces less algae per unit of injected fuel than during steam reforming of the same fuel. Partial oxidation of methane.

Reaction $CH_4 + ½O_2 \rightarrow CO + 2H_2$ (+ heat)

Water gas shift reaction $CO + H_2O \rightarrow CO_2 + H_2$

Potential uses of hydrogen[24]:

a) Industry processes:

- Chemical industry: Hydrogen can be used as a feedstock for the production of ammonia and fertilizers, replacing fossil fuels and reducing carbon emissions. It can also be used in the petrochemical industry to refine oil and in metallurgy to produce steel.
- Steel production: Using hydrogen as a reducing agent in the steel industry could significantly reduce carbon emissions, representing an important step towards decarbonizing the steel

[24] The Role of Hydrogen in Decarbonising Industry

industry, which currently accounts for a significant portion of global CO_2 emissions.

- Oil refining: Hydrogen can be used to replace fossil fuels in oil refining processes, reducing emissions and improving the environmental footprint of these industries.

b) Electricity generation and energy storage:

- Fuel cells: Hydrogen can be used in fuel cells to produce electricity, providing a clean and reliable source of energy. This technology can be used in power plants to decarbonize the electricity industry.
- Energy storage: Hydrogen can be used as an energy storage source and applied to balance the electrical system receiving electricity from renewable sources (solar and wind power plants).

c) Transport:

- Fuel Cell Electric Vehicles (FCEV): Hydrogen can be used to power fuel cell electric vehicles, offering a zero-emission alternative to traditional gasoline vehicles. Major automobile makers are pursuing initiatives to develop and deploy FCEV.
- Heavy vehicles: Green hydrogen is being explored for use in heavy vehicles, buses and trains, with the aim of reducing emissions and increasing sustainability in these sectors.

d) Heating of residential premises:

- Hydrogen boilers: Hydrogen can be used in hydrogen boilers and fuel cells to provide heating and hot water with zero carbon emissions. Pilot projects are currently being implemented to explore the possibility of using hydrogen for residential heating.

7) Conducting scientific research with the involvement of QazaqGaz's internal research centers to assess the effectiveness of the project to collect flushing liquid and associated gas generated during drilling and major repairs of gas wells.

The proposed method provides for the installation of a tank for collecting flushing liquid and associated gas, the use of equipment for their separation, as well as the direction of the gas fraction to the gas collection point for subsequent sale or use for technological purposes. This approach potentially reduces the amount of gas flaring after drilling and repairing wells, as well as reduces the leakage of natural gas into the atmosphere, which, in turn, reduces the negative impact on the environment and helps reduce greenhouse gas (GHG) emissions.

In addition, as part of the implementation of this direction, it is planned:

- application of new technologies for the development of producing gas wells;
- implementation of energy-efficient technologies for gas extraction and treatment;
- implementation of carbon capture technologies [CCUS (Carbon Capture and Storage)/CCS (Carbon Capture, Utilization and Storage)].

Since the implementation of the Low-Carbon Development Program provides for periodic monitoring of the results achieved and the development of new measures to reduce GHG emissions for subsidiaries and dependent organizations (affiliates), it is advisable to include this initiative in the Low-Carbon Development Program for the future (for example, from 2027) as a pilot project, subject to a positive conclusion based on the results of R&D.

3. Implementation of comprehensive measures to reduce natural gas leaks from the main production processes

8) To study approaches to reducing methane leaks, the following companies were included in

the reference group: Eni, Exxon Mobil, Trans Canada, MOL Group (Hungary's largest oil and gas company). In general, based on the results of the study, it can be noted that reducing methane emissions requires an increased level of automation in monitoring natural gas leaks (for example, the use of LDAR systems), that is, the introduction of automated monitoring systems at gas transportation infrastructure facilities. The improvement of technical accounting systems, combined with an increase in the number of natural gas metering units in various sections of the gas transportation and gas distribution infrastructure, combining their readings into a single automated monitoring system, will make it possible to identify non-technological costs of natural gas in various sections (the more metering points, the more detailed it is possible to restore the picture of material flows of gas transportation flows and identify even the most minor leaks, which will be able to quickly eliminate the internal technical services of the company) and reduce commercial losses from leaks (volatile emissions) of methane. Optimization of the repair work schedule and search for additional solutions aimed at reducing the volume of gas venting. As an innovation, drones equipped with the necessary equipment (methane detection detectors, infrared cameras) can be used to detect methane leaks throughout the gas pipelines.

9) purchase of a new modification of mobile compressor units for pumping gas from the repaired section to the existing section of the gas pipeline to reduce volatile GHG emissions into the atmosphere from gas venting processes during repair work on the gas pipeline section.

10) development of a comprehensive modernization program for obsolete equipment at compressor stations until 2033 to reduce specific energy consumption and fugitive GHG emissions from the operation of the main production equipment.

4. Application of compensatory instruments to reduce direct and indirect GHG emissions

11) Direct GHG emissions can be offset by purchasing carbon offsets from climate projects or renewable energy sources;

12) Reduction of indirect GHG emissions of Scope 2 can be achieved through the purchase of I-REC certificates confirming that the purchased electricity was produced from renewable energy sources. The implementation of strategies to consistently reduce indirect GHG emissions in the Scope 2 category will minimize emissions in this category at a relatively low cost (taking into account the low cost of I-REC certificates in Kazakhstan).

5. Reduction of flare burning during the development of gas fields

It is necessary to exclude the combustion of APG without pre-processing. It is permissible to burn only the methane fraction, while maximizing the use of C3+ fractions (propane, butane and higher).

The following technologies are promising to be used:

- GTL (gas-to-liquids) for remote fields. Gas-to-liquids (GTL) — a refining process that converts natural gas or other gaseous hydrocarbons into longer-chain hydrocarbons such as gasoline or diesel fuel. Methane-rich gases are converted into liquid synthetic fuels. There are two general strategies: (i) direct partial combustion of methane to form methanol and (ii) Fischer-Tropsch type processes that convert carbon monoxide and hydrogen to hydrocarbons. Strategy ii is accompanied by various methods of converting mixtures of hydrogen and carbon monoxide into liquids. Direct partial combustion has been demonstrated in nature, but has not been reproduced on an industrial scale. Direct partial

combustion has been demonstrated in nature but not replicated on an industrial scale. Technologies based on partial combustion have been commercialized mainly in regions where natural gas is cheap. The motivation for GTL is to produce liquid fuels that are easier to transport than methane. Methane must be cooled below its critical temperature of -82.3 °C so that it can be liquefied under pressure. Because of the need for cryogenic equipment, LNG carriers are used for transport. Methanol is an easy-to-handle flammable liquid fuel.

- mini-production for obtaining LNG (liquefaction and transportation);

- gas compression (the process allows increasing the density of gas or air, which is necessary for various technological operations and ensuring safety at manufacturing facilities) for local use.

6. Participation in the formation of the regulatory framework for the development of the gas sector and improvement of the company’s internal documents in accordance with the requirements

Participate in government consultation meetings on the development of the regulatory framework for the gas sector. Conduct regular analysis of the current regulatory framework related to QazaqGaz activities and update the company's existing documents in terms of:

• climate and environmental requirements;

• compliance with international standards;

• requirements for technological equipment and the ability to implement the best global technologies;

• company’s obligations within the framework of ESG requirements and maintaining high ESG ratings.

7. Findings

To achieve the set goals of reducing GHG emissions and implementing the Low-Carbon Development Program of JSC NC QazaqGaz by 2033, it is necessary to consistently implement comprehensive decarbonization measures - technical, organizational and auxiliary. At the same time, it is necessary to establish realistic and achievable targets for reducing GHG emissions by 2033, taking into account the technical potential and available financial resources directed to improving energy efficiency and reducing GHG emissions.

The right strategy, taking into account the combination of short-term and long-term initiatives to reduce GHG emissions based on the existing set of measures, as well as annual monitoring of the actual effect achieved from the implementation of measures to reduce GHG emissions, assessment of additional efforts and implementation of timely adjustments necessary to achieve the set goals of reducing GHG emissions, implementation of additional technical and support measures (including climate projects and acquisition of carbon offsets) - will allow QazaqGaz to implement the low-carbon development program by the scheduled date.

Annex 1. Actual implemented energy efficiency measures for QG subsidiaries and affiliates

Report on the implementation of measures to improve the energy efficiency of ICA JSC for 2024

Energy saving measures (reduction of indirect GHG emissions of Scope 2 category)							
No.	Measure name, type of energy resource	Scope of implementation	Annual energy savings		Expenses, thousand tenge	Note (transfer in tfoe)	Breakdown by Branches
			In physical terms, thousand kWh	In monetary terms, million tenge			
1	**Replacing inefficient cathodic protection stations with new generation stations**	**175**	**3 255.0**	**114 207.3**	**514 533**	**400.4**	
	Replacement of ineffective cathodic protection stations with new generation stations along the Makat CS	12.0	223.2	8 972.6	41 430	27.5	Atyrau GTPA
	Replacement of inefficient cathodic protection stations at new generation medical treatment plants Akkol, Kulsary, Inder, Redut	67.0	1 246.2	50 097.2	333 798	153.3	Atyrau GTPA
	Replacement of inefficient cathodic protection stations at a new generation plant at Aktau GTPA (1 unit - saving 18.6 thousand kWh)	24.0	446.4	12 432.2	12 432	54.9	Aktau GTPA
	Replacement of inefficient cathodic protection stations at the new generation stations of Almaty LPGTPA, GRS facilities (1 unit - saving 18.6 thousand kWh).	3.0	55.8	1 678.5	8 949	6.9	Almaty GTPA
	Replacement of inefficient cathodic protection stations at a new generation plant along Taraz LPM Taraz GTPA	28.0	520.8	17 342.6	55.9	64.1	Taraz GTPA

	Replacement of inefficient cathodic protection stations at the new generation along Poltoratsky LPM Shymkent GTPA	10.0	186.0	6 882.0	29 831	22.9	Shymkent GTPA
	Replacement of inefficient cathodic protection stations at the new generation along Kostanay GTPA (1 unit – saving 18,6 thousand kWh).	31.0	576.6	16 802.1	88 037.2	70.9	Kostanay GTPA
2	**Replacing indoor lighting with LED counterparts**		**237.6**	**6 435.9**	**32 724.9**	**25.1**	
	Replacing indoor lighting with LED counterparts (БЛПУ, ЖЛПУ, ОЛПУ)	375	65.7	1 553.8	1 829.7	22.6	Aktau GTPA
	Replacing indoor lighting with LED counterparts (УЛПУ, ЧЛПУ, ДЛПУ)	3	122.9	3 089.0	29 877.0	2.3	Uralsk GTPA
	Replacement of indoor lighting with LED analogues - Industrial base Kaskelen Almaty LPGTPA	115 units	2.732	82.191	176.4	0.246	Almaty GTPA
	Replacement of existing indoor lighting fixtures for buildings at the Poltoratskoye Industrial Complex Shymkent GTPA with energy-efficient LED counterparts	CS	46	1 711	841.8	5.7	Shymkent GTPA
3	**Replacing outdoor lighting with LED counterparts**	**CS**	**576.0**	**16 386.2**	**41 773.4**	**70.8**	
	Replacing outdoor lighting with LED counterparts (CS-12)	CS	6.0	276.0	1 628.8	0.7	Aktobe GTPA
	Replacing outdoor lighting with LED counterparts (CS-13)	CS	6.0	276.0	1 628.8	0.7	Aktobe GTPA

	Replacing outdoor lighting with LED counterparts (CS-14)	CS	6.0	276.0	1 628.8	0.7	Aktobe GTPA
	Replacing outdoor lighting with LED counterparts (АРУ)	АРУ	6.0	276.0	1 628.8	0.7	Aktobe GTPA
	Replacing outdoor lighting with LED counterparts (БЛПУ, ЖЛПУ, ОЛПУ)	210	91.98	2 175.2	2 561.6	11.3	Aktau GTPA
	Replacing outdoor lighting with LED counterparts (УЛПУ, ЧЛПУ, ДЛПУ)	3	318.28	8 001.0	11 467.0	39.1	Uralsk GTPA
	Replacing outdoor lighting with LED counterparts – Kaskelen induxtrail base, Almaty LPGTPA	26	5.616	168.929	234.0	0.7	Almaty GTPA
	Replacement of existing outdoor lighting fixtures at Akyrtobe industrial site with energy-efficient LED counterparts	94	14	466.48	8 900.0	1.7	Taraz GTPA
	Replacement of existing outdoor lighting fixtures at the DCS TIP-02 Akyrtobe industrial site with energy-efficient LED counterparts	50	7.5	249.75	4 700.0	0.9	Taraz GTPA
	Replacement of existing outdoor lighting fixtures along GRS of Taraz LDM with energy-efficient LED analogues	35	5.25	174.825	1 200.0	0.6	Taraz GTPA
	Replacement of existing outdoor lighting fixtures for buildings at Poltoratskoye CS industrial site of Shymkent GTPA with energy-efficient LED counterparts	CS	109	4 046	6 195.7	13.5	Shymkent GTPA
4	Introduction of frequency control of the electric drive of AVO gas fans for CS-12	CS	83.6	3 845.6	22 400.0	84.8	Aktobe GTPA

5	Replacement of TIROSOT rectifier device with the KRU-35 kV CS-11	CS	8.5	391.0	24 577.0	9.7	Aktobe GTPA
6	Optimization of loading of CS-5 (with electric drive) Taraz GTPA	CS	4 383.0	146 041.6	0.0	539.1	Taraz GTPA

The total energy savings from the implemented measures for 2024 amounted to 8,543.6 thousand kWh, which is 6,753.74 tCO2-eq.

Measures to reduce natural gas consumption				
No.	**Unit name**	**Description of energy efficiency event**	**Gas savings, thousand cubic meters**	**Reduction of GHG emissions, tCO2-eq.**
1	Uralsk GTPA	Actual savings in natural gas during the implementation of the measure to optimize the compressor station loading amounted to 2462.8 thousand m^3 Actual savings of natural gas during the implementation of the measure to lower the temperature at night, on weekends and holidays in administrative and industrial premises amounted to 133.8 thousand m^3, accordingly, the volume of reduced emissions will be 133.8 thousand m^3.	2462.8 133	4780 260
2	Kyzylorda GTPA	Kyzylorda GTPA due to the implementation of measures within the framework of the implementation of the plan of measures for energy saving and increasing the energy efficiency of Intergas Central Asia for 2021-2025. The actual savings of natural gas during the implementation of the measure to optimize the loading of the compressor station amounted to 133.8 thousand m^3 Actual savings of natural gas during the implementation of the measure to lower the temperature at night, on weekends and holidays in administrative production premises amounted to 2462.8 thousand m^3, and accordingly the volume of reduced emissions will be: 2462.8 thousand m^3.	133.8 2462.8	285 5238
3	Shymkent GTPA	Shymkent GTPA due to the implementation of measures under the plan of measures for energy saving and increasing the energy efficiency of Intergas Central Asia for 2021-2025 such as: optimization of the compressor station (with gas turbine drive) loading, lowering the temperature at night, on weekends and holidays in administrative and production premises, a reduction in greenhouse gas emissions by 5203 tons of CO2 was achieved in 2021. The actual savings of natural gas during the implementation of the event to optimize the loading of the compressor station amounted to 2462.8 thousand m^3	2462.8	4935

The actual savings of natural gas during the implementation of the measure to lower the temperature at night, on weekends and holidays in administrative production premises amounted to 133.8 thousand m³		133.8		268
	Total:	**7 789**	**15**	**766**

Annex 2. Report on the implementation of measures to improve the energy efficiency of JSC AGP for 2024 – 2025

Energy saving measures (reduction of indirect GHG emissions of category Scope 2)			
No.	Name of measure, type of energy resource	Measures description	Delivery status
1	LDAR	Leak Detection and Repair (LDAR) system is a specialized technology that uses multiple frequencies to monitor and detect gas leaks. The system is equipped with sensors that react to various chemical compounds and is capable of measuring their concentrations in the air. The system is equipped with sensors that react to various chemical compounds and is capable of measuring their concentrations in the air. Currently, infrared sensing is carried out at compressor stations, but adverse weather conditions - rain, snow, fog or strong wind - often cause false alarms of the system. To improve the monitoring efficiency, advanced thermal imaging technology for detecting gas leaks has been implemented at compressor stations CS-1, CS-2, CS-4 and CS-7. This technology provides 24-hour remote scanning in real time and allows for accurate detection of gas leaks. At the current stage of equipment operation at production facilities, no leaks have been recorded, since all equipment and auxiliary systems are inspected and serviced on a daily basis. The equipment is currently at the testing and approbation stage.	Delivered
2	Waste heat boilers	This measure has been implemented at all production facilities in the Partnership. Use of hot gases from waste heat boilers that recuperate the thermal energy of the hot exhaust gases from GPU (formed during the combustion of natural gas) allows saving natural gas that would otherwise be used in boiler houses for heating purposes. The annual saving of natural gas during the heating period from 13 waste heat boilers is 18,270 thousand cubic meters.	Delivered
3	GPU major repairs	The partnership carries out major and medium repairs on a permanent basis in accordance with the scheduled operating time of the manufacturer's equipment (GE and RR GPUs).	Annually
4	Improving the energy efficiency of a gas pumping unit during a major overhaul of a gas turbine engine	Conducted in accordance with the scheduled operation of the equipment of the manufacturer	Annually

Annex 3. A consolidated list of measures to reduce GHG emissions for JSC NC QazaqGaz for period 2025–2033 with assessment of GHG emissions reduction potential

No.	Measures	GHG Emission Category	GHG emission reduction potential, tCO2-eq.	Relative reduction of GHG emissions from value of achieving target indicators, in %	Estimated capital expenditures, USD	Estimated operating costs, USD	Affiliates	Planned period for activities delivery
Technical measures								
1	Major repairs of 19 GPPP at compressor stations	Scope 1	1 088,4	0,14%	7 400 000	Operation maintenance of GPPP is provided by AGP operation technical services	AGP	2025–2026
2	Replacing the power supply system of block valve units with solar panels	Scope 1	123,7	0,02%	3 600 000	When servicing RES, operating costs are estimated at approximately 5% of capital costs: USD 180 000 per year	AGP	2025–2026
3	Optimization of use of electricity generated by GPPP at CS-6	Scope 1	1 223,6	0,16%	8 160 000	Operation maintenance of GPPP is provided by AGP operation technical services	AGP	2025–2026

4	Installation of active harmonic filters for frequency converter GPU No. 1 of Turkestan CS	Scope 1	184.7	0,02%	3 705	By BSG Technical Services	BGS	2027
5	Optimization of equipment operating modes. Determination of the optimal operating mode of GPU while maintaining the gas transportation mode.	Scope 1	28 058,1	3,63%	By BSG technical services	By BSG Technical Services	BGS	2025–2033
6	Carrying out adjustment works of existing reactive power compensation devices (RPCD) at Aral CS, Korkyt Ata CS, Turkestan CS	Scope 1	2.326	0,0003%	0	By BSG Technical Services	BGS	2026
7	Modernization of energy supply system using renewable energy sources	Scope 2	374	1,38%	220 000	Operating costs for servicing a 1 MW solar power plant are estimated at an average of USD 19 000 to USD 25 000 per year. Note: operating costs for servicing a solar power plant amount to USD 20 000 per year	QGA	2030–2033
8	Using a compressor flow part flushing system	Scope 1	4 625,6	0,60%	0	By ICA Technical Services	ICA	2025

9	Using mobile compressor stations (MCS) to conserve natural gas during repairs on a single gas supply system	Scope 1	95 980,2	12,43%	774 610	By ICA Technical Services	ICA	до 2030
10	Improving the energy efficiency of a gas pumping unit during a major overhaul of a gas turbine engine	Scope 1	7 448,5	0,96%	712 381	By ICA Technical Services	ICA	2025
11	Replacing existing lamps with energy-efficient LED analogs	Scope 2	135,4	0,50%	207 314	By ICA Technical Services	ICA	2025
12	Replacing inefficient cathodic protection stations with new generation stations	Scope 2	602,8	2,22%	275 238	By ICA Technical Services	ICA	2025
13	Replacement of obsolete pumping units for domestic and drinking water supply with energy-efficient automatic two-pump stations with horizontal pumps	Scope 2	31,1	0,11%	994	By ICA Technical Services	ICA	2025
14	Modernization of power supply system using RES of autonomous hybrid	Scope 2	256	0,9%	743 640	By ICA Technical Services	ICA	2030–2033

	power plant AGEU with a capacity of 172 kW							
15	Replacement of shut-off valves with diameters from Ø800mm to Ø1440mm	Scope 1	4 840	0,63%	21 461 321	By ICA Technical Services	ICA	2025
16	Using low-emission fuel combustion technology in combustion chambers of the gas generator of GPA fuel system	Scope 1	18 715	2,42%	400 000 за одну камеру DLE. Для установки 30 DLE на ГПА затраты 12 000 000	110 000 for installation of one low-emission camera. Total 3 300 000	AGP	2025–2026 (15 GPA in 2025 and 15 GPA in 2026)
17	Using dry gas seals on centrifugal compressors	Scope 1	188,7	0,02%	3 553 000	By AGP Technical Services	AGP	2025–2026
18	Maintaining the main equipment in good condition	Scope 1	557	0,07%	0	By AGP Technical Services	AGP	2025–2026
19	Modernization of existing power supply system of block valve units on the linear part of BBS MGP taking into account the RES introduction: Mangistau region block valve unit BVU No. 1;	Scope 1	279	0,036%	3 261 000	When servicing RES, operating costs are estimated at approximately 5% of capital costs: USD 163 000 per year	BSG	2026-2028

	- Aktobe region block valve unit BVU No. 12; - Kyzylorda region block valve unit BVU No. 32; - Turkestan region block valve unit BVU No. 43;							
20	Implementation of RES at railway crossings in the amount of 6 units	Scope 2	8	0,03%	361 700	Estimated USD 18 000 per year	BSG	2026-2027
Organizational measures								
21	Implementation of policies on energy conservation, energy management, and organizational practices of personnel aimed at careful attitude to the use of energy resources	Scope 1	14,09	0,001%	0	no	QGA	2026–2028
			2 704,25	0,35%	0	no	AGP	
			1 514,13	0,198%	0	no	ICA	
			1 530,54	0,196%	0	no	BSG	
Supportive measures								
22	Launch of Green Office project for administrative buildings of subsidiaries and affiliates	Scope 2			0	Green Office project is implemented by office staff and technical services of subsidiaries and affiliates	QGA, EP	2025–2033
23	Purchase of I-REC certificates to reduce	Scope 2	27 154	33%	68 700	no	ICA	2030–2033

	indirect emissions of Scope 2							
24	Formation of a portfolio of offset projects (climate, renewable energy)	Scope 1, 2				no	ICA, QGA, AGP, BSG	2030–2033
25	Introduction of MIST — Methane Intensity Screening Tool	Scope 1				no	ICA	2030–2033
26	Joining to Oil and Gas Methane Partnership initiative (OGMP) 2.0	Scope 1				no	ICA	2030–2033

Final reduction of direct GHG emissions by subsidiaries and affiliates from planned measures

Affiliates	Relative reduction of GHG emissions from implementation of measures from established contribution of subsidiaries and affiliates, %	Relative reduction of GHG emissions from QazaqGaz targets, %	Absolute reduction of direct GHG emissions from the implementation of measures, tCO2-eq.
Total by ICA	100.0%	14.8%	114 408
Total by AGP	6.9%	3.2%	24 600
Total by BSG	21.3%	4.27%	31 585
Total by QGA	0.01%	0.002%	14.09

Annex 4. Assessment of efficiency of achieving specific GHG emissions for period 2025-2033 for JSC NC QazaqGaz

	QAZAQGAZ НАЦИОНАЛЬНАЯ КОМПАНИЯ	**Efficiency passport**				
	Efficiency name:	**Specific indicator of greenhouse gas emissions**			**Unit measure**	ton CO2 eq./GJ
	Description:	Efficiency reflects a reduction in greenhouse gas emissions per unit consumption of fuel and energy resources				
	Calculation formula:	Efficiency = Vfact 2025 / total fuel and energy complex consumption for the period 2025				
	Decoding the formula elements:	**Designation**	**Decoding**	**Unit measure**	**Information source**	**Action by**
		Vfact	Volume of gross greenhouse gas emissions Scope 1 for 2025, calculated according to a unified approach under JSC NC QazaqGaz Low-Carbon Development Program	tonsCO2 eq.	Greenhouse gas emissions inventory reports, greenhouse gas verification reports	HSE
		total fuel and energy complex consumption	Total fuel and energy complex consumption for period 2025	GJ=TJ *1000		
	Function:	Organization of the process to reduce greenhouse gas emissions by JSC NC QazaqGaz				

	Indicator is calculated and provided by:	HSE					
	Responsible person for efficiency:	Senior and managerial staff of the group of companies of JSC NC QazaqGaz					
	Agreed by:						
	JSC NC QazaqGaz HSE Dept. Director				_____	Dzhakubaliyev A.K.	
	(name)				(signed, date)		